Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development.

Technical Report · January 2013

DOI: 10.13140/RG.2.1.2264.5206

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ISSN 2070-6103

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FAO Expert Workshop
21–24 April 2010
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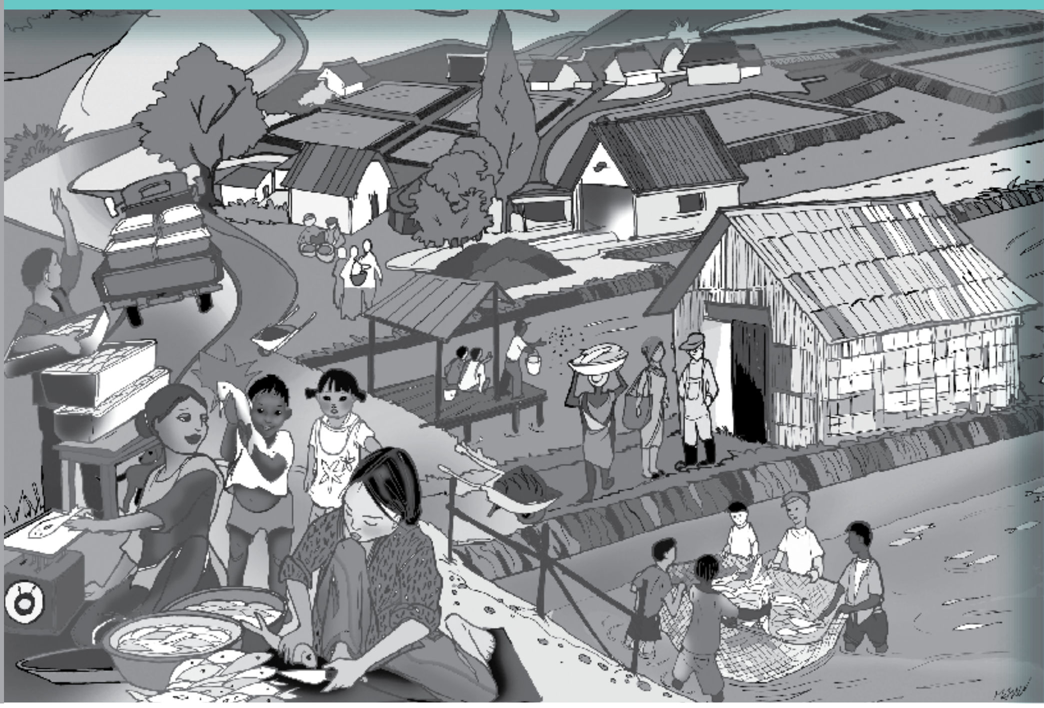

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Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2013

ISBN 978-92-5-107407-7 (print)
E-ISBN 978-92-5-107961-1 (PDF)

Preparation of this document

The project “Enhancing the contribution of the small-scale aquaculture sector to food security, poverty alleviation and socio-economic development” was undertaken through a series of desk studies and an expert workshop. The project culminated in the publication of this document, which is presented in two parts.

Part 1 contains the proceedings of the expert workshop, FAO Expert Workshop on Enhancing the Contribution of the Small-Scale Aquaculture Sector to Food Security, Poverty Alleviation and Socio-economic Development, held in Hanoi, Viet Nam from 21 to 24 April 2010. The workshop was informed by a number of thematic papers to assist in understanding the various issues concerning small-scale aquaculture. Part 2 contains 18 technical papers contributed by 27 specialists and presented during this workshop.

The commissioned review papers and expert workshop were technically supervised by Dr Melba B. Reantaso, Aquaculture Officer, Aquaculture Branch (FIRA), FAO Fisheries and Aquaculture Department. The papers contained in this work have been reproduced as submitted.

The study, workshop and publication were made possible with financial assistance through FIRA’s Regular Programme of Work and Budget.

Abstract

About 70–80 percent of all those actors involved in fish farming worldwide are considered small-scale. The small-scale aquaculture (SSA) sector, is recognized as making an important contribution to food security, poverty alleviation and socio-economic development. However, assessing its contribution in a systematic way has been an uphill task.

An expert workshop on "Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development" was convened to: (i) understand SSA and its contribution/potential contribution and challenges/issues facing the sector and the SSA producers; (ii) identify and elaborate on entry points for enhancing its contribution to food security, poverty alleviation and socio-economic development; (iii) identify concrete action plans to strengthen the capacity of SSA producers and households to deal with threats, risks, shocks, crises and emergencies; and (iv) identify elements of a planned Technical Guidelines for Enhancing the Contribution of Small-Scale Aquaculture to Food Security, Poverty Alleviation and Socio-Economic Development within FAO's Code of Conduct for Responsible Fisheries technical guidelines series. Some 38 experts from governmental, inter-governmental, regional and international organizations, and universities participated in this expert workshop.

The report and proceedings of this expert workshop are presented in this publication. Part 1 contains the outcomes of the deliberations of the experts participating in the workshop; Part 2 consists of 18 technical papers presented during the workshop.

Bondad-Reantaso, M.G. and Subasinghe, R.P., eds. 2013.
Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development.
FAO Fisheries and Aquaculture Proceedings No. 31. Rome. FAO. 255 pp.

Contents

Acknowledgements

This publication is the end product of the work of many individuals and experts who participated in this project, starting from the commissioned desk studies through to the successful convening of an expert workshop. They are all gratefully acknowledged.

Thanks are also accorded to the officials and staff of the Research Institute for Aquaculture No. 1 through the leadership of Dr Le Thanh Luu for administrative and logistical arrangements. Special thanks are due to the representatives and experts from governments (China, Ghana, Kenya, Uganda and Viet Nam) and various regional intergovernmental organizations (e.g. NACA[1], SEAFDEC[2]), regional and international organizations (e.g. WorldFish Center, INFOFISH[3], CIRAD[4], DANIDA[5]), and universities (from Australia, India, the Philippines, Thailand, Viet Nam and the United Kingdom of Great Britain and Northern Ireland) for their active participation during the workshop. The authors of contributed papers are sincerely acknowledged for their time, expertise and involvement in ensuring the publication of this document. The editors would also like to thank Ms Marika Panzironi, Ms Danielle Rizcallah, Ms Nathalie Perisse, Ms Marianne Guyonnet and Ms Tina Farmer of the FAO Fisheries and Aquaculture Department, Ms Maria Lorica Jarmin and Ms Kathleen Dela Merced (FAO consultants) and Mr José Luis Castilla Civit (layout designer) for various types of assistance during the final production of this document. Mr Jiansan Jia, Branch Coordinator, is gratefully acknowledged for his support, guidance and encouragement.

1 Network of Aquaculture Centres in Asia–Pacific.
2 Southeast Asian Fisheries Development Center.
3 Intergovernmental Organization for Marketing Information and Technical Advisory Services for Fishery Products in the Asian and Pacific Region.
4 Agricultural Research for Development (France).
5 Danish International Development Agency.

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Acronyms and abbreviations

ACC	Aquaculture Certification Council
ACFS	National Agricultural Accreditation Body
ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
AECID	Agency for International Cooperation and Development
AFS	Asian Fisheries Society
AIDA	Ayuda Intercambio y Desarrollo
AIT	Asian Institute of Technology
ANAF	Aquaculture Network for Africa
ASC	Aquaculture Stewardship Council
BAP	best aquaculture practice
BFAR	Bureau of Fisheries and Aquatic Resources
BFDA	Brackish Water Fish Farmers Development Agency
BMHS	backyard multispecies hatchery system
BMPs	best management practice
BRAC	Bangladesh Rural Advancement Committee
CAFS	Chinese Academy of Fishery Science
CAGES	Cage Aquaculture for Greater Economic Security
CAS	Country Assistance Strategy
CBCRM	community-based coastal resource management
CBO	community-based organization
CCRF	Code of Conduct for Responsible Fisheries
CDR	complex, diverse and risk-prone
CIFA	Central Institute of Freshwater Aquaculture
CIFE	Central Institute of Fisheries Education
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CoC	Code of Conduct
COFI	Committee on Fisheries
CP	Charoen Pokphand Company
CPRC	Chronic Poverty Research Centre
CRM	Coastal resource management
CSPs	European Union's (EU) Country Strategy Papers
CSR	corporate social responsibility
DA BAR	Department of Agriculture Bureau of Agricultural Research
DANIDA	Danish International Development Agency
DASF	Department of Agriculture Stock and Forestry (Papua New Guinea)
DFID	Department for International Development
DOF	Department of Fisheries
DOST	Department of Science and Technology

EAA	Ecosystem Approach to Aquaculture
EHP	Eastern Highland Provinces
EHPG	Eastern Highlands Provincial Government
EMMA	Environmental Monitoring and Modeling of Aquaculture in the Philippines
EU	European Union
EU 27	European Union 27 member countries
FAO	Food and Agriculture Organization of the United Nations
FARMC	Fisheries and Aquatic Resources Management Council
FAs	fisherfolk associations
FCR	feed conversion ratio
FFRC	Freshwater Fisheries Research Center
FiA	Fisheries Administration of Cambodia
FINIDA	Finland Department for International Development Cooperation
FISHAID	Fisheries Improvement through Stocking Higher Altitudes for Inland Development
FIVIMS	Food Insecurity and Vulnerability Information and Mapping Systems
FOSCOT	Federation of Shrimp-farmer Cooperatives of Thailand
FPA	floodplain aquaculture
GAA	Global Aquaculture Alliance
GAP	good aquaculture practice
GDI	Gender-related Development Index
GDP	gross domestic product
GEF-STAP	Global Environment Facility – Scientific and Technical Advisory Panel
GIAHS	Globally-important Indigenous Agriculture Heritage System
GIFT	genetically improved farmed tilapia
GIS	geographic information system
GNP	gross national product
GRIM	Gondol Research Institute for Mariculture
GTZ	German Agency for Technical Cooperation
HAQDEC	Highland Aquaculture Development Centre at Aiyura
HEPR	Hunger Eradication and Poverty Reduction
HPA1	avian influenza
HRD	human resources development
IAA	Integrated Agriculture Aquaculture
IAAS	Institute of Agriculture and Animal Science
IBRD/WB	International Bank for Reconstruction and Development/World Bank
ICAFIS	International Centre for Aquaculture and Fisheries Sustainability
ICAR	Central Institute of Fisheries Education
ICAR	Indian Council for Agricultural Research
ICDSA	Institutional Capacity Development for Sustainable Aquaculture
IDRC	International Development Research Centre of Canada
IFAD	International Fund for Agricultural Development
IFAS	integrated fisheries aquaculture systems
IISD	International Institute for Sustainable Development
IMF	International Monetary Fund

INFOFISH	Intergovernmental Organization for Marketing Information and Technical Advisory Services for Fishery Products in the Asian and Pacific Region
IOM	integrated operation module
IPAS	integrated peri-urban aquaculture system
ISO	International Organization for Standardization
ISSD	International Institute for Sustainable Development
IUCN	International Union for Conservation of Nature
IVAC	Improved VAC
IVLP	Institute Village Link Programme
JICA	Japan International Cooperation Agency
JSPS	Japan Society for the Promotion of Science
LAC	Latin America and the Caribbean
LF	large farms
LGUs	local government unit
LSA	large-scale export oriented aquaculture
M & E	monitoring and evaluation
MA	Millennium Ecosystem Assessment
MARD	Ministry of Agriculture and Rural Development
MD	movement document
MDA	Marine Development Authority
MDG	Millennium Development Goal
MF	medium farm
MFI	micro-finance institution
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MOA	memorandum of agreement
MOLISA	Ministry of Labour, Invalids and Social Affairs
MOU	memorandum of understanding
MPA	marine protected area
MPEDA	Marine Products Export Development Authority
MRC	Mekong River Commission
N	nitrogen
NACA	Network of Aquaculture Centres in Asia-Pacific
NaCSA	National Centre for Sustainable Aquaculture
NARI	National Agricultural Research Institute
NASO	National Aquaculture Sector Overview
NDAL	National Department of Agriculture and Livestock
NDCC	National Disaster Control Council
NDP	National Development Plan
NEEDS	National Environmental, Economic and Development Study
NFA	National Fisheries Authority (Papua New Guinea)
NGO	non-governmental organization
NGO-MFI	non-government micro-finance institution
NOMA-FAME	Norad's Master Program Fisheries and Aquaculture Economics and Management
NORAD	Norwegian Agency for Development Cooperation

NRC	National Research Council
NRI	Natural Resources Institute
NTU	Nha Trang University
OAPC	Organic Aquaculture Farm and Product Certification Center
OIE	Office International des Epizooties
P	phosphorus
PACCOM	Peoples Aid Co-ordinating Committee
PAD	Pangasius Aquaculture Dialogue
PIC	Pacific Island Countries
PICTS	Pacific Island Countries and Territories
PL	post-larvae
PNG	Papua New Guinea
Pos	Peoples' organizations
PPP	public-private partnership
PRSP	Poverty Reduction Strategy Papers
QUEDANCOR	Quedan and Rural Credit Guarantee Corporation
R&D	research and development
RAP	FAO Regional Office for Asia and the Pacific
REECS	Resources, Environment and Economics Center for Studies, Inc.
RFM	rural financial market
RIA1	Research Institute for Aquaculture No. 1
RIDS - Nepal	Rural Integrated Development Society – Nepal
RLF	Resources Legacy Fund
RRD	Red River Delta
SAPA	Sustainable Aquaculture for Poverty Alleviation
SARNISSA	Sustainable Aquaculture Research Networks in sub-Saharan Africa
SEAFDEC	Southeast Asian Fisheries Development Center
SEAFDEC/AQD	Aquaculture Department of the Southeast Asian Fisheries
SHGS	self-help groups
SHP	Southern Highland Provinces
SIDA	Swedish International Development Assistance
SIDS	Small Island Developing States
SLA	Sustainable Livelihoods Approach
SMEs	small and medium enterprises
SPC	Secretariat of the Pacific Community
SPFS	Special Programme for Food Security
SPS	Sanitary and Phytosanitary
SRD	sustainable rural development
SRFSEP	Sepik River fish stock enhancement program
SSA	small-scale aquaculture
SSP	Sustainable Shrimp Program
SSP	Surat Shrimp Program
SUDA	Sustainable Development of Aquaculture
SWOT	strengths, weaknesses, opportunities and threats
TAS	Thai Agricultural Standard
TBT	Technical Barriers to Trade

TCP	Technical Cooperation Programme
TDS	trickle-down system
TG	Technical Guidelines
TM	team member
TSP	triple superphospate
TTL	Task Team Leader
TVAC	Traditional VAC
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
UNOPS	United Nations Office for Project Services
UPV	University of the Philippines, in the Visayas
USA	United States of America
USD	United States dollar
UWS	University of Western Sydney
VAC	Vuon-Ao-Chuong (Vietnamese)
VHLSS	Viet Nam Household Living Standard Survey
VINAFIS	Viet Nam Fisheries Society
VND	Vietnamese dong
WB	World Bank
WCED	World Commission on Environment and Development
WDB	Water development board
WDB	World Data Bank
WFC	WorldFish Center
WG	working group
WHP	Western Highland Provinces
WTO	World Trade Organization
WWF	World Wildlife Fund

PART 1

PROCEEDINGS OF THE FAO EXPERT WORKSHOP ON ENHANCING THE CONTRIBUTION OF SMALL-SCALE AQUACULTURE TO FOOD SECURITY, POVERTY ALLEVIATION AND SOCIO-ECONOMIC DEVELOPMENT

Hanoi, Viet Nam, 21–24 April 2010

FAO expert workshop on enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development

Hanoi, Viet Nam, 21–24 April 2010

PURPOSE

An expert workshop on "Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development" was convened to: (i) understand small-scale aquaculture (SSA) and its contribution/potential contribution as well as the challenges/issues facing the sector and SSA producers; (ii) identify and elaborate on entry points for enhancing its contribution to food security, poverty alleviation and socio-economic development; (iii) identify concrete actions plans to strengthen the capacity of SSA producers and households to deal with threats, risks, shocks, crises and emergencies; and (iv) identify elements of a planned Technical Guidelines for Enhancing the Contribution of Small-Scale Aquaculture to Food Security, Poverty Alleviation and Socio-Economic Development within FAO's Code of Conduct for Responsible Fisheries (the Code) technical guidelines (TG) series.

PARTICIPATION

Thirty-eight experts from various regional and international organizations, government institutions and universities, with specialization and experience on general aquaculture development, small-scale aquaculture, aquaculture economics, rural development, agriculture, geography and sociology participated in the workshop (see Appendix 1 for a list of participants and Appendix 5 for the workshop group photo).

PROCESS

The expert workshop consisted of four sessions:

Sessions 1, 2 and 3 covered three thematic presentations corresponding to objectives i–iii above. These three sessions also consisted of three simultaneous working groups that tackled the following: (i) SSA SWOT[1] analysis, (ii) guiding principles to be included in the Code technical guidelines, (iii) entry points for enhancing the contribution of SSA to food security, poverty alleviation and socio-economic development, (iv) action plans to protect SSA producers and households from threats, risks, shocks, crises and emergencies, and (v) essential elements (and scope) to be included in the Code technical guidelines.

Session 4 presented the expert workshop conclusions and the way forward.

The workshop programme is attached as Appendix 2.

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[1] Strengths, weaknesses, opportunities and threats.

WORKSHOP HIGHLIGHTS

Opening session

The opening remarks were provided by Mr Vu Van Tam, Vice Minister of the Ministry of Agriculture and Rural Development, Viet Nam, and Mr Jiansan Jia, Chief of the Aquaculture Branch, FAO Fisheries and Aquaculture Department, Rome, Italy. Mr Vu Van Tam's speech is attached as Appendix 3 and Mr Jiansan Jia's speech is attached as Appendix 4.

Presentation highlights

Dr Melba B. Reantaso (FAO) presented the background, purpose, process, participation and expected outcomes. She expressed FAO's appreciation to the participating experts for their support to this initiative on understanding the role of the SSA sector, how to assess its contribution to poverty alleviation, food security and socio-economic development and how to enhance support for the sector.

Dr Peter Edwards of the Asian Institute for Technology, in his presentation "Review of small-scale aquaculture: definitions, characterization, numbers", identified the distinction between traditional aquaculture and modern aquaculture. With respect to SSA, there are a number of existing definitions for such terms as: (i) rural aquaculture; (ii) artisanal aquaculture; (iii) urban aquaculture; and more recently (iv) SSA. The common elements characterizing the definition of SSA include: ownership of, or access to, an aquatic resource; ownership by family or community; and the sector being of relatively small size. The presentation provided information on characterization of the SSA sector in relation to the hopes and aspirations of farmers, developmental options and aquaculture technology. Asian aquaculture, which dominates global production, is predominantly small-scale although data to support this are lacking. The use of average farm size can only give an indication of the possible contribution of SSA to total national aquaculture production and value. Furthermore, much of what is considered today as SSA is probably medium-scale as it is only 'small' relative to large-scale aquaculture, so there remains a boundary issue. Dr Edwards closed his presentation by enumerating challenges facing the sector and best approaches to maximize the developmental impact of aquaculture and the roles that SSA might play.

Mr Phillip Townsley (FAO consultant), presented a review paper "Concepts of poverty, vulnerability, food security, aquatic resources management, rural livelihoods and development and how these concepts evolved within the field of small-scale aquaculture". The presentation highlighted that the recent crisis in world food prices has called attention for the need to increase support to agriculture. Aquaculture, a sub-sector of agriculture, given its impressive growth rates over the last three decades is well-positioned to achieve greater recognition of its contribution to food security, poverty reduction, rural livelihoods and development. While current understanding of poverty has progressed significantly in the last decade, ongoing discussion on the role of SSA in poverty reduction still tends to approach the poor as a relatively homogeneous group and does not generally take into account the important differentiations among the poor groups. In relation to food security, there is often a similar blurred distinction between the actual and potential roles of SSA as a direct provider of food for producers and as a means to generate income through sales and employment to improve access to food. While the Sustainable Livelihoods Approach (SLA) can increase the understanding as to how small-scale rural aquaculture can alleviate poverty and ensure food security, discussions on livelihoods often focus excessively on people's direct access to livelihood assets and fail to take proper account of the key linkages between people, their access to assets and the political, institutional and power context within which they operate. Putting SSA in this context, and mainstreaming it into broader rural development strategies depends on properly understanding, and attempting to address these issues. Recent literature has recognized the importance of an enabling environment, appropriate policies and institutional support, the challenges involved in working with the poorest groups in rural society and the need for sustained support.

Dr Tipparat Pongthanapanich of Kasetsart University presented a paper on the "Contribution of SSA to rural development: outcomes of case studies in China, the Philippines, Thailand and Viet Nam". An indicator system to measure the contribution of SSA to sustainable rural development (SRD) developed based on the SLA framework and its five livelihood assets/capitals, i.e. natural, physical, human, financial and social, was used in the case studies. The results showed diverse contribution of SSA in terms of livelihood assets with all studies indicating high contribution to social capital. The two types of SSA (Type I and Type II) gave different magnitudes of contribution to the livelihood capitals, i.e. Type I SSA contributed more to natural capital, while Type II SSA contributed more to financial and physical capitals. The contribution to human capital tended to be relatively low for Type II SSA in terms of household food security but high in terms of food supply to society. Based on the findings and recommendations of the case studies, implications were drawn for policy interventions that would improve the ability of the SSA sector to contribute to the build-up of these livelihood capitals.

Dr Peter Edwards' second presentation on "Successful SSAs and their contributions to economic growth at the national level and poverty alleviation and rural development at the local level", showcased 34 case studies (27 from Asia, four from Africa and three from Latin America). The case studies included both grow-out and seed production, within a range of continents, systems, and inland/coastal settings and evaluated the issues affecting them. The results showed that the major social benefits from SSA were seen in many countries in Asia, much fewer and to a less degree in Africa and Latin America. For Type I SSA, there was a complete agreement on its characteristics with limited resources, requiring assistance or intensification of crops/livestock or off-farm livelihoods. For Type II SSA, the major issue involved the boundary definition of medium-scale enterprises, i.e. whether they should be considered as SSA or as small- and medium-enterprises (SMEs).

Mr Philip Townsley's second presentation, on "Challenges to sustainable use and management of aquatic resources for small-scale aquaculture producers", emphasized that careful analysis of the characteristics and dynamics of poverty underpins choices about instruments for poverty alleviation. Generic policies against poverty have tended to generate generic impacts with specific groups being missed. In order to reach out to these missed groups, policy-makers would need to create an enabling environment for SSA. In creating an enabling environment, there are several challenges that policy-makers would face including: (i) implementation issues such as minimizing risk (being aware of consequences of increased risk for the poor), phasing (putting networks in place) and skills sets (comparative advantage, poverty and livelihood analysis); (ii) resource access (market access, water and transport infrastructure, etc.); (iii) institutional context (aquaculture institutions that are "open"); (iv) policy context (diagnostic tools, policy formulation tools, policy assessment tools, institutional analysis); and (v) political context (giving the poor greater control of their environment, empowerment, representation and voice).

Dr Ben Belton (formerly of the University of Stirling), in a presentation on "Small-scale aquaculture, poverty and development: a reassessment", attempted to provide greater clarity to discussions of SSA with reference to empirical data on the characteristics of specific inland aquaculture production systems in Asia. Data were drawn from four case studies of systems which span a broad spectrum in terms of geographical location, size, investment, productivity, ownership patterns, and economic impact. He found that inland Asian aquaculture is extremely diverse. However, in general terms, fish production does not usually offer a way for people to escape poverty, but rather a way in which the already relatively well-off create additional wealth, or maintain and enhance levels of well-being. Market entrants to aquaculture come from both agriculture and non-farming sectors, and the activity usually represents a form of livelihood upgrading or commercial investment rather than a means of agricultural diversification. Most aqua-farms are predominantly operated by family labour, but absentee ownership was also common at the larger end of the spectrum. On-farm employment intensity is low, but substantial secondary employment is created elsewhere in the value chain. High volumes of relatively affordable fish produced in commercial systems serve large urban domestic markets and may contribute to national food security. In contrast, the extremely small-scale forms of low input aquaculture have relatively limited impacts in terms of employment and societal food security, and often remain beyond reach of the poorest.

Dr Le Xuan Sinh of Can Tho University presented a paper titled "Role of small-scale aquaculture to food security, poverty alleviation and socio-economic development in Mekong Delta, Viet Nam" based on black tiger shrimp and snakehead fish case studies in the Mekong Delta. The area of small-scale extensive shrimp farms was equal to one-third of medium farms and one-eighth of large farms. The household size and the number of family labourers participating in shrimp farming were not different between small-scale and medium-scale farms (approximately five persons), but slightly higher in the case of large farms (5.5 persons). About 37.5 percent of the number of family labourers for small-scale intensive farms was female, more than the rate for larger farms. He found that smaller-size intensive farm had higher production costs but a lower net return per kilogram in comparison with that of larger farms. Small-scale intensive shrimp farms had an average living expenditure of VND5.4 million per capita, equal to two-thirds and one-half of the expenditure levels of medium farms and large farms, respectively. For extensive shrimp farms, the expenditure was VND2.5 million. However, less than 50 percent of the shrimp households had enough net income to cover their annual living expenditures. Small-scale snakehead farms were nearly one-third of medium farms and one-twelfth of large farms. About 40–50 percent of the number of family labourers for fish culture were female, a higher rate for small-scale and large farms but lower for medium farms. The rates of households that obtained negative profits from fish culture were 27 percent, 32.1 percent and 33.8 percent for small-scale, medium-scale and large-scale farms, respectively. The case studies revealed the following: (i) small-scale aquaculture farmers are vulnerable; (ii) overuse of trash fish for aquaculture create a number of problems; (iii) perception of farmers on food safety, environmental management and cooperation in aquaculture are important; (iv) better support is needed regarding capital, technical knowledge and market information; and (v) better statistics and formal studies on the scales of aquaculture need to be conducted for major species and typical water bodies.

Mr Imtiaz Ahmad's (FAO consultant) presentation on "Improving access to financial services by small-scale aquaculture producers: challenges and issues" informed the workshop of three sources of finance for small-scale producers, namely: (i) formal financial institutions, e.g. development banks and commercial banks; (ii) semi-formal financial institutions, notably NGOs[2], credit unions and cooperatives; and (iii) informal sources or entities, e.g. money lenders, shopkeepers, friends and relatives,

[2] Non-governmental organizations.

and suppliers. Supply of affordable and easily accessible financial services is important to support: (i) smoothing small-scale producers' household income cycle, e.g. consumption loans to mitigate cash flow problems; (ii) meeting unforeseen costs, e.g. adverse weather; and (iii) supporting new businesses or scaling up existing businesses, e.g. need for loans to operate SSA enterprises. However, formal financial institutions in the developing regions are generally cautious in extending loan facilities to SSA producers because of the inherent risks (i.e. outbreak of diseases, long production cycle needed for repayment, the high costs involved in small transactions, and the lack of adequate collateral to cover risks). Semi-formal institutions, mainly NGOs, have emerged as key players, but are mostly dependent on grants and subsidies provided by donors. As such, sustainability of NGO programmes remains an issue after withdrawal of donor support. Informal sources provide the bulk of loans to small-scale producers, but the small size of loans is an issue, particularly during scaling-up of operations. To ensure sustainability of programmes supporting small-scale producers, governments have an important role to play by first creating an enabling policy environment and then providing enterprise development (technical and capacity building services) to small-scale producers through specialized bureaus and agencies promoting micro-enterprises and small businesses.

Ms Shirlene Maria Anthonysamy of INFOFISH, in her presentation on "Growth in global fishery trade and its benefit to small-scale aquaculture producers", reported on aquaculture's increasing contribution to international fishery trade, which reached USD 100 billion in 2008. Almost 53 million tonnes of fishery products (live weight) entered international trade in 2008. A significant part of the global food fish supplies is being contributed by small-scale aquaculture producers. Higher production of carp, *Pangasius* catfish, tilapia and freshwater prawn have pushed global aquaculture output to new highs – contributing to greater international and domestic trade. Despite the rising international fishery trade, which reflects a growing demand for fishery products, Ms. Anthonysamy observed that there were negative trends in some major markets affected by the economic recession. In Japan, overall imports of fishery products have been dwindling over the years due to changes in consumption patterns. In the United States of America, overall fishery consumption declined in 2009. The slowdown in the economy coupled with high unemployment made consumers reduce dining out. However, the popularity of freshwater tropical fish is becoming firmer in United States retail stores; tilapia is now the second best-selling fish behind salmon. Imports from Asian sources sustain this demand. The European Union (EU), the largest market block among developed countries, has shown steady growth for imports of fishery products. China remains the leading supplier of re-processed fishery products to the EU. With increased farming of *Pangasius* catfish, Viet Nam has emerged as a major supplier of fish fillets to this market. Shrimp is a product group with high value, which is being supplied by the small-scale farming sector in South and Southeast Asia. Tilapia is another item gaining market acceptance in Europe. Despite the slowdown taking place in major international markets, for consumers in Asia, there appears to be no lull in food consumption or spending habits. Consumption of fish and fishery products in most Asian producing countries continue to grow, and the high preference for fishery products in the region is a major contributor to this growth.

Mr Koji Yamamoto (formerly of the Network of Aquaculture Centres in Asia and the Pacific), in his presentation on "Small-scale aquaculture in Thailand: farmer group and certification" noted the value of aquaculture in Thailand at USD 2.8 billion in 2010. White shrimp is the most valuable species in the country followed by Nile tilapia, and hybrid catfish. There is a strong drive towards "sustainable seafood" by the society including consumers, retailers and NGOs. The need for certification is increasingly becoming important to address food safety and sustainability of the products. Various measures and schemes have been introduced to the industry in Thailand such as national regulations, industry/private schemes, and farmer group originated schemes. However, from Thai producers' point of view, aquaculture certification is not easily acceptable due to the proliferation of schemes, cost of certification, and lack of incentives. It is important to consider ways for those resource-poor small-scale farms to participate in certification schemes to protect their livelihoods and rural communities. The Department of Fisheries (DOF) and other governmental agencies are providing various support to farmers in the country, and one of those ongoing efforts is an FAO Technical Cooperation Programme (TCP) to upgrade existing governmental certification schemes to ensure international acceptance, and to establish and implement group certification for small-scale shrimp and tilapia farmers. There are few promising pilot cases in the country and in the region demonstrating small-scale farmers being organized into groups to improve their technical capacities and achieving access to profitable markets. It is expected that such partnerships with producers, private sectors, and support from government will establish a sustainable business model for SSA, and shares experiences and encourage the wider adoption of group certification in Thailand and other countries in the region.

Dr Dilip Kumar of the Indian Council for Agricultural Research, in his presentation on "Good governance, policies and other frameworks that work in favour of small-scale aquaculture producers", discussed some recent field level interventions by the Central Institute of Fisheries Education (CIFE) in several northeastern states of India, which demonstrated considerable possibilities in significantly improving the livelihoods of small-scale farmers through good governance practices, appropriate technologies, innovative extension and market support services. The presentation concluded that, first, few technologies, namely manure-based low-cost carp polyculture, manure- and feed-based carp polyculture, were adapted through action research and demonstration following a Trickle Down System of aquaculture extension from 2003–2004 to 2007–2008 in Manipur, Tripura and Assam by CIFE in Mumbai. The technology is most appropriate for small-scale farmers with less surplus and limited cash income. It offered less risk, was simple to use and relied mainly on local resources, except for the purchase of yearlings. Secondly, small-scale fish farmers in Tripura formed more than 600 fisheries-based self-help groups and cooperated as a collective group for joint advance planning of culture activities so as to regulate supply, for collective purchase of seed and other inputs at reduced rates, and regulated multiple harvest to control supply in local markets for better price. Third, various technical, social, managerial and marketing interventions along with community mobilization, organization and subsequent empowerment with active support of a grassroots NGO led to significant increase in fish production and income while ensuring gender equity. Last, it is incumbent upon the policy-makers and planners to clearly recognize and prioritize policy objectives. Experiences from within India have shown varied objectives, often implicit in programmes and strategies adopted, and have produced interesting insights in terms of implications for small-scale fish farmers.

Dr Le Thanh Luu of the Research Institute for Aquaculture No. 1 presented the lessons learned from the Sustainable Aquaculture for Poverty Alleviation (SAPA) strategy in Viet Nam. Policies in the fishery sector and the SAPA strategy were formulated by national and international expert groups with the support of the Norwegian Government and were formulated to contribute to the goal of poverty alleviation as part of the overall government strategy called "Hunger Eradication and Poverty Alleviation". The purpose of the SAPA was to enhance the livelihoods of the poor and vulnerable people through aquaculture. The SAPA strategy also proposed an implementation scheme and an action plan with a list of projects for funding.

An implementation scheme for the SAPA strategy was developed, which facilitated the support of various donor agencies to the aquaculture sector via multi-donor coordination. Lessons learned from the SAPA strategy were that: (i) clear pro-poor policy framework from the government guided the development of the sector in the right direction; (ii) building capacity of the poor in addressing their poverty problems enabled the poor to make their own solutions and action plans to overcome their poor situation; (iii) implementation capacity of involved institutions and stakeholders should be sufficient to ensure that the policies were implemented to support the poor; (iv) building strong cross-sector linkages (agriculture/fishery/bank) ensured that all efforts from the sectors support the poor; and (v) improved access to public services benefitted the poor.

Mr Miao Weimin (FAO), in his presentation on "Best practices to support and improve the livelihood of small-scale aquaculture households", noted that SSA is a major source of cultured fish products for the national and international markets and is an important source of livelihood for the rural population. However, the SSA sector faces a changing external environment, with increasingly more stringent standards on food safety and quality as well as strict governance for social empowerment and environmental integrity. Due to the limitations of SSA stakeholders, it is hard to expect SSA farmers to effectively cope with the problems and meet the challenges without external support and facilitation. Many practices have proved to be effective and successful although modifications are still needed. Such practices can be categorized into three types, namely: (i) self-empowerment facilitated by external support; (ii) improved public support and service; and (iii) intra-sectoral collaboration. Self-empowerment of SSA households includes the establishment of different types of farmer organizations with the facilitation and support of government and NGOs. Improved public support and service means strengthening technical and information services by the government to the SSA sector. Intra sectoral collaboration refers to public and private sectors providing different types of support and services to SSA households.

Mr Imtiaz Ahmad, in his second presentation on "Overview of the role of aquaculture in country poverty reduction strategy", showed the extent to which the fisheries (including aquaculture) sector is mainstreamed into national Poverty Reduction Strategy Papers (PRSPs), other National Development Plans (NDPs), Country Assistance Strategies of the World Bank (CAS), Country Strategy Papers (CSPs) of the European Union and other donor support programmes. The presentation was based on the findings of an FAO desk study on mainstreaming the fisheries (including aquaculture) sector in the above-cited national and donor country strategies and plans, the first of its kind (carried out between June 2003 and February 2004). Five core principles underlie the PRSP approach. PRSPs should be: (i) country-driven; (ii) results-oriented and focused on outcomes that will benefit the poor; (iii) comprehensive in recognizing the multidimensional nature of poverty; (iv) partnership-oriented, involving coordinated participation of development partners; and (v) long-term based. The overall findings and conclusions showed that: (i) the fisheries sector (including aquaculture) was most effectively mainstreamed in Asia (case of PRSPs, NDPs and WB CAS), closely followed by the African (Latin America scored poorly as far as mainstreaming the fisheries sector in PRSPs and NDPs); (ii) 17 countries provided examples of best practices in their PRSPs or NDPs; (iii) 9 CSPs (from a sample of 116) and two CAS (from a sample of 80) provided examples of best practices with regards to issues and responses; and (iv) future research may be carried out covering three areas: detailed analysis of best practice cases to produce a synthesis of "best" best practice; a study examining why certain countries with significant fisheries were not effectively mainstreamed; and a study identifying the local institutions and policy-making process that have allowed countries where the sector is relatively unimportant in terms of trade/consumption and/or poverty/employment to create opportunities for greater inclusion in national agendas.

Dr Paul Smith of the University of Western Sydney presented a paper on "Small-scale aquaculture in Papua New Guinea (PNG): lessons from international R&D projects on enhancing the contribution to food security, poverty alleviation and socio-economic development". While the country is rich in resources, the key issues of concern for its people are health, education, governance and distribution of wealth. Fish farming was introduced to the country during the 1960s, and more than 25 exotic fish species were introduced. In the 1950–1960s, the colonial administration encouraged villagers to construct ponds and carp fingerlings provided from government facilities, such as Bomana fish ponds in Port Moresby and Dobel ponds in Mt. Hagen. Substantial efforts have been made to overcome the technical and scientific bottlenecks that have held back the development of the sector. Programmes by FAO (FISHAID), the Japan International Cooperation Agency (JICA), the European Union (Member Organization), and the Australian Centre for International Agricultural Research (ACIAR) were carried out in collaboration with government agencies such as the National Fisheries Authority (NFA), National Department of Agriculture and Livestock (NDAL) and provincial governments. The most important aquaculture facility is the Highland Aquaculture Development Centre (HAQDEC) at Aiyura. It was the last-remaining aquaculture facility from the colonial days, and JICA had expanded the facility from four ponds to 38 ponds in the mid-1990s, based on a plan by FAO. Many of the key challenges continually being faced by the sector in Papua New Guinea were related to the social structure of the country as well as attitudes of overseas aid providers. It was found that: (i) grassroots were driving the growth of SSA; (ii) community farms overcome impediments; (iii) there was growing optimism about the sustainability of SSA; (iv) recognition of direct benefits of SSA in terms of food and income; (v) social benefits including employment, especially for youth were observed; (vi) spillovers such as education, health, social benefits and local infrastructure benefitted the community as a whole; and (vii) HAQDEC was in district control and public-private partnerships (PPP) were practised.

Dr Wilson Mwanja and Ms Beatrice Nyandat (Ministry of Fisheries of Uganda and Kenya, respectively) looked into the challenges and issues facing small-scale producers in Eastern African. In Eastern Africa, SSA remains at subsistence level and continues to face many challenges including the lack of necessary guidelines and management skills/technologies, as highlighted by several recent proposals for large-scale investment in mariculture; as well as the inability of the region to tap natural aquaculture potential. There are also limitations on the quality of species farmed, the technologies employed to harness the potential of these farmed species and the inability of farmers to economically invest and operate aquaculture enterprises. Aside from the usual challenges facing SSA, specific challenges that apply to East Africa include: (i) lack of fish culture tradition, and in some cases, lack of successful stories/examples of aquaculture production and farming systems; (ii) lack of critical mass to meet the necessary threshold for aquaculture to blossom; (iii) reliance on non-monetary means to access the required inputs and technical advice; and (iv) the issue of land tenure where small-scale farmers may not own land but may either rent, share crop, or farm on public or communally owned land. Farmers also tend to be scattered over great distances, which is not a good incentive to attract a private-sector service industry. Under these conditions, land security and ownership are weak and do not allow farmers to engage in expansive or long-term investments. The latest challenge is the increasingly erratic and unpredictable climate, which has proved to be a major challenge for SSA in East Africa. Recently, however, the region has witnessed increased levels of public interventions in an effort to mitigate key constraints hindering SSA growth and development.

Dr Doris Soto (FAO) in her presentation on "Challenges and issues facing small-scale aquaculture producers: perspectives from Latin America and the Caribbean (LAC)" reported that rural aquaculture was promoted by the governments in the LAC region from 1960 to 1980 as a means to solve food security problem. However, fish consumption continued to be very low. Assistance to SSA was given through provision of seeds, some infrastructure and some technical training but most interventions lacked the ability to create self-sustained capacity for SSA. Little attention was given to strengthening the marketing aspects or small-scale trade. Assistance was provided in very isolated places, thus it was difficult to move the products and was perhaps a "too paternalistic approach" to solve immediate hunger. In the LAC region, SSA was about 80 percent large-scale export-oriented aquaculture, and SSA grew more (around 10 to 15 percent up to 2009) as a result of the success of these export-oriented ventures and with more focus on species and systems that require the least investment. Preliminary evaluation of the social impact of aquaculture in the LAC region indicated that in 2008 the aquaculture industry generated around 400 000 jobs through direct employment while small-scale fisheries (SSF) accounted for approximately 50 000 farmers although it is difficult to estimate their number and their contribution to employment. In general, SSA has had limited impact on food security and poverty alleviation in LAC. Challenges facing SSA include: (i) large mangrove deforestation, which has been attributed to shrimp farming; (ii) a strong decline in the shrimp fisheries due to apparent larvae/adult overfishing with bag nets in nursery areas; (iii) impact from large and small shrimp farms on the estuary; (iv) large farms do not allow small farms in; (v) space conflicts between small fishers and aquaculture farmers as well as between large farms and small farms; and (vi) small-scale fishers who want to become aquaculture farmers. The main goal in LAC was to ensure that aquaculture policies enhance the contribution of the sector to poverty alleviation and food security, and this may be achieved by developing local and regional markets, providing profitability assessment tools and providing investment support and insurance, among others.

Dr Pepito Fernandez of the University of the Philippines in the Visayas presented a paper on "Governance institutions and the adaptive capacity of small-scale aquaculture to climate change in the Philippines". The Philippines, as a country, is vulnerable to climate change, i.e. intense and prolonged weather patterns caused by emissions from fossil-fuel-dependent and industrialized countries, due to its physical characteristics. The physical and ecological threats of climate change are aggravated by the high level of poverty, inequality, and poor health of residents. All these can lead to conflict and magnify existing environmental, political, economic and socio-demographic issues and concerns. Case examples revealed that successful adaptation to climate change in the Philippines was possible at different scales. Maintaining and up-scaling best practices was important. For SSA, at the household level, there was evidence that the adoption of extensive polyculture practices, complemented by small-scale agriculture and mangrove reforestation, proved to be resilient to climate change. At the local community level, e.g. leadership, trust and social network, the creation of aquaculture cooperatives provided advantage when: constructing sea walls and beach reinforcements; strengthening fishponds and related infrastructures; tapping into developmental and livelihood projects/programmes from external partners/donors; and operating fishponds for profit and poverty alleviation. At the larger political-geographic level, support of state and/or civil society groups was important in setting up technological and/or people-centered approaches to: (i) institutionalize early warning techniques, environmental education and awareness-raising systems; (ii) create hazard and vulnerability maps; (iii) improve communication and transport systems; (iv) conserve and enhance watersheds, coral reefs, mangroves, sea grasses and littoral vegetation; (v) address vulnerabilities (e.g. public health, waste management and water resources); (vi) improve legal, judicial and police systems; and (vii) promote local livelihood and economic development (e.g. through mariculture parks using intensive methods). Proper monitoring and investment in large-scale and intensive aquaculture and mariculture operations, however, was crucial to prevent pollution and disease outbreaks, promote social equity, and develop a market for "sustainable seafood". At the national and international levels, lobby groups and international partners should push for the proper implementation of pro-poor aquaculture-related projects and programmes to prevent the opposition of private interests. Current institutional arrangements and strategies may be enhanced by improving the level of trust and partnership between state and non-state sectors.

Mr Pedro Bueno (FAO Consultant), in his presentation on "Social issues in small-scale aquaculture", noted that any impact of aquaculture, whether directly on people or on the environment, is an impact on society. It becomes a social risk when society feels it is harmed and mounts a challenge. The presentation asserted the two basic social responsibilities of a fish farm. First, to remain viable; a failed farm contributes nothing positive to society; and second, was not to cause harm. He presented several ways of dealing with social issues in SSA. One way to deal with a social impact of one's own making was not to do the activity that was causing the impact, for example adopting good management practice or an alternative way of producing the same output without the impact. Another way was to turn the problem into an opportunity, in which case it ceases to be a problem. For social problems that defy this approach, or for which solutions lie with other social or political institutions, the least aquaculture can do is to not exacerbate them. The ability of SSAs enterprises to mitigate their impacts on society and the impacts of social problems on their viability, or convert either into an opportunity rests on the following: (i) their strength, which was innate with their being small and which their cultural context endows and (ii) the opportunities that their socio-economic circumstances and political context allowed them. He then outlined apparent and indicative sets of SWOT associated with SSAs, and concluded that any effort to mitigate any risk has a cost and that the only way to pay for the cost without becoming insolvent was to be profitable.

Mr Renato Agbayani, formerly of the Southeast Asian Fisheries Development Centre (SEAFDEC), presented a paper on "Resiliency of small-holder fish farmers to climate change and market prices in selected communities in the Philippines". Guided by lessons and insights from years of doing research on community-based coastal resources management and implementing aquaculture livelihood projects, the Aquaculture Department (AQD) of SEAFDEC launched in mid-2006 its Institutional Capacity Development for Sustainable Aquaculture (ICDSA) Project. The project's goal was to empower stakeholders of coastal resources to become responsible stewards of their natural resources even as they harness these for their food and livelihood through sustainable aquaculture. As of April 2010, SEAFDEC/AQD had four on going ICDSA projects. The presentation highlighted the study findings that: (i) respondents from all sites experienced climate change and suffered damage in their fish farms, households, and communities in various forms and degrees; (ii) respondents did not fully understand what climate change was and its impacts on their income and livelihood; (iii) high market prices influenced harvest schedules; (iv) institutional support from government was erratic, mostly "knee-jerked" responses because of the unpredictability of climate change and the extent of damage of such occurrences;

and (v) for research, there was a need for a more concerted and interdisciplinary approach to investigate the vulnerability of small-scale fish farmers and recommend adaptive measures in terms of technology, socio-economic diversification, and policy reorientation to improve the preparedness of small-scale fishers and lessen the damages caused by climate changes.

Dr M.C. Nandeesha, of the Centre for Aquaculture Research and Development, discussed the gender issues in SSA. A review of published literature and interaction with people involved in aquaculture project implementation in different parts of the world showed that a focus on gender can help derive sustainable benefits from SSA. Early research focused on the participation and contribution of women in various aquaculture interventions. These research results showed SSA to be an integral part of family activities; women participated in the activity even without any training. However, the degree of participation varied based on the culture and policy environment prevailing in the countries. The most active participation of women in aquaculture was reported from China and some Southeast Asian countries because of the prevailing liberal value system coupled with a high literacy rate. In South Asia, the role of women in aquaculture development was limited due to cultural restrictions coupled with low literacy. In Africa, where several countries recognized aquaculture as an important tool to meet the fish shortage, women were actively engaged in the activity. Results from various projects clearly demonstrated the need to have flexible approaches in project operations to allow involvement of women. Training methodologies should take into consideration the low literacy rate and women's multiple roles when devising appropriate learning techniques. Access to credit was a major concern in many locations, and as women do not have ownership of the land, they cannot borrow the money from banks. Self-help groups and other rural banks have evolved and contributed to some extent to address this problem. To derive greater benefits from SSA, the need for attitudinal change of people in the society was emphasized. It became also necessary to promote SSA as an economic activity to generate food and income. Climate change and the anticipated impacts are likely to affect the SSA sector. To cope with such changes, alternative strategies have to evolve. The presentation provided some suggestions such as: (i) enhancing the knowledge of aquaculture professionals on gender issues confronting the sector and focusing on gender can bring greater benefits; (ii) introducing a course on gender for aquaculture students in the institutions offering aquaculture education; (iii) attracting more women to aquaculture education, particularly in those countries where women are poorly represented in the aquaculture service sector; (iv) encouraging collection of gender-disaggregated data on the staff strength in education, research and development; (v) encouraging training of women by adopting flexible time-frame and training approaches and ensuring record maintenance on the number of people trained; (vi) promoting credit support that are sustainable; (vii) promoting crop insurance to cover various types of risks; and (viii) celebrating aquaculture gender day annually to promote responsible SSA.

Dr Jharendu Pant, of the WorldFish Center, discussed the experiences and lessons learned from a project in Nepal that empowered women through aquaculture. Small-scale pond aquaculture was an effective tool for poverty alleviation in South/ Southeast Asia. Low-cost technologies (on-farm nutrient recycling and fertilization with inorganic fertilizers) relevant to small-scale farmers are being used. Women's empowerment was an important achievement. Replication of the project is likely to benefit a large number of poor women farmers in different contexts. Efficiency of SSA systems increases with the introduction of high-value species, e.g. freshwater prawns in Nepal. Targeting the community as a whole (in cluster) was key to the sustainability of SSA interventions. Sustainable SSA development is a steady process (5–6 years might be ideal but may vary with the context). Viability of SSA also depended on infrastructure, communication systems, market and social harmony. Other potentials for SSA intervention include, for example integration of fish culture with irrigation systems; fish culture in seasonal pond, lakes and reservoirs.

Dr Rohana Subasinghe (FAO), in his presentation on "Recovery and sustainable development of aquaculture industry affected by tsunami in Indonesia", stressed six key learnings from the experiences of Indonesian farmers. First, huge incentives with little service often led to poor results. Second, little incentives coupled with huge service led to better results. Third, it takes time for result visualization (knowledge, attitude, practice, and sustainable results). Fourth, diversification was the key! Diversification reduces risk and vulnerability. Fifth, the context of small-scale farming sector includes four key issues: connectivity, inclusive growth, sustainability and globalization. Last, cluster management was important in addressing these key issues.

Working group session

Dr Melba B. Reantaso introduced the guidelines for the working group discussions, after which the participants were divided into three working groups to discuss the following:

- SWOT analysis.
- Entry points and action plans to enhance SSA contribution of SSA to food security, poverty alleviation and socio-economic development.
- Elements/scope that can be included in the Code technical guidelines on SSA.

Working group tasks

For three half days, the working groups collaborated to discuss and provide inputs on the the different tasks related to achieving the workshop objectives. Table 1 below shows the task assignments completed by each working group.

The results of the discussions pertaining to the above tasks and the group presentations are in the succeeding sections.

TABLE 1
Assigned tasks for the working groups

	Tasks			
	SWOT	Entry points	Action plans	Guiding principles
Working group 1	√	√		√
Working group 2	√	√	√	√
Working group 3	√	√	√	√

WORKING GROUP FINDINGS

Working group members

The working groups were composed of different experts from the academe, government and various international organizations who participated in the workshop. The members of the working group are presented in Table 2.

TABLE 2
Working group members

	Members
Working group 1	Rohana Subasinghe, Paul Smith, Beatrice Nyandat, Peter Ziddah, Tipparat Pongthanapanich, Harvey Demaine, Shirlene Maria Anthonysamy, Benjamin Belton, Pepito Fernandez, Davide Fezzardi and Le Xuan Sinh
Working group 2	Erik Keus, Le Thanh Luu, Pedro Bueno, Weimin Miao, Koji Yamamoto, Kim Anh Thi Nguyen, Hanh Chau, Dung Tien Vu, Dilip Kumar, Jharendu Pant, Renato Agbayani, Melba Reantaso and Philip Townsley
Working group 3	Imtiaz Ahmad, Flavio Corsin, Wilson Mwanja, Peter Edwards, Mudnakudu Nandesha, Doris Soto, Trinh Quang Tu, and Yongming Yuan

Analysis of strengths, weaknesses, opportunities and threats (SWOT analysis)

A structured analysis to evaluate the sector's internal attributes (strengths and weaknesses) as well as its external environment (opportunities and threats) was undertaken. These are recorded as Table 3.

TABLE 3
Analysis of internal (strengths, weaknesses) and external (opportunities and threats) attributes of the small-scale aquaculture sector (SWOT analysis)

Pillar: food security			
Internal attributes		External attributes	
Strengths	Weaknesses	Opportunities	Threats
Less impact on environment and sustainable	Activities are undertaken as single farmers making it more vulnerable and riskier	Potential for good income generation by tapping niche market, e.g. freshwater prawn, high-value species	Market risks are prevalent such as uncertainties in market price fluctuation
Benefits in terms of quality fish, health benefits, overcoming problems with seasonalities	Farmers often lack appropriate technical know-how; resources needed and services are often missing; inadequate supply of affordable inputs or access to seed, lack of feed, and market price information are prevalent in the industry	Availability of low-value sources, especially for the poor	Available alternative livelihood opportunities leads to withdrawal of labour/resource in developing economies
Income generation at household level thus ability to buy food	Use of labour competes with other farm activities	Presence of diverse livelihood, economics, risk mitigation studies	Increased land-based activity (effect of water quality/pollution) presents a challenge
Wider community level through provision of fish for consumption	Less efficient in terms of economies of scale	Involvement of poor, women with specific impact on nutritional status of women and children	Urbanization may lead to less access to land
Produces high-value and nutritious products which generally have high market demand		Opportunity for increased fish production with available technological support	Climate change and its effect on production
Reduces dependence on wild fish stocks for food		Products can be sold as naturally grown, chemical-free leading to better prices for products	
Increases welfare (health, etc.) for the SSA household		Low carbon food production compared with livestock	

TABLE 3 (Cont.)

Pillar: poverty alleviation			
Internal attributes		External attributes	
Strengths	Weaknesses	Opportunities	Threats
Source of income Efficiently and fully use labour Relatively higher returns compared with agriculture Creates job opportunities through input provision and market services Provides employment for the poor; in rural areas, it is a source of self-employment Increases social status, i.e. an SSA farmer has an elevated social and economic status	Methods are often very site-specific, thus it can not be done everywhere Become more dependent on inputs as systems are intensified or scaled up Increased risks with intensification Attracts users who are likely to be less assertive and influential, thus making the activity vulnerable Requires specific know-how and sometimes new knowledge and skills Development will often require services and support that may be lacking in the sector As it is small-scale, thus difficult to see and diffuse; difficult to measure the output and attract investment Difficulty to control quality Production in small volumes, thus market access difficult Highly dependent on access to key resources such as land and water Highly dependent on access to key resources such as land and water Diversity makes it difficult to see, count and control Small and extensive SSA is generally not labour-intensive (but intensification generates more demand for labour) Extensive SSA generally gives relatively low returns on labour Production periods are relatively long compared with some other agricultural products	Increased opportunities with better public support services Potential for integration with other farm activities Access to fair trade and niche markets can offer potential for SSA Demand for fish is generally increasing and supply from wild stocks is reducing Can serve as safety net or fallback activity Supports empowerment process when used as a focus for group or cluster approaches Opens new business opportunities through marketing and value addition Supports more effective land and water use, particularly in more remote areas Increasing recognition as an efficient production system Encourages more awareness and attention to water management Provides potential for involving large numbers of people and generating diffuse benefits	SSA up scaling or expansion leads to resource constraints Poor quality may affect viability and market access Disease can be a threat, particular during expansion and up scaling Can generate environmental pollution and presented as a threat Market price fluctuation can threaten its viability Poorer and disorganized groups makes it more vulnerable to shocks and other threats Increasingly stringent food quality and traceability requirements More vulnerability to shocks Ageing farm populations could represent a threat to capacity to undertake and develop SSA

TABLE 3 (Cont.)

Pillar: socio-economic development			
Internal attributes		External attributes	
Strengths	**Weaknesses**	**Opportunities**	**Threats**
Sharing of fish De-centralized and participatory Empowerment of local communities Strengthens community traditions and values Relatively easy undertaking for small farmers as it can use low cost inputs and on-farm resources Generates more job opportunities, especially in intensified production areas Flexible and adaptable to a changing environment because of low investment Have a range of levels of risk depending on type of SSA and thus can be tailored to local circumstances and users Wide and diverse technological options are available which are relatively easy to adopt, apply and adapt Activities can be conducted in rural areas Simple technology exists for SSA thus available for everyone to try Contributes to increased GDP	Unpredictable product quality may lead to negative influence on domestic waste; food hygiene and safety is sometimes questioned Limited output, observed at the farm level only Late adopters of new technologies because of limited capacity, etc.; low capacity and awareness, e.g. access to credit Youth driven to bad habits, e.g. some forms of SSA leads to large amounts of money which can lead to gambling, etc. Inability to cope with competition from large-scale farms. Lack of government support and economic incentives that would allow for SSA to compete Bigger economic margin as SSA generally has lower cost of employment, an advantage of SSA; thus SSA needs to move from subsistence to business-oriented. Transition to become an SME or establish a cluster/group for profitability Need to stress the ecological value of SSA and for it to be done in a sustainable manner. Limited information on markets and legal requirements Difficulty in complying with certification requirements Risk-prone/increased vulnerability	Contract farming enables access to feed and seed and market Institutional support from government can be generated, as well as research support from international organizations and NGOs; corporate social responsibility can be used as a platform for support Viable group for group/cluster formation Increased demand of aquaculture products in view of declining capture fisheries, population growth and increasing welfare and knowledge on the health benefits of fish Strengthening of the sector through increased value through organic/fair-trade mechanisms may strengthen the sector Low carbon footprint systems can lead to an environmentally friendly sector Comparatively powerful approach for poverty alleviation and improved welfare Application of modern technology for diversification and intensification will make the sector profitable and enable efficient use of wastes Enabling environment can be provided through pro-poor and pro-SSA government policies Local market development	Low legal property status, i.e. property loss due to external factors difficult to document Disease outbreaks can be prevalent Changing and increasing market requirements, e.g. certification Economic crises may affect the sector negatively Natural/environmental disasters and resource limitations (i.e. climate change, reduced water availability, scarce land) can negatively affect the sector Poor or lack of policy support Better alternative livelihood options Low competition with large-scale farms

Entry points

The workshop identified entry points that can guide SSA stakeholders in their contribution to food security, poverty alleviation and socio-economic development. They range from political support through policies, resolution of issues surrounding SSAs and partnerships with key stakeholders to financial strengthening of SSA activities through education, training and access to financial funds and also through infrastructure improvements and gender awareness. These entry points are shown in Table 4.

TABLE 4
Entry points to guide and strengthen the SSA sector's contribution to food security, poverty alleviation and socio-economic growth

Pillars	Entry points
Food security	Infrastructure and technological improvements through: - better methods of production and better distribution, storage, transport and service provision - better supply chains - quality of products not compromised Conducive and enabling policy environment through: - recognition of SSA farmers - appropriate allocation of resources - coordinated implementation of policy by all actors Empowerment, participation, co-management and SSA-led decision-making through: - strengthening of assets through cooperative endeavours - rationalization of resource use and improved methods for efficiency - creating farmer groups/cooperatives Viable economic activities and species utilized in SSA Proper and timely information, education, and training through: - communicating needs of producers - service providers and consumers to make informed market choices that are also ecologically sound Links with indigenous ecological biodiversity and ecosystem services Acceptable food utilization, fish processing, value-added processes and other innovative, culturally and nutritionally acceptable by-products Opportunities for: - restocking and culture-based fisheries - urban, recreation, tourism and ornamental aquaculture
Poverty alleviation	Harmonized activities through: - integrated with the broader poverty alleviation process, - building on strength and support to overcome obstacles - identifying synergies with other sectors Financial services Access to land and water resources Analysis of SSA situation and inter-relationships with livelihood and poverty Basic support services Domestic market Provision of seed and feed Broad stakeholder consultation for: - sectoral needs - policy influence - incentives and interest - use of local resources - conflict avoidance measures - development and demonstration of tested technologies - long-term strategic thinking - promotion of public and private sector partnerships Resource assessment and impact pathway studies Social mobilization

TABLE 4 (CONTINUED)

Pillars	Entry points
Socio-economic development	Value chain private-public partnership Policies conducive to sectoral contribution to economic growth Consensus/agreement among farmers or different actors in the supply chain Advocacy for equity, transparency and opportunity creation Successful aquaculture initiatives for possible scaling up in the appropriate context (nursing networks, clusters/aquaclubs; BMP, GAP, GlobalGAP) Diversification (land-based, water-based, inland and coastal aquaculture) Resilient systems: - integrated multitrophic aquaculture systems - use of natural feed - use of species low in the food chain - use of filter-feeding fish - culture-based fisheries in reservoirs and rivers

Action plans

Action plans were also identified to strengthen SSA producers so that their contribution to food security, poverty alleviation and socio-economic development can be enhanced (Table 5).

TABLE 5
Examples of action plans for strengthening SSA producers in enhancing their contribution to food security, poverty alleviation and socio-economic development

Pillars	Action plans
Food security	Create policies that will: - provide access of SSA producers to resources (land and water), - undertake critical assessment of contribution of SSA to food security including preparation of guidelines - support to SSA through appropriate institutional framework and - enable integration of SSA to nutritional programme policy Make available services that will: - assist in organizing farmers, - provide capacity building for SSA producers (grassroots level) - provide markets and linkages (transportation, cold storage, etc.) - improve production efficiency of SSA and promote viable SSA farming systems that supports the use of local resources for increased producion Undertake 'real world' case studies and document good practices as basis for planning Identify mechanism that works to produce cheap and nutritious fish through SSA Develop action plans for SSA based on the World Food Summit (2009) commitments
Poverty alleviation	Create policies that support: - allocation of national budget - needs identification - national assessment of its contribution to poverty alleviation, - studies on impacts pathways - farmer organization for better market access Build capacity and raise awareness of institutions and SSA producers on poverty alleviation issues Strengthen supply market chain Encourage diversification from agriculture to aquaculture Extend and disseminate current knowledge on contribution of SSA to poverty alleviation Empower SSA communities and strengthen extension services Identify incentives and other measures to support SSA Prepare an inventory of best practice cases
Socio-economic development	Create policies on SSA planning, private sector involvement, education, provision of safety nets, partnership with private sector to help strengthen its role in economic growth Integrate SSA policies to rural development programmes and action plans on SSA to PRSP Make available infrastructure for year-round seed supply and seed distribution network Promote and improve access to market for SSA producers (through case studies) and facilities for market linkages Promote group-based farming systems Review comparative better practices (aquaculture and agriculture) for generating lessons learned

Elements of the Code technical guidelines for enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development

Using the outcomes of Sessions I-III, the following considerations (Guiding Principles, Vision, Process and Content (Elements) were deemed appropriate to be included in the SSA TG.

The preparation of the SSA TG will be supported by a technical document (FAO Fisheries and Aquaculture Proceedings) containing background materials and thematic papers contributed during the Hanoi SSA workshop.

A team of experts[3] will assist FAO in the further development and finalization of the TG.

Draft guiding principles

Guiding Principle #1: The diverse and dynamic nature of SSA (including its species and operations) must contribute to environmental sustainability and biodiversity as well as health benefits for its intended beneficiaries.

Guiding Principle #2: The SSA sector should strive to be cost-effective and take advantage of opportunities for expansion and increased productivity through low-input practices; horizontal and vertical expansion; utilizing low value inputs for high value products; and value addition in its production in order to gain access to niche markets and, ultimately, better prices.

Guiding Principle #3: The SSA producers will judiciously use resources available to the sector and exercise good judgement in choosing alternative options in their use, particularly of scarce resources.

Guiding Principle #4: The SSA sector must ensure economic viability for income generation and provide opportunities for SSA producers to enhance their contribution to the production of fish and other products.

Guiding Principle #5: In order to create, enable and enhance SSA production, building of appropriate, energy-efficient and low-maintenance infrastructures should be fostered.

Guiding Principle #6: Gender and community empowerment by framing SSA policies using participatory and gender-sensitive processes should be fostered, including empowering the community by addressing their vulnerabilities and enhancing capacities (institutional, voice, choice and politics).

Guiding Principle #7: Social capital and safeguards should be strengthened through participation (social ownership in the decision-making processes).

Guiding Principle #8: Empowerment of SSA producers through targeted knowledge and training for development, as well as mainstreaming of ecological and food system literacy should be sought.

Guiding Principle #9: Public-private sector partnerships (PPP) with a focus on SSA should be promoted and sought.

[3] The experts identified are: I. Ahmad, P. Townsley, H. Demaine, P. Bueno and M. Phillips.

Guiding Principle #10: In undertaking SSA activities, the SSA sector must strive to avoid conflicts and enhance its contribution to poverty alleviation by trying to address the multiple dimensions of poverty.

Guiding Principle #11: The SSA sector should strive to remain profitable and balance its assets to ensure its continued contribution to food security, poverty alleviation and socio-economic development.

Draft outline of the TG

The draft outline of the TG is below:

1. Background (will include a paragraph on the outcomes of the World Summit on Food Security held in Rome, 16-18 November 2009 in its Declaration).
2. General Guiding Principles pertaining to the development of the SSA TG.
3. Definition of relevant terms and concepts.
4. Section putting in context SSA in terms of food security, poverty alleviation and socio-economic development, the SSA should be put in the right context within these three pillars (including their inter-relationships) as a continuum, as follows:
   - food security in terms of availability, access, utilization, stability;
   - poverty alleviation in terms of access to opportunities, inclusion, representation, stability/vulnerability alleviation, safety nets;
   - socio-economic development in terms of GDP growth, export growth, wealth creation, employment, safety nets, environmental services, health and nutrition
5. Draft Vision:
   - "...responsible and sustainable practices in support of improving the livelihood of rural, resource-poor communities, small-scale producers and small-scale farmer organizations...".
6. Guidance in enhancing the contribution of SSA to food security, poverty alleviation and socio-economic growth: this will include 2 major parts, i.e. process and contents (elements):
   - Process: will present a description of process, considerations and prerequisites, which need to be in place to ensure government commitment to support SSA, e.g. through recognition of SSA producers as important players, appropriate sector national policies and legislation, appropriate adjustments, in cases where aquaculture policies and legislation exist, etc;
   - Elements:
     - Institutional commitments,
     - Policies, legislation and governance to ensure food security,
     - Policies, legislation and governance to support resource-poor communities,
     - Policies, legislation and governance to create opportunities to generate wealth,
     - Inclusive growth: integrating SSA with commercial aquaculture and other sectors SSA interaction with agriculture but also with fisheries, this is especially relevant in large inland water basins, lakes, reservoirs (the role of aquaculture-based fisheries for SSA, etc.) and particularly in marine coastal zones,
   - Creating markets for SSA producers:
     - Human capacity development of the primary SSA producers including the secondary players in the value chain,
     - Systematic assessment of SSA contribution, SSAs for upscaling based on good practice cases, potential SSAs for specialization and intensification, negative impacts,
     - Appropriate financial services,
     - Appropriate technology,
     - Self-empowerment of risk-averse SSA producers to identify and manage risks,
     - Diversification to reduce risk and vulnerability,

  - Effective communication,
  - PPP and other incentives.
7. Monitoring and evaluation,
8. Implementation considerations.

The way forward

Based on the outcomes of the WG discussions, the following were indicated as activities/actions that may be considered by FAO (in partnership with governments and other relevant organizations) for implementation:

- Support the following studies: (i) assessment studies, (ii) best practice studies, (iii) best marketing practice studies, and (iv) guidance for SSA producer empowerment through SSA producer organizations.
- Generate funding to implement some of the identified action plans/follow-up recommendations as part of FAO's normative programme and/or in collaboration with relevant partners.
- Report the outcomes of the Hanoi SSA expert workshop (SSA TG and implementation of follow-up work) as a potential agenda to future sessions of the COFI Sub-Committee on Aquaculture.

Closing session

The workshop closing ceremony was graced by Dr Andrew Speedy, FAO Representative in Viet Nam, who thanked RIA1 for its excellent hosting. He noted the achievements of the expert workshop, particularly focusing on people and small-scale producers as well as putting SSA in the broader context of aquaculture, large-scale aquaculture, aquaculture-based fisheries, as well as agriculture and rural development and the need for cross-sectoral integration of development efforts. Mr Jia formally closed the workshop after expressing FAO's gratitude to RIA1 and all participating experts who actively contributed and thus made the workshop a successful event.

APPENDIX 1

List of participants

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APPENDIX 2

Expert workshop programme

Date and Time	Activities		
21 April 2010 (Wednesday)			
08.30–08.45	Registration and distribution of expert workshop information package		
	Opening Session		
08.45–09.30	Opening ceremony Mr Vu Van Tam, Vice Minister, Ministry of Agriculture and Rural Development Mr Jia Jiansan, Chief, Aquaculture Service, FAO Fisheries and Aquaculture Department Self introduction by participants Presentation of objectives, expected outcomes, workshop mechanics (Dr Melba Reantaso)		
09:30–10:00	Group photo and coffee break		
	SESSION 1 Session 1.1 Thematic Presentations: Understanding small-scale aquaculture (SSA): its contribution/potential contribution and challenges/issues facing SSA producers		
10:00–10:20	Presentation 1: Review of small-scale aquaculture: definitions, characterization, numbers (Dr Peter Edwards)		
10:20–10:40	Presentation 2: Concepts of poverty, vulnerability, food security, aquatic resources management, rural livelihoods and development and how these concepts evolved within the field of small-scale aquaculture (Mr Philip Townsley)		
10:40–11:00	Presentation 3: Contribution of SSA to rural development: outcomes of case studies in China, the Philippines, Thailand and Viet Nam (Dr Tipparat Pongthanapanich)		
11:00–11:20	Presentation 4: Successful SSAs and their contributions to economic growth at the national level and poverty alleviation and rural development at the local level (Dr Peter Edwards)		
11:20–11:40	Presentation 5: Challenges to sustainable use and management of aquatic resources for small-scale aquaculture producers (Mr Philip Townsley)		
11:40–12:00	Presentation 6: Small-scale aquaculture, poverty and development: a reassessment (Mr Benjamin Belton)		
12:00–12:20	Presentation 7: Role of small-scale aquaculture to food security, poverty alleviation and socioenonomic development in Mekong Delta, Viet Nam (Dr. Le Xuan Sinh)		
12:20–12:50	General discussion		
12:50–14:00	Lunch break		
14:00–14:15	Session 1.2 Working Group discussions Presentation of Session 1.2 guidelines		
14:15–16:15	Working Group 1	Working Group 2	Working Group 3
	SWOT analysis on the role of SSA to food security Elements/scope that will be included in the Technical Guidelines	SWOT analysis on the role of SSA to poverty alleviation Elements/scope that will be included in the Technical Guidelines	SWOT analysis on the role of SSA to wider economic growth Elements/scope that will be included in the Technical Guidelines
16:15–16:45	Coffee break		
16:45–17:45	Session 1.3: Working Groups 1, 2 and 3 presentations		
17:45–18:15	General discussion		

Appendix 2 (Cont.)

Date and Time	Activities		
22 April 2010 (Thursday)			
	SESSION 2 Session 2.1 Thematic Presentations: Entry points for enhancing the contribution of SSA to food security, poverty alleviation and socio-economic development		
08:30–08:50	Presentation 8: Improving access to financial services by small-scale aquaculture producers: challenges and issues (Mr Imtiaz Ahmad)		
08:50–09:10	Presentation 9: Growth in global fishery trade and its benefit to small-scale aquaculture producers (Ms Shirlene Maria Anthonysamy)		
09:10–09:30	Presentation 10: Small-scale aquaculture in Thailand: farmer group and certification (Mr Koji Yamamoto)		
09:30–10:00	Coffee break		
10:00–10:20	Presentation 11: Good governance, policies and other frameworks that work in favour of small-scale aquaculture producers (Dr Dilip Kumar)		
10:20–10:40	Presentation 12: Lessons learned from the SAPA strategy in Viet Nam (Dr Le Thanh Luu)		
10:40–11:00	Presentation 13: Best practices to support and improve the livelihood of small-scale aquaculture households (Mr Weimin Miao)		
11:00–11:20	Presentation 14: Overview of the role of aquaculture in country poverty reduction strategy(Mr Imtiaz Ahmad)		
11:20–11:40	Presentation 15: Small-scale aquaculture in Papua New Guinea: lessons from international R&D projects on enhancing the contribution to food security, poverty alleviation and socio-economic development (Dr Paul Smith)		
11:40–12:20	General discussion		
12.:20–13:30	Lunch break		
13.30–13:40	Session 2.2: Working Groups discussions Presentation of Session 1.2 guidelines		
13:40–16:00	Working Group 1	Working Group 2	Working Group 3
	Entry points for enhancing the contribution of SSA to food security Guiding Principles to be included in the Technical Guidelines	Entry points for enhancing the contribution of SSA to poverty alleviation Guiding Principles to be included in the Technical Guidelines	Entry points for enhancing the contribution of SSA to wider economic growth Guiding Principles to be included in the Technical Guidelines
16:00–16:30	Coffee break		
16:30–17:30	Session 2.3: Working Groups 1, 2 and 3 presentation		
17:30–18:00	General discussion		

Appendix 2 (Cont.)

Date and Time	Activities		
23 April 2010 (Friday)			
	SESSION 3 Session 3.1 Thematic Presentations: Actions plans to protect SSA producers and households from threats, risks, shocks, crises and emergencies		
08:30–08:50	Presentation 16: Challenges and issues facing small-scale aquaculture producers: perspectives from Asia (Dr Sena De Silva)		
08:50–09:10	Presentation 17: Challenges and issues facing small-scale aquaculture producers: perspectives from Eastern Africa (Dr Wilson Mwanja and Ms Beatrice Nyandat)		
09:10–09:30	Presentation 18: Challenges and issues facing small-scale aquaculture producers: perspectives from Latin America and the Caribbean (Dr Doris Soto)		
09:30–10:00	Coffee break		
10:00–10:20	Presentation 19: Governance institutions and the adaptive capacity of small-scale aquaculture to climate change in the Philippines (Mr Pepito Fernandez)		
10:20–10:40	Presentation 20: Social issues in small-scale aquaculture (Mr Pedro Bueno)		
10:40–11:00	Presentation 21: Resiliency of small-holder fish farmers to climate change and market prices in selected communities in the Philippines (Mr Renato Agbayani)		
11:00–11:20	Presentation 22: Gender issues in small-scale aquaculture (Dr MC Nandeesha)		
11:20–11:40	Presentation 23: Recovery and sustainable development of aquaculture industry affected by tsunami in Indonesia (Dr Rohana Subasinghe)		
11:40–12:10	General discussion		
12.10–13.40	Lunch break		
13:40–14:00	Session 3.2: Working Groups discussions Presentation of Session 3.2 guidelines		
14:00–16:00	Working Group 1	Working Group 2	Working Group 3
	How can SSA's contribution to food security be made more resilient to threats/risks, crises/emergencies (action plans) How can these be incorporated into the Technical Guidelines	How can SSA's role in poverty alleviation be made more resilient to threats/risks, crises/emergencies (action plans) How can these be incorporated into the Technical Guidelines	How can SSA's contribution to wider economic development and growth be made more resilient to threats/risks, crises/emergencies (action plans) How can these be incorporated into the Technical Guidelines
16:00–16:30	Coffee break		
16:30–17:30	Session 3.3: Working Groups 1, 2 and 3 presentation		
17:30–18:00	General discussion		
19:00–	Farewell Dinner		

Appendix 2 (Cont.)

Date and time	Activities
24 April (Saturday)	
08:15–09:00	SESSION 4: Presentation of Workshop Outputs and the Way Forward – FAO Secretariat
09:00–09:30	Closing of the Workshop Mr Andrew Speedy, FAO Representative to Viet Nam Dr Le Thanh Luu, Director, RIA1
09:30–20:00	Field trip/Departure of some participants
25 April (Sunday) - Departure of participants	

APPENDIX 3

Opening remarks: Mr Vu Van Tam

Dear representatives of the Food and Agriculture Organization of the United Nations, respected scientists, experts, ladies and gentlemen;

Today, I am very honored to be invited to attend the opening ceremony of the workshop and on behalf of the leadership of the Ministry of Agriculture and Rural Development and on behalf of the Administration of Fisheries I would like to welcome you to this workshop.

I was informed that participants of the workshop today are lead researchers, top experts in the field of aquaculture, especially in small-scale aquaculture. I am really excited to meet you to say many thanks and highly appreciate the initiative of FAO, and with a hope to share few ideas and also learn from you, the leading international experts, your experiences in aquaculture.

The workshop itself entitled "Enhancing the Contribution of Small-Scale Aquaculture (SSA) to Food Security, Poverty Alleviation and Socio-Economic Development", expresses the important role of small-scale aquaculture for the livelihood of a large group of the rural population, especially the disadvantaged mountain and remote areas.

As you know, aquaculture production in Viet Nam has reached approximately 2.6 million tons in 2009. Sixty five to seventy percent of this total production is produced by the small-scale farming households. It shows that small-scale aquaculture plays very important role in Viet Nam. It provides a cheap protein source to meet the food demand of local population, it creates jobs for farmers (although this is the secondary occupation), it increases income and it uses more rationally land, water resources and by-products from animal husbandry and agriculture.

Recognizing the role of aquaculture in general, family-scale aquaculture in particular, for socio-economic development of the country, in the past decade, the Government of Viet Nam has set out several policies to encourage the development of aquaculture in all regions (mountain, lowland and coastal), in all farming environments such as freshwater, brackishwater and marine and also to diversify culture species. Hopefully, the Viet Nam experts will present these policies to you during the workshop. Among the policies, the "Vietnamese Fishery Law", the programme for "Aquaculture Development for a period 1999-2010", the programme for "Aquatic animal seed production to 2010" and the strategies for "Sustainable Aquaculture for Poverty Alleviation" had played significant roles to stimulate high growth rate of the fishery sector in this decade.

I think that in the coming decades, household aquaculture will still have an important role in the lives of rural communities in Viet Nam, since the number of farmers will remain high: currently 70 percent, following two decades would be reduced to 30-35 percent; an average agricultural land per head in Viet Nam is low (currently about 300- 800m^2/person), while the water surface area potential for aquaculture is still abundant. However, the farming intensification should be improved; the forms of organization for production need to be changed to match the development trends to ensure high quality products which meet the safety requirements of consumers.

Technologies for small-scale aquaculture also need to be improved to be in harmony with the environment meaning not to create pollution and damage the environment. Some other matters related to the sustainability of small-scale aquaculture such as disease prevention, the effectiveness of the use of feed, seed quality and capacity access their products to market chain will also be issues of concern, especially issues relating to climate changes, natural disasters, rising of sea water with Viet Nam being one of five most affected countries. Hopefully the lead scientists and experts will find effective solutions and approaches to help the small producers.

I also wish that the diverse experiences of the different countries in the world should be shared so everyone has possibility to access, to learn so that they will practice better creating better social benefits. From Viet Nam, we guarantee that all our experiences will be shared with those people and communities who and where the needs are.

Finally, once again I wish the workshop success; also wish you having effective working days and enjoy in Hanoi. Good health.

APPENDIX 4

Welcome remarks: Mr Jiansan Jia

Mr Vu Van Tam, Vice-Minister of the Ministry of Agriculture and Rural Development, Dr Le Thanh Luu and colleagues at the Research Institute for Aquaculture No. 1 (or RIA1), all participating experts, FAO colleagues, ladies and gentlemen;

On behalf of FAO Director General Jacques Diouf and Assistant Director General Ichiro Nomura of the FAO Fisheries and Aquaculture Department, I would like to welcome you to this FAO Expert Workshop on Enhancing the Contribution of Small-Scale Aquaculture to Food Security, Poverty Alleviation and Socio- Economic Development.

First of all, we would like to thank RIA 1 for kindly hosting this workshop and the excellent arrangements. We also equally thank the participating experts who have travelled from as far as eastern Africa, Australia, Europe and many colleagues from Asia for taking the time to participate in this workshop. And last but not least, I personally thank Vice-Minister Vu Van Tam for gracing the opening session of the workshop.

As you are all aware, small-scale aquaculture (or SSA as we will constantly refer to in this workshop) is a significant backbone of the aquaculture sector especially in developing countries which produce majority of aquaculture products. Aquaculture in Asia is dominated by small-scale aquaculture. While the contribution of small-scale producers are recognized in more general terms such as for example, food security and improved nutrition, efficient use of resources, livelihood diversification, generation of rural income and employment, women involvement – there still lacks a deep understanding and systematic assessment of its positive contribution, negative impacts, potential and other important and emerging issues affecting the SSA sector.

As experts in this field, we are pleased that you are able to assist FAO in our work particularly on SSA so that we can provide appropriate guidance to FAO members with respect to properly managing the SSA sector so that the benefits derived from it will trickle down to the thousands of small-scale producers, their families and the communities dependent on SSA for food security and livelihood.

Viet Nam is one of the top 10 aquaculture producing countries and it is opportune that we hold this expert workshop here and to learn from our Vietnamese colleagues. In addition, we also hope to learn from experiences in China, India, Thailand, Bangladesh and the Philippines – also among the top ten aquaculture producers. We also welcome very much experiences from Latin America, Eastern Africa, Papua New Guinea. While gaining knowledge on country level experiences, we also hope to learn from the various concepts and themes that will increase our understanding of SSA as basis for appreciating the sector and provide pathways for drawing useful interventions.

There is a long three-day ahead of us and a rather tight programme. We hope that the carefully selected technical presentations will adequately inform the 3 working groups sessions and the deliberations that will follow - will enable us to provide measures that will enhance the contribution of SSA to food security, poverty alleviation and socio-economic growth.

With your wide-ranging experience and expertise, I am confident that we will achieve the goals of the workshop – which will be presented by Melba in the next couple of minutes.

Once again, I wish everyone a productive workshop and we look forward to an active exchange of ideas and recommendations.

Have a good day.

APPENDIX 5

Expert workshop group photos

Expert workshop participants pose for a group photo during the closing ceremony (upper photo) and during a field trip (lower photo)

PART 2

CONTRIBUTED PAPERS ON ENHANCING THE CONTRIBUTION OF SMALL-SCALE AQUACULTURE TO FOOD SECURITY, POVERTY ALLEVIATION AND SOCIO-ECONOMIC DEVELOPMENT

Review of small-scale aquaculture: definitions, characterization, numbers

Peter Edwards
Bangkok, Thailand

Edwards, P. 2013. Review of small-scale aquaculture: definitions, characterization, numbers. *In* M.G. Bondad-Reantaso & R.P. Subasinghe, eds. *Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development*, pp. 37–61. FAO Fisheries and Aquaculture Proceedings No. 31. Rome, FAO. 255 pp.

ABSTRACT

None of the various definitions for small-scale aquaculture are satisfactory. Traditional aquaculture is usually integrated with other human activity systems as these provided the only sources of nutritional inputs for farmed aquatic organisms in the past, before the relatively recent manufacture and rapidly increasing use of chemical fertilizers and pelleted feed. Exceptions are coastal mollusks and seaweeds which depend on suspended particles and dissolved nutrients in the water column, respectively.

Rural aquaculture is still widely used but the term 'small-scale' aquaculture (SSA) has come into vogue. A definition of SSA was agreed at the Nha Trang workshop[1] indicating that SSA comprises a spectrum:

1) systems involving limited investment in assets, some small investment in operational costs, including largely family labour and in which aquaculture is just one of several enterprises (known in earlier classifications as Type 1 or rural aquaculture); and
2) systems in which aquaculture is the principal source of livelihood, in which the operator has invested substantial livelihood assets in terms of time, labour, infrastructure and capital (this was labeled as Type II SSA system).

Common elements characterizing this SSA definition are ownership of, or access to, an aquatic resource; ownership by family or community; and relatively small size of landholding. However, if aquaculture becomes the primary livelihood activity, there is likely to be greater investment and hire of labour with an indistinguishable overlap between small and medium or even large scale-aquaculture.

This papers reviews the definition and characterization of SSAs and provides information in terms of numbers of SSAs and some perspectives on how the small-scale farmer model can contribute to achieving FAO's mandate and vision of a world free of hunger and malnutrition.

Keywords: small-scale aquaculture definition, rural aquaculture, rural development.

[1] Bondad-Reantaso, M.G. and Prein, M., eds. 2009. Measuring the contribution of small-scale aquaculture: an assessment. *FAO Fisheries and Aquaculture Technical Paper*. No. 534. Rome, FAO. 2009. 180p.

INTRODUCTION

Definitions of aquaculture in general are reviewed: traditional and modern aquaculture, intensity of production, and various types of integration. Definitions and their ambiguity with particular reference to small-scale aquaculture (SSA) are discussed: rural aquaculture, artisanal aquaculture, urban aquaculture and finally SSA. Small-scale aquaculture is characterized in relation to aspirations of small-scale farmers, developmental options for small-scale farming households, and appropriate technologies. Alternative development strategies are discussed in relation to the 'green revolution' and 'blue revolution'. The limitations in official statistical data are outlined. The degree to which promotion of SSA could contribute to FAO's mandate are discussed.

DEFINITIONS OF AQUACULTURE SYSTEMS

There is a need to briefly outline these as aquaculture systems have been and continue to be characterized in a wide range of often poorly defined ways.

Traditional and modern aquaculture

Traditional inland aquaculture has been defined as being developed and disseminated by farmers and local communities using on-farm and/or locally available resources in contrast to modern aquaculture which is increasingly a science/industrial-based technology using agro-industrially formulated feed, new species and breeds, induced hormonal breeding and various techniques to control disease (Edwards, 2009a).

Small-scale farming mainly uses unimproved breeds of fish in traditional culture facilities such as ponds but it is supported by modern hatchery technology and especially agro-industrial fertilization and feeds.

In the recent book 'Success stories in Asian aquaculture' De Silva and Davy (2009) wrote that the 'traditional practices tend to be largely small-scale operations'. However, there are several traditional systems that are large. Village-level ponds were leased to the highest bidder in China over 70 years ago so these relatively large systems would also have been operated by the better-off farmers (Hoffmann, 1934). Many peri-urban integrated livestock/fish systems are large-scale as are wastewater-fed fishponds, e.g. in Kolkata, India and milkfish ponds in Indonesia and the Philippines.

The main point in contrasting traditional and modern aquaculture is that most aquaculture, small as well as large can only be sustainable in the context of use of modern technology for it to be productive and therefore socially and economically sustainable.

However, the distinction between traditional and modern aquaculture technologies is becoming blurred as some of the principles of traditional aquaculture are being used to reduce the adverse environmental impact of modern industrial aquaculture e.g. seaweeds to remove the nutrients from intensive cage culture of salmon.

Intensity of production

Extensive, semi-intensive and intensive are commonly used terms for the degree of intensification of production through nutrition in aquaculture (Edwards, 2009a). As these terms are used in varying ways, they are defined below for the purpose of this study. Although the classification below is based on nutrition, increasing intensification is correlated with higher levels of other inputs such as seed, labour, capital and management. This classification system is less relevant for mollusks and seaweeds because they feed on the level of natural food in the water irrespective of the level of intensification.

Extensive systems

Organisms farmed in extensive systems depend on natural food produced within the system without nutritional inputs provided intentionally by humans. Natural food consist of plankton (e.g. bacterioplankton; phytoplankton; and zooplankton) suspended in the water column and benthos (e.g. insect larvae and adults; snails; and worms) in sediments and is usually high in protein (50-70% dry matter). Extrapolated annual fish yields are usually less than 1 tonne/ha.

Examples of extensive aquaculture systems include traditional rice/fish culture in China and traditional pond culture in the Indian sub-continent. Project-introduced examples are cage culture in eutrophic lakes in Nepal; and community-based fisheries in lakes and reservoirs and in rice field floodplains.

Semi-intensive systems

Farmed organisms in semi-intensive systems depend on intentional fertilization to produce natural food *in situ* and/or on the addition of supplementary feed to complement high-protein natural food. Natural food is also a source of minerals and vitamins. Natural food provides a significant amount of nutrition for fish in semi-intensive systems and may be increased traditionally by organic fertilization with human, livestock or green manure (vegetation) or chemical fertilizers such as urea to provide N (nitrogen) and triple superphospate (TSP) to provide phosphorus (P). There is also a residual fertilizer effect from uneaten fish feed and fish excretory products and faeces which increases with intensity of feeding.

Traditional supplementary feeds are locally available plants and agricultural by-products, often with a low protein content (<20% dry matter) that nutritionally complement high-protein natural food rice bran, broken rice, and waste vegetables; domestic waste food from households or restaurants; volunteer (wild) or cultivated terrestrial vegetation e.g., grass and weeds; wild or cultivated aquatic macrophytes, e.g. duckweed, water spinach and pond weed; agro-industrial by-products, e.g. rice bran, broken rice and oil cakes; and also food processing wastes such as waste noodles and confectionary produce.

Supplementary feed is traditionally fed as single ingredients, unprocessed and uncooked in pond culture in China and Southeast Asia although feeding practices in more recently developed aquaculture may involve mixed ingredients offered to fish on trays or in perforated sacs in some countries such as Bangladesh and India.

Extrapolated annual fish yields range from 1-5 tonnes/ha for low-quality fertilizers and feeds, 5-10 tonnes/ha for high-quality fertilizers and feeds and 10-20 tonnes/ha for fertilized ponds supplemented with formulated feeds.

Examples of traditional semi-intensive systems are mostly integrated agriculture/aquaculture systems (IAAS) and some wastewater-fed integrated peri-urban aquaculture systems (IPAS). Chemical fertilization is widely practiced in IAAS, in small irrigation reservoirs stocked with carps in China and in milkfish ponds.

Intensive systems

Fish farmed in intensive systems depend on nutritionally complete feed with little to no contribution from natural food.

Examples of complete feeds in traditional systems are trash fish (small or low-value marine or freshwater fish, "naturally" complete diets for carnivorous fish); slaughterhouse waste such as chicken bones and offal and moist or dry feed formulations, e.g. trash fish and rice bran. Use of farm-made feeds is common in traditional intensive aquaculture. Intensive aquaculture increasingly uses agro-industrial formulated pelleted feed. Most modern cage, raceway and recirculation systems depend on pelleted for almost all their nutrition.

There may be an overlap between semi-intensive and intensive modes of production. As increasing amounts of supplementary feed are provided to growing fish in a semi-intensive pond, the proportion of nutrition derived from natural food declines markedly relative to that of added feed so that the system increasingly resembles an intensive one in the later stages of the culture cycle.

Extrapolated annual fish yields range from 5-20 tonnes/ha for carps and tilapia, up to 50-100 tonnes/ha for airbreathing fish such as striped catfish (*Pangasianodon hypophthalmus*), African catfish (*Clarias gariepinus*), hybrid walking catfish (*Clarias gariepinus* x *C. macrocephalus*) and striped snakehead (*Channa striata*) in static water ponds, and up to 600-1 000 tonnes/ha for fish fed pellets in ponds with significant water exchange and in raceways.

Examples of traditional intensive culture are striped catfish in cages in Cambodia and striped catfish and hybrid walking catfish in ponds in Thailand.

Integrated aquaculture

Traditional aquaculture is usually integrated with other human activity systems as these provided the only sources of nutritional inputs for farmed aquatic organisms in the past, before the relatively recent manufacture of chemical fertilizers and pelleted feed. Exceptions are coastal mollusks and seaweeds which depend on suspended particles and dissolved nutrients in the water column, respectively.

Three major types of traditional integrated aquaculture systems have been recognized (Edwards, 2009a):

- IAAS with on-farm or local sources of vegetation, manures and agricultural by-products as nutritional inputs, e.g. rice/fish, crop/fish and livestock/fish. Its main physical features are waste or by-product recycling which provide the nutrition for the fish and improved space utilization with crops grown on pond dikes or on frames extending over the pond water surface and/or livestock raised on the pond dike or over the pond water surface. In some societies household nightsoil is a traditional pond input. These are semi-intensive.
- IPAS use wastes of cities and agro-industry. These include wastewater (human sewage or agro-industrial effluents); waste vegetables from markets; waste food from canteens and restaurants; and factory processing wastes from the food industry, including offal from slaughterhouses and fish processing factories. Fertilized IPAS are semi-intensive systems but those fed with large amounts of food and factory processing wastes may approach an intensive mode of production or be intensive if stocked with carnivorous fish fed with trash fish, or livestock or fish processing offal. They may be semi-intensive or intensive depending on the type of input.
- integrated fisheries aquaculture systems (IFAS) use freshwater or marine trash fish as feed. These are intensive.

Traditional integrated aquaculture may be direct and use inputs from on-farm or be indirect and use off-farm wastes (by-products) or products of diverse human activity systems such as agro-industry, fisheries and sanitation from local rural or peri-urban areas, and thus involve transportation of nutritional inputs.

DEFINITIONS RELATING TO SMALL-SCALE AQUACULTURE

Rural aquaculture

Rural aquaculture ‘defies simple definition although the beneficiaries are clear: the poor’ (Edwards *et al*., 2002). The term “rural aquaculture” derives from the traditional dichotomy of development into rural or agricultural and urban or industrial (Edwards and Demaine, 1997). Implicit in the term is the promotion of aquaculture systems appropriate for small-scale farming households towards alleviating widespread poverty and inequality in developing countries, in both inland and coastal areas.

The term 'rural aquaculture' appears to have been first used in the 1970s although it was not defined when it was initially coined. The term may have been first used in 1975 in the project document of an aquaculture project funded by the International Development Research Centre (IDRC of Canada) in northeast India (CIFR/IDRC, 1979), and then in the proceedings of the Kyoto conference (Pillay, 1967).

It does not subsequently appear to have been in use for over a decade. Pillay in his preface to the volume of papers and recommendations of the above Kyoto conference wrote that 'aquaculture, particularly small-scale fish farming, can have a major role in integrated rural development, and it was suggested that governments should give appropriate consideration for the inclusion of aquaculture as an integrated part of rural development plans, whenever possible' although he did not use the term rural aquaculture Pillay (1979).

Martinez-Espinosa (1992) wrote in a provocatively entitled article 'Rural aquaculture, from myth to reality' that 'the term rural aquaculture is being revised due to valid objections about the convenience of its use'. He was concerned about two issues:

- the rapid development of 'industrial aquaculture' of salmon and shrimps had almost eclipsed institutional support in rural aquaculture for the needs of 'small farmers'; and,
- although aquaculture may play an important role in improving the welfare of rural people the 'approach applied so far to development projects must be changed'.

He went on to point out further that 'aquaculture is no panacea for solving the problems of rural poverty. He pointed out that while farmers in economically depressed areas with very low fish production may value limited supplies of fish and continue with aquaculture, farmers in areas with more remunerative economic activities off-farm are more likely to abandon low-intensity fish culture.

In a subsequent article, Martinez-Espinosa (1995) proposed the division of rural aquaculture into two categories 'Type 1' and 'Type 2':

- Type 1, the 'poorest of the poor' aquaculture (very low cost/very low output mostly subsistence aquaculture with a small part of the production not consumed by the household sold or bartered in small domestic markets close to the farm and /or to middlemen. Such farmers have been called peasants, especially in the past. Bray (1986) defined peasants as farmers with a degree of independent control over their resources but who produce for their own consumption but also sometimes for barter or sale, relying principally if not exclusively upon household labour.
- Type 2, the 'less poor' aquaculture (low/medium cost, low/medium output), by well-off farmers who are financially solvent and have managerial capacity and add aquaculture to the traditional agriculture activities, with only a small part of the production consumed by the family and the bulk sold to generate income.

He pointed out that paradoxically 'Type 2' rural aquaculture had received hardly any assistance from governments and development agencies even though he considered it to have greater potential than 'Type 1'.

Edwards and Demaine (1997) were subsequently commissioned by the Food and Agriculture Organization of the United Nations (FAO) to write a monograph 'Rural aquaculture: overview and framework for country reviews', an introductory volume to provide a global overview of rural aquaculture and guidelines for individual country reviews, although only a few of the planned series of national reviews on the role of aquaculture in rural development were eventually published. They pointed out that considerable promotion is required for aquaculture to fulfill its potential to provide significantly increased food, employment and income for the rapidly growing populations of developing countries. Furthermore, they offered the view that the division of rural aquaculture by Martinez-Espinosa (1992, 1995) into two types is a 'false dichotomy' because most small-scale farmers are motivated to carry out aquaculture mainly to provide income rather than as a source of household subsistence.

Pillay (1997) pointed out that with a few exceptional cases, 'aquaculture programmes devoid of economic incentives have not become sustainable activities... the economics of the operation serve as the main incentive for such farming, rather than any social benefits'.

These authors therefore defined rural aquaculture into a single definition as follows:

- 'the farming of aquatic organisms by small-scale farming households or communities, usually by extensive or semi-intensive low-cost production technology appropriate to their resource base. The resource-poor base of most farms requires off-farm agro-industrial inputs to intensify production. This implies use of mainly inorganic fertilizers rather than formulated feed to provide low market value produce affordable to poor consumers'.

The authors proposed an abbreviated version of the definition as follows:

- 'the farming of aquatic organisms by small-scale farming households using mainly extensive and semi-intensive husbandry for household consumption and/or income'.

The author was invited by the then Fisheries Adviser of the United Kingdom, J. Tarbit, to present a paper entitled 'Aquaculture and poverty: past, present and future prospects of impact' at the 5th Fisheries Development Donors Consultation at FAO, Rome in 1999 (Edwards, 1999a). Tarbit's main concern was to answer the question: 'to what extent is aquaculture a poverty reducing technology?' as poverty had by then become the donors main focus of interest.

Yap (1999) based on experience in the Philippines with coastal aquaculture, suggested that:

- neither feeding or trophic level of the cultured organism nor the affordability of the product to poor consumers should be used be used as criteria for rural aquaculture.
- aquaculture contributes to rural development in diverse ways, directly to small-scale farmers, as well as indirectly from increased availability of low-cost fish in local or urban markets and/or from employment on medium or large-scale farms in the aquaculture sector.

According to Yap (1999):

- culture of grouper in cages is intensive as it depends on trash fish, and the consumers are affluent because of the high market price of the product; yet small holders whose only other source of income may be fishing may also produce high-value fish such as grouper
- culture of the seaweed *Eucheuma* is extensive yet the product is mainly used to extract a high-value colloid, carrageenan, which is exported; culture is again carried out by small-scale farmers who may still be engaged in part-time fishing
- culture of milkfish in brackishwater ponds is mainly extensive to semi-intensive; but ponds are large, ranging in size mostly from 5-100s ha, and are owned by better-off farmers.

Yap (1999) characterized rural aquaculture as follows:

- carried out by small-scale farming or fishing households or communities
- uses production technology appropriate for the area and the species
- does not result in additional pressure on local resources or infringe on the nutrition and/or livelihood of others
- and, most importantly, it helps to alleviate poverty.

Later in the same year Edwards was commissioned by FAO to prepare a discussion paper 'Towards increased impact of rural aquaculture' for the First meeting of the APFIC *Ad Hoc* Working Group of Experts on Rural Aquaculture at the FAO Regional Office in Bangkok (Edwards,1999b). The paper was based mostly on the Rome paper prepared a few months earlier but rural aquaculture was redefined following the two recommendations of Yap (1999) to also include the wider benefits to the poor from large as well as SSA (Box 1):

BOX 1

Contribution of aquaculture to the livelihoods of the rural poor

Direct benefits

- high nutritional value food, especially for vulnerable groups such as pregnant and lactating women, infants and pre-school children
- employment through farming, including women and children
- income through sale of relatively high-value produce.

Indirect benefits

- increased availability of low-cost fish in local markets
- employment on larger farms, seed supply networks and market chain and manufacture/repair functions
- benefit from common properly resources, particularly the landless, through cage culture, culture of molluscs and seaweeds, and enhanced fisheries in otherwise underutilized resources
- increased farm sustainability through:
  - construction of ponds which also serve as small-scale on-farm reservoirs
  - rice / fish culture as a component of integrated pest management.

- "rural aquaculture contributes to the alleviation of poverty directly through small-scale household farming of aquatic organisms for domestic consumption and/or income; or indirectly through employment of the poor as service providers to aquaculture or as workers on aquatic farms of wealthier farmers; or indirectly by providing low-cost fish for poor rural or urban consumers'

Rural aquaculture was considered in a similar way in the book 'Rural Aquaculture' based on the papers presented at the session on rural aquaculture at the Fifth Asian Fisheries Forum, International Conference on Fisheries and Food Security', held in Chiangmai in 1998 (Edwards *et al*., 2002).

In 2001, Edwards was invited by the Network of Aquaculture Centres in Asia and the Pacific (NACA) to write a regular column called rural aquaculture for the magazine Aquaculture Asia which he has continued for nearly a decade. Although the column covers inland aquaculture with an emphasis on aquaculture for rural development, he has not discussed definitions during this period. An exception was a recent column on rural aquaculture in which he wrote that for the purpose of describing rice farm-based aquaculture in Myanmar, a small-scale farmer is a person who 'operates a family-level, crop-dominated farm, here rice, with small numbers of scavenging pigs and poultry, and is diversifying his/her livelihood through incorporation of a third sub-system, aquaculture'(Edwards, 2009b).

The most recent view on the definition of rural aquaculture is that of Demaine (2009) in a paper commissioned for the FAO Expert Workshop on Indicators for Assessing the Contribution of Small-Scale Aquaculture to Sustainable Rural Development entitled 'Rural aquaculture: reflections ten years on'. The author stated his view that the very broad definition of rural aquaculture proposed by Edwards (1999b) 'goes too far' since he correctly pointed out that the provision of employment and low-cost fish for urban consumers may derive from any aquaculture system irrespective of size. He recommended that the term 'rural aquaculture' should be confined to the low-cost production systems suitable for implementation by the poor. However, he did not suggest excluding the culture of high-value species from the definition, while recognizing that the latter require higher inputs.

Artisanal aquaculture

Although not in common use in aquaculture, the term artisanal has been more commonly used in capture fisheries for 'adaptations based in the acquisition of craft skills based in locally adapted knowledge' (Johnson, 2006).

In a study of Francophone sub-Saharan Africa, Lazard *et al.* (1991) classified aquaculture into four types by degree of commercialization, one of which was artisanal aquaculture:

- aquaculture for subsistence (family-level)
- artisanal aquaculture, producing for the market on a small-scale scale
- specialized aquaculture in which various stages of the production cycle are carried out by different farmers, and
- industrial-scale aquaculture.

The first three types above could all be family-level and therefore be defined as small-scale in current usage while the first and second type correspond to 'Type 1' and 'Type 2' rural aquaculture as defined by Martinez-Espinosa (1995).

The author was requested to write a paper comparing traditional and modified inland artisanal aquaculture systems for an IDRC and EU DGXII funded workshop entitled 'Aquaculture Research and Sustainable Development in Inland and Coastal Regions in South-east Asia' at the University of Cantho, Vietnam in 1996 (Edwards, 1997). He concluded that while the dictionary definition of an artisan is one who is skilled, especially manually, in a trade, and this could include aquaculture as farming practice, a better term is 'small-scale', mainly because artisanal implies use of traditional technology and there is an increasing need for and use of science-based technology in the development of all scales of aquaculture.

Urban aquaculture

Urban aquaculture is another term that has recently entered the lexicon, probably in an attempt to distinguish aquaculture in urban and peri-urban areas from rural aquaculture. However, the main definitional criterion for urban or peri-urban aquaculture is spatial rather than social as is usually the case for rural aquaculture although many small-scale famers are involved in urban aquaculture, especially using nutrient-rich city wastes and by-products.

Urban aquaculture has been defined by Bunting and Little (2003) as:

- 'the practice of aquaculture occurring in urban settings, or areas subject to urbanization, incorporating by definition, peri-urban areas'

Most of today's peri-urban aquaculture systems are inherently unstable and transitional and are probably not sustainable because of their location at the edge of mostly rapidly expanding cities.

An alternative way to view urban aquaculture is primarily ecological (Costa-Pierce *et al*., 2005). As written in the preface to the book 'Ecological Aquaculture', it is 'our challenge and our duty to encourage the art of aquaculture in urban areas and plan creatively for its beauty and utility in revitalized cities' as the greatest human migration of all times from rural to urban areas is taking place. Integrated aquaculture systems put in our schools, which would of necessity need to be 'small-scale, could help people in increasingly human-dominated urban ecosystems to reconnect with nature.

Small-scale aquaculture (SSA)

While the term 'rural aquaculture' is still widely used, the still ambiguous term 'small-scale aquaculture' has come into vogue more recently. In the recent book 'Success stories in Asian aquaculture' De Silva and Davy (2009) defined small-scale farming as:

- 'family-wned, managed and operated'.

De Silva (pers.comm.) later modified this definition to:

- 'family-owned or leased, managed and operated'.

Unfortunately, information on the ownership of aquaculture operations is usually not available (NACA, 2006) which constrains use of the term.

The Nha Trang workshop agreed on a broad definition of SSA (Box 2) which recognizes the diversity of systems and scales commonly referred to as SSA. However, there are weaknesses in this definition:

- it did not address the issue of the boundary between small and large-scale aquaculture. For the term SSA to be useful it is necessary to separate SSA from medium to large-scale aquaculture.
- the Nha Trang definition of SSA mentioned the term 'operator' but did not distinguish between an 'owner-operator' which is a clear characteristic of a small-scale farm and a 'hired-operator' by an off-farm or urban investor or entrepreneur which may also characterize a medium or even large-scale farm.
- the list of typical characteristics accompanying the definition of SSA state that limited investment, usually limited value of sales, and low household income all 'do not necessarily apply to Type 2' SSA but these also do not apply to medium and large-scale aquaculture farms or enterprises.

BOX 2

Agreed definition and characterization of small-scale aquaculture at the Nha Trang Workshop

Small-scale aquaculture (SSA) is a continuum of:

1) systems involving limited investment in assets, some small investment in operational costs, including largely family labour and in which aquaculture us just one of several enterprises (known in earlier classifications as Type 1 or rural aquaculture); and
2) systems in which aquaculture is the principal source of livelihood, in which the operator has invested substantial livelihood assets in terms of time, labour, infrastructure and capital (this was labeled as Type II SSA system).

Common elements characterizing this SSA definition:

(a) ownership of or access to an aquatic resource;
(b) ownership by family or community; and
(c) relatively small size of landholding.

SSA may farm low or high value species, be conducted in a variety of containment (ponds, cages, pens, raceways, barrels, bottles, jars) and be practiced as monoculture, polyculture or integrated systems.

Other typical characteristics or attributes of SSA:

- Mostly based on family labour (Type 1)
- Informal management structures (Type 1)
- A certain degree of vulnerability (Type 1)
- Often limited access to physical and technical resources (Type 1)
- Limited technical expertise (Type 1)
- Limited access to information, including market information (Type 1)
- Limited investment (this attribute does not necessarily apply to Type 2)
- Usually limited value of sales (not necessarily for Type 2)
- Low household income (not necessarily for Type 2)
- May or may not contribute significant proportion of total household income
- Contributes to family food supply (not necessarily directly in the case of Type 2).

Source: Bondad-Reantaso *et al.*, 2009.

- while it states that Type 2 is mostly based on farm labour, it does not specify the upper limit of hired labour for Type 2 SSA.
- nor is there mention of an important recent concept in development, that of small and medium enterprises (SMEs). SME's could bridge the conceptual gap between the larger and more commercialized small-scale farmers and medium and large-scale aquaculture.

An attempt is made to highlight some of the above concerns by dividing farm size into six categories from subsistence to corporate-scale aquaculture, covering small, medium and large-scale aquaculture (B. Belton, *pers.comm.*) (Table 1):

- small-scale subsistence-level aquaculture or scale 1 is usually only considered by the poorest farming households. However, better-off households may derive most or all of their income from farming crops or livestock and/or through off-farm employment; such households may have a fish pond to provide an occasional meal or to serve as recreation through angling or as a garden feature. For relatively poor farming households involved in aquaculture as a commercial venture, it usually provides less than 10% of the total household income which is mainly derived from other on-farm and off-farm sources (Belton, pers.com).
- better-off but still relatively small-scale farmers may derive a much larger share of their total income from aquaculture if they consider aquaculture to be a feasible income generating activity relative to alternative on-farm and/or off-farm employment as in scale 2, small-scale.
- as aquaculture becomes the primary livelihood activity, there is likely to be greater investment and hire of labour as represented in scale 3 in which there is an indistinguishable overlap between small and medium scale.
- scale 4 could still be family owned but clearly beyond a small-scale characterization and be medium or large-scale as are scales 5 and 6.
- scales 5 and 6 are clearly large-scale aquaculture.

TABLE 1
Six categories of farm size from subsistence to corporate-scale aquaculture

	Farm categories					
Item	**1**	**2**	**3**	**4**	**5**	**6**
Scale	Small	Small	Small/medium	Medium/large	Large	Large
Market Orientation	Subsistence and/or local	Local/district	District/urban	Urban/national	National/export	National/export
Investment	Low	Low/moderate	Moderate	Moderate/high	Moderate/high	Very high
Ownership	Family owned & operated	Family owned & operated	Family owned & operated	Family owned & operated or absentee owner	Absentee owner	Absentee owner or corporate ownership
Labour	Family	Family & possible occasional hired	Family & occasional hired	Permanent labour	Permanent labour Some technical or clerical staff	Permanent labour Professional technical & clerical staff
Organisation	Minor activity in a portfolio of livelihood options or 'hobby' activity for moderately wealthy	One of a portfolio of livelihood options	Primary livelihood activity	Primary livelihood activity or entrepreneurial investment activity	Primary livelihood activity or entrepreneurial investment activity Possible partial or complete vertical integration	Entrepreneurial investment activity or large business Likely partial or complete vertical integration

Source: Belton, *pers. comm.*

Thus, while categories 1 (poor SSA) and 2 (better-off SSA) are clearly SSA, category 3 contains both small and medium-scale, category 4 contains medium and large-scale, with categories 5 and 6 clearly both large-scale aquaculture.

The problem of defining 'small-scale' is not confined to aquaculture but is well recognized in both fisheries (Ashley and Maxwell, 2001) and agriculture (Grigg, 1966).

The concept of small-scale fisheries entered discussions of fisheries development only in the 1970s and there is considerable ambiguity over what constitutes the category of small-scale fisheries with considerable overlap with large-scale fisheries (Johnson, 2006). According to Staples *et al.* (2004), it would be futile to formulate a universally applicable definition for a sector as dynamic and diverse as the small-scale fisheries that operate at widely differing organizational levels ranging from self-employed single operators through formal micro-enterprises to formal sector businesses

CHARACTERIZATION

Characterization needs to be considered in relation to farmer hopes and aspirations, developmental options and aquaculture technology.

Hopes and aspirations

Farmers and their families like all of us seek to improve their lives and have increasing hopes and aspirations. Their main concerns are that aquaculture should make money and be profitable and therefore they compare the attractiveness of aquaculture to alternative livelihood options both on-farm and off-farm. For farmers at the smaller end of the SSA spectrum, aquaculture is likely to be only one of several income generating activities. Small-scale farmers are increasingly turning to non-farm livelihoods, either part or full-time, as they driven by rising aspirations and needs and are constrained in agriculture by a usually contracting as well as resource-poor base, unfavourable terms of trade, and a belief that farming is a low-status occupation (Rigg, 2003).

It is well documented that the age of farmers in many developing countries is rising as the young in particular leave the farm for alternative employment. Farmers often state that they do not want their children to become farmers because of the relatively low standard of living it provides on resource-poor small-scale farms; and their children especially wish to migrate to the city (Rigg, 2003).

According to Beets (1990) in a monograph written two decades ago, 'Raising and sustaining the productivity of smallholder farming systems in the tropics', small-scale farms in developing countries are in a 'state of flux' and 'the isolated subsistence farm... hardly exists anymore. He wrote 'the move from peasants producing, with their own resources, a wide range of agricultural products for home-consumption to specialized production of only a few crops for the market, is perhaps the single most important phenomenon in tropical agriculture in this Century. It has meant that millions of hitherto isolated and independent smallholders have become part of regional or national economies'. For aquaculture today may be added international economies or markets.

Household consumption of fish produced through aquaculture by poor farming households is likely to be small because of their limited resource base. However, such small amounts of high-quality food may be highly significant to the relatively small overall household economy. Furthermore, the view of fish production aimed solely at providing household food security or income is over simplistic. Households culturing fish tend to consume more fish but food security may be achieved through more complex strategies in which producer households purchase cheaper fish for consumption and either sell, gift or consumed strategically their own higher-value farmed fish to meet household needs for cash, social benefits and food security (Little *et al.*, 2007).

Development options

Historical trends

Aquaculture has certainly contributed towards alleviating poverty in those countries in the world in which it is traditionally practiced although it would be difficult to provide documentary evidence. There is literature documenting the role of aquaculture in poor rural societies in the past e.g., China (Hoffmann, 1934), Indonesia (Ilan and Sarig, 1952) and Vietnam (Chevey and Lemasson, 1937).

The earliest attempts to promote aquaculture through institutions were in response to the growing concerns about rapidly increasing human populations and increasing pressure on the available food supply in developing countries. Worthington (1943) described the limited animal protein and minerals in the diets of the peoples of the British Empire and suggested that these deficiencies could be provided from fish. He forecasted that there was a big future for fish culture but that before such a vision could be brought to reality there was need for intensive research to develop appropriate technology. Delays caused by World War III delayed this initiative for more than a decade until the Fish Culture Research Station in Malacca in the then British Colony, Malaya, was opened as the first research station in the tropics on the scale of a major agricultural station for the fundamental study of fish culture (Hickling,1959).

A mission to Thailand in 1948, shortly after FAO was established, justified itself because of the 'dietetic and economic importance of fish' in Thailand and reported that there was potential for increased production in both inland and coastal waters through aquaculture although at the time Thai fisheries were in a 'primitive and unorganized condition' (FAO, 1949).

The justification provided for the first FAO World Symposium on Warm-water Pond Fish Culture held in 1996, the 'first gathering - in the more than 3000 years of the history of fish culture - of workers in this field for discussion on a global basis', was the 'most pressing need in the developing countries to increase the supply of animal protein' and the recognition that 'fish culture can form a valuable and integral part in farm homesteads and in land and water development projects (FAO, 1976). It was hoped that the symposium would lead to the 'development of a more complete science of warm-water pond fish culture – one which can do much to improve the economy of any country and alleviate the hunger and malnutrition of the developing ones'. It was believed that 'subsistence fish culture, which has indeed served its limited purpose, remains still to be expanded into commercial fish farming'. A major concern was that while 'remarkable results have, however, been achieved in fish rearing in small holdings... the progress has failed to keep pace with the exploding population increase'

In the second world conference on aquaculture organized by FAO at Kyoto in 1976, it was stated in the technical proceedings (FAO, 1976) that the 'role of aquaculture in integrated rural development is now better understood in many countries and has been readily accepted by planners and administrators as a part of integrated rural development but that the success of 'small-scale rural aquaculture' would to a large extent depend on the support services that are made available such as a 'package of technical assistance, provision of inputs and credit on reasonable terms. Furthermore, inclusion of aquaculture in integrated rural development programmes would 'increase small-scale aquaculture enterprises in areas where it will benefit the maximum number of poor people'.

Developmental strategies

In a monograph called 'Farming systems and poverty, improving farmers' livelihoods in a changing world', Dixon *et al.* (2001) list five main farm household strategies to improve livelihoods:

- intensification of existing production patterns
- diversification of production and processing
- expansion of farm or herd size
- increased off-farm income, both agricultural and non-agricultural; and
- complete exit from agriculture.

These strategies are not mutually exclusive and it is well recognized that small-scale farming households usually pursue a mixed set of strategies.

Development has been conceptualized more graphically for small-scale farmers (Dorward, 2009) as:

- "hanging in" and barely surviving, which is hardly a sustainable option
- "stepping up" and improving their farming system
- "stepping out" and leaving the farm for the factory or the city.

'Hanging in' characterizes the poorest of the poor and is clearly unacceptable as reflected in the Millenium Development Goal to significantly reduce poverty. Only two and three are feasible development options. Only option two may involve aquaculture and farmers may chose to intensify crops and/or livestock rather than fish.

'Stepping up' is the only option that involves aquaculture, increasing its productivity and/or profitability. On-farm resource bases for SSA are typically poor; or small-scale farmers have limited access to communal, government or public water sources. The major constraints facing many poor farmers are aptly expressed by the following quotation:

- "In the early, naive days, the idea of development was encapsulated by a widely repeated proverb: 'Give a man a fish, and you feed him for a day. Teach him to fish and you feed him for life'. But knowing how to fish often turned out to be the least of his – or her – problems... the knowledge transfer needed was not how to fish, but the skill to organize, bargain collectively, expose misappropriation and get corrupt officials off their heads... It became clear that interventions to support livelihoods not only had to fit economic and social realities, but also to contend with power structures. If they did not, vested interests might destroy them or co-opt every benefit to themselves" (Black, 2002).

'Stepping out' is an option being increasingly followed by small-scale farming households, especially in developing countries with off-farm employment opportunities in-country or abroad, either part-time or permanently. Agriculture has declined relative to other sectors of the economy as countries develop, with movement of the farming population into other livelihoods (Hazel and Wood, 2008).

A similar concern has been expressed earlier in both small-scale fisheries and small-scale agriculture. Johnson (2006) wrote that 'the underlying reason for the power of the category... of small-scale fisheries... lies in the values of social justice and ecological sustainability that it has come to represent in response to dominant high modern narratives of change. Fisheries governance may better be served by prioritizing these values rather than by making a fetish out of small-scale fisheries'.

Clearly, aquaculture needs to be considered in a broad developmental context and not only the promotion of the livelihoods of poor farming households through small-scale aquaculture as is also recognized by the World Bank (World Bank, 2007).

Aquaculture technology

Generic technologies

Generic technologies exist for SSA in inland and coastal areas.

In China, semi-intensive carp polyculture, most of it probably SSA, still contributes over 50 percent of total inland aquaculture but the trends are to introduce new species and intensify production, driven by consumer demand for higher-value species and farmer pursuit of increased returns (Miao and Liang, 2007). Farmers are moving increasingly to pellet-based monoculture as extrapolated annual yields of intensive monoculture of fish such as common carp are up to 30-40 compared to 12-15 tonnes/ha for traditional polyculture so the former "becomes the choice of farmers for higher production and profit" (Miao, 2007).

Small-scale farms in most developing countries usually have such a low resource base that in many cases aquaculture in rice fields and ponds provides mainly household subsistence with limited sale of fish if any. The most common type of IAAS in Southeast Asia is feedlot livestock/fish but attempts to introduce scaled-down feedlot/livestock to small-scale farmers have met with little success because they are usually unable to continue to maintain feedlot livestock following withdrawal of project support. Livestock farms are increasingly run as separate, biosecure and highly specialized enterprises and this trend has been re-enforced by concerns about avian influenza (HPA1), commonly known as bird flu.

Small-scale IAAS provide small but significant contributions towards relatively poor farming household nutrition and income; and they also provide an almost risk-free safety mechanism through which farmers may gain aquaculture experience before deciding if they wish to intensify production and profitability through use of off-farm inputs i.e. the "first step on the ladder of intensification" for farmers interested in possibly developing aquaculture as a livelihood.

A decade ago (Edwards *et al.*, 2000) wrote that IAAS have the greatest potential because land-based culture systems in inland areas could be integrated with the existing agricultural practice of small-scale farming households. In light of recent developments in Asian aquaculture this statement needs to be qualified to refer to indirect integration with pond-based aquaculture integrated with agricultural by-products such as brans and oil cakes and manure from intensive livestock feedlots from surrounding local areas as direct IAAS are constrained by the limited on-farm resource-base of small-scale farms. According to FAO (2006), semi-intensive and primary production-based aquaculture that includes culture-based fisheries has the potential to be adopted by millions of smallholders in Asian developing countries and in Africa but this could only be true for indirect and not direct IAAS. Excepting so-called "non-fed" mollusks and seaweeds which do have great potential for poverty alleviation as they do not require intentional provision of nutrient inputs, small-scale farmers need to purchase off-farm inputs as their farms usually have too limited a resource base to permit significant fish production.

It has also been suggested that SSA producing low food chain species of fish using locally available nutritional pond inputs has potential for organic aquaculture as it is environmentally sustainable. However, most type 1 SSA has too a low production for aquaculture to be a significant contributor to livelihoods and therefore also be socially and economically sustainable.

Direct and indirect IAAS

An important distinction in integrated aquaculture/agriculture systems (IAAS) is between sole reliance on the usually limited on-farm nutrient base to feed the fish (direct IAA); and increasing use of fertilizers and/or supplementary feeds from off-farm but from the local agricultural resource base (indirect IAAS). Significant fish production can be achieved by small-scale farmers through use of indirect IAA without the need for formulated pelleted feed.

Small-scale seed production

Discussion of rural aquaculture focuses mainly on grow-out but the various stages of seed production (hatchery or breeding, and subsequent nursing) are usually separate farming activities that may be carried out by small-scale farmers. Small-scale farmers are increasingly involved in nursing to produce fingerlings as aquaculture becomes more specialized and segmented. Hatcheries in some countries have linked up with small-scale farmers to nurse fry or larvae because of the large area of land needed for nursing and the more profitable production for hatcheries of larger numbers of fry or larvae than fingerlings or post-larvae. Furthermore, nursing may be more appropriate for small-scale farmers than grow-out because its short production cycle requires less skill than breeding or hatchery and involves less risk.

Hatchery is usually a highly specialized business carried out by better-off skilled farmers but there are small-scale hatcheries for both inland and coastal species e.g. small-scale marine finfish hatcheries in Indonesia; and small-scale prawn and shrimp hatcheries in Thailand. However, such small-scale hatcheries usually do not hold and induce broodstock to breed but purchase fertilized eggs or newly hatched fry or larvae from larger hatcheries and so should more correctly be referred to as nurseries rather than hatcheries.

Decentralized seed production of species that readily breed without hormone treatment such as common carp and tilapia has been successfully introduced to small-scale farmers, especially in Bangladesh, in areas remote from large-scale hatcheries in well-endowed and more central areas for aquaculture (Barman *et al.*, 2007). The various issues concerning small-scale seed production are discussed in the working group findings and recommendations in Bondad-Reantaso (2007).

Alternative development strategies

Green revolution

The phrase 'Green Revolution was coined by W.S. Gaud, a USAID administrator in 1968 (Hesser, 2009):

- 'Developments in the field of agriculture contain the makings of a new revolution. It is not a violent Red Revolution like that of the Soviets, nor is it a White Revolution like that of the Shah of Iran. I call it the Green Revolution'.

The dwarf wheat varieties developed by Norman Borlaug led to a marked increase in the yields on small-scale farms and to the reduction of hunger, initially in Mexico because of their large breadth of geographic adaptability combined with high genetic yield, high responsiveness to heavy doses of fertilizers, shorter and stiffer straw able to respond to the heavy doses of fertilizer without lodging or falling over, and a broad spectrum of disease resistance. Under irrigation these new varieties yielded 2-3 times more grain per unit area than traditional taller varieties. They were called "miracle wheats' at CIMMYT in Mexico from which they were later introduced into S.Asia and 'miracle rices' at IRRI in the Philippines from which they were introduced into irrigated regions throughout Asia.

In the foreword of the 1969 Bellagio Conference held to seek donors and partners to disseminate the Green Revolution, it is stated in support of industrial agriculture that: 'In recent years, we have become increasingly aware that in the underdeveloped nations, most of which are predominantly agrarian, agricultural development must precede or at least be concomitant with industrial and other economic and social developments. We now understand that, better than in the past, that a modern industrialized society cannot be built on the quicksand of a traditional subsistence agriculture, particularly in nations where 75 to 85 percent of the people are engaged in agriculture... If the developing nations are to catch up with the developed nations, they must make massive strides in increasing the productivity and efficiency of their agricultural sector' (Hesser, 2009).

The Green Revolution has been criticized on social and environmental grounds but according to Norman Borlaug, its father (Hesser, 2009):

- 'by producing more food from less land... high yield-farming will preserve... wild habitats' and therefore benefit the environment.

According to Borlaug:

- 'Africa needs a 'twin-track anti-hunger strategy... one track is to get small-scale commercial agriculture moving, first among those farmers in the relatively more favored agricultural lands closest to markets. These are the farmers best suited and able to intensify production in the near term... later the more distant small-scale farmers can be incorporated, as production and marketing conditions improve'.

The 'Green Revolution' demonstrated well that the application of science and technology can transform people's lives for the better and eliminate hunger and poverty, but technologies need to developed for rainfed and less well endowed areas of South Asia and Sub-Saharan Africa with the most widespread poverty (Conway, 1997). Conway in his provocatively titled book, 'The doubly green revolution, food for all in the 21st century', made the case that in contrast to the first Green Revolution in which the starting point was biological to produce high-yielding grain crops, the new revolution has to start with the socio-economic demands of poor households and then carry out research to identify technologies that can provide sustainable livelihoods for poor farmers. He pointed out that the development of modern science and technology will need to involve partnerships between farmers and scientists and also be combined with social and economic reform. This is especially important for farming households from marginal, complex, diverse and risk-prone (CDR) environments in which local indigenous technical knowledge may need to be combined with science to develop appropriate technology.

Blue revolution

The term "blue revolution" is often applied to the rapid growth of global aquaculture.

There was mention of a blue revolution or 'aquaplosion' in India as early as the 70s (Tripathi, 1979). However, it is also true that the "blue revolution" is increasingly resembling the "green revolution" through which science-based technology led to a major increase in cereals, chickens and pigs. A major feature of the "blue revolution" is the increasing use of agro-industrial pelleted feed rather than traditional aquaculture technology involving integration and by-product and waste recycling which is often considered to be more sustainable.

According to Costa-Pierce (2002), the 'blue revolution must go green' with the 'alternative aquaculture development model' socially sustainable 'ecological aquaculture' with technical aspects incorporating ecological principles in aquaculture; and comprehensive planning for wider social, economic and environmental contexts of aquaculture. He points out that the concept of ecological aquaculture is not new as traditional integrated aquaculture closely resembles natural ecosystems. However, with the exceptions of so-called extractive culture systems such as seaweeds and mollusks, and culture-based fisheries, there are limited appropriate 'alternative methods for finfish and crustaceans in inland and coastal aquaculture which increasingly rely on pelleted feed. The blue revolution today is mainly based on pelleted feed although integration with some of the principles of traditional technology may help to reduce the adverse impacts of effluents from intensive aquaculture (Edwards, 2009a).

Self-sufficient economies

So-called 'post-developmentalists' propose returning to a largely pre-modern agricultural society based on a 'self-sufficient' economy because of some adverse social and environmental impacts but traditional agriculture and aquaculture technology are insufficiently productive to support this. Furthermore, local people are motivated by the desire to gain better access to globalization rather than to distance themselves from it (Rigg, 2003).

There is a voluminous literature on the development of alternative agricultural systems to conventional modern agriculture (Altieri, 1987; Bellagio, 1999; Uphoff, 2002). According to Altieri (2009), the 'new models of agriculture' will be 'rooted in ecological rationale of traditional small-scale agriculture'. The World Bank (2007) also calls for technologies that exploit biological and ecological processes to minimize use of external inputs such as conservation tillage, improved fallows, green manure cover crops, soil conservation, and pest control relying on biodiversity and biological control more than pesticides. However, these may have more relevance for agriculture than either livestock or aquaculture although wastes and effluents from intensive livestock and intensive aquaculture still cause unaceptable environmental problems. Environmental issues of aquaculture are being addressed by FAO in the ecosystem approach to aquaculture initiative (EAA) (Soto *et al.*,2008).

These 'alternative agricultural systems' are largely based on ecologically sound, low-input, traditional agricultural technology that could not produce significant yields of fish. Two candidate aquaculture technologies often discussed as having major future relevance, integrated rice/fish culture and integrated crop/livestock fish farming, have limited potential for intensification.

A sustainable future for developing countries, including their small-scale farmers, is best secured by building connections with the wider world as global development is mainly driven by agricultural modernization and increasing development of non-farm economies (Rigg, 2003). According to Rigg (2003), there is no radical alternative path to development even though major issues of inequality and environmental degradation remain to be addressed. The fundamental message is 'higher productivity is likely to be the source of agricultural sustainability and not a return to the methods of the past' (Hesser, 2009).

For small-scale 'fed-aquaculture' to become a more meaningful livelihood option for small-scale farmers through increased income from sale of fish, there is a need to intensify fish production, thereby expanding the aquaculture component of their farm to become a SME. This would also contribute to national food security which the current low level of production from most small-scale farms is unable to do.

The main options to become an aquaculture SME are to increase production through use of:

- off-farm fertilizers and supplementary feeds i.e. to move from direct IAA to indirect IAA, or to
- pelleted feed.

There is a major trend towards intensification and use of formulated pelleted feed in aquaculture. Furthermore, aquaculture is moving towards higher value species that present greater profit margins, even in species that are traditionally considered to be relatively low-input species such as tilapia that are increasingly being fed pellets rather than being raised in semi-intensive systems (Lundgren et al.,2006). A decade ago the question was posed 'could salmon, or some other farmed fish, ever really emulate the chicken as a mass market source of animal protein?'(Forster, 1999). At the NACA/FAO 'Aquaculture in the Third Millenium' conference, a guest lecture was entitled: 'Livestock production: a model for aquaculture?'(Swick and Cremer, 2001). Development of aquaculture over the past decade indicate that the above two questions can be answered affirmatively.

Promotion of SSA

Aquaculture system

As there are two main types of SSA, Types 1 and 2, interventions to promote them may differ even though their distinguishing characteristics do not differ fundamentally but only in degree. Both types of SSA must eventually become entirely a private sector activity of farmers without project support for them to be sustainable.

Type 1 SSA would more likely comprise a government or international donor poverty alleviation or rural development initiative in which aquaculture may only be one of several possible on-farm and off-farm income generating activities as farmers are mainly motivated to increase their income.

Efforts to improve Type 2 SSA would likely involve introduction of better management practices or BMPs to increase production sustainably and increased access to markets, possibly involving certification.

Therefore, two kinds of strategy may be appropriate for small-scale farming households:

- promotion of SSA for the poorest households (Type 1 rural aquaculture) based mainly on semi-intensive production using the limited on-farm nutrient resource base i.e. direct IAA, for subsistence as well as some income generation but with low risk. This would provide farmers with the opportunity to gain experience and confidence with aquaculture; the first 'step on the ladder of intensification' as for most farmers aquaculture would be a new farming initiative. They would then be able to decide whether SSA could become a more significant livelihood option through intensification and possible also expansion of aquaculture area.
- a strategy for better-off households to significantly improve productivity of an existing aquaculture system through intensification of production, based mainly on off-farm but locally available fertilizers and feeds i.e. indirect IAA; with maximum profit mainly for income generation, and to also be able to contribute significantly to national food security through producing fish for sale. This would require an enabling environment in which aquaculture would grow, developing input markets that are usually missing in the early stages of aquaculture establishment, particularly for fingerlings, feed (fertilizers and supplementary feed), and credit.

The development of marketing channels for fish from SSA producers would be especially important as fish is highly perishable, especially with high tropical temperatures, and fish is costly to assemble and bulk from dispersed SSA.

Donor priorities

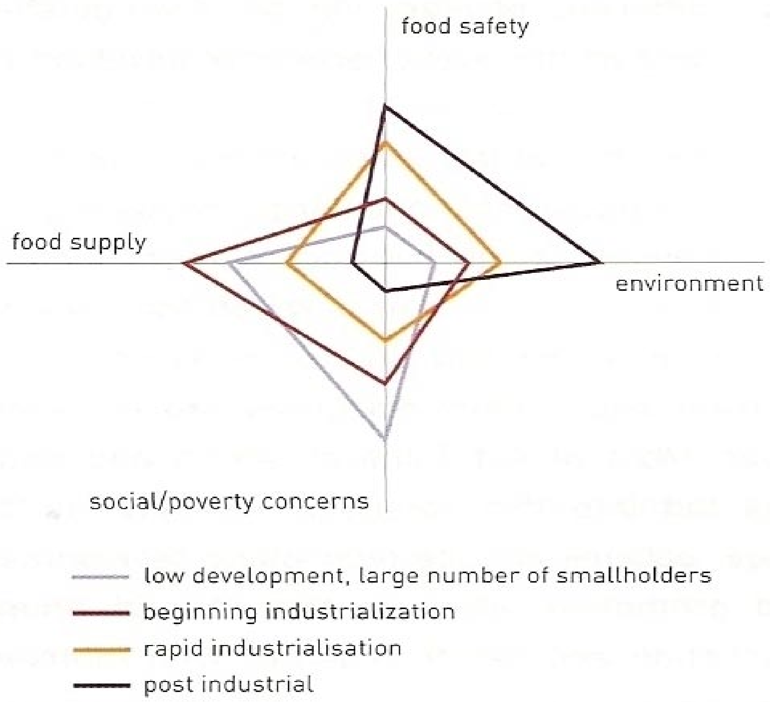
There has been a significant shift in donor programming in the last two decades to poverty alleviation. However, rather than funding aquaculture R&D directly a decade ago, more recent funding for aquaculture has had to be embedded within larger rural development and poverty alleviation programs of donors built around country-level Poverty Reduction Strategic Plans (PRSP's) in which agriculture *sensu lato* became an often minor component compared to provision of social services, governance and decentralization, safety nets, and policy and budgetary support.

The international donor community has recently 'changed the goal posts' yet again with the rise in world food prices. While there is at least recognition of the need to invest in agriculture and aquaculture, this is now often framed in terms of reducing poverty within an economic growth and private sector perspective. The World Development Report 2008 called for better use of agriculture for development and it recognized that aquaculture can provide an important source of livelihood for the rural poor (World Bank, 2007). Furthermore it also recognized that the main path way out of poverty is to make smallholder farming more productive and sustainable while recognizing that 'commercial smallholders' and those involved in 'subsistence farming' will require different kinds of support.

Policy

There is a shift in policy objectives of government as a nation undergoes economic development as indicated in Figure 1 from Steinfeld *et al.* (2006). While the discussion related to livestock policy objectives, it applies equally to aquaculture policy formulation. For countries with low levels of economic development and large numbers of small-scale farmers, policy formulation is driven by concerns for poverty alleviation. As a country develops and moves up the ladder of economic development into the early stages of industrialization, attention is usually also given to environmental and public

FIGURE 1
Changing national policy objectives with economic development



Source: Steinfeld *et al.*, 2006.

health objectives although social objectives remain predominant. Once industrialization of the aquaculture sector begins, the smallholder sector tends to diminish in relative importance. As countries continue to industrialize and export produce to developed countries, legal frameworks for food safety start to become established and enforced.

There appear to be widening gaps and perceived conflicts regarding SSA between policies directed to increasing the role of aquaculture production in national food security and those directed to using SSA for poverty alleviation. How both objectives can be pursued at the same time and reinforce one another need to be considered. This would require a more detailed understanding of the pathways through which expanding aquaculture impacts the poor. The objective should be to demonstrate where the largest impacts can be obtained and how these can best be achieved through investment options rather than only promoting SSA. Does it really matter if aquaculture contributes to economic growth, poverty alleviation and rural development through ways other than through SSA?

NUMBERS OF SSA

It is commonly stated that aquaculture in Asia is predominantly small-scale:

- The 'great bulk of aquaculture farming systems in Asia are small-scale' (De Silva and Davy, 2009).
- aquaculture is 'at large a small-scale farmer driven production sector... production remains predominantly Asian and is still largely based on small-scale operations' (Subasinghe, Soto and Jia, 2009).

However, data to support such views are lacking:

- In a report 'Towards improving global information on aquaculture', FAO stated in a section on data collection systems for aquaculture in rural development that 'many small-scale and subsistence aquaculture holdings, particularly in developing countries, are not well monitored... and... are probably under-estimated and therefore under-represented in current aquaculture status and trends information'.

- According to NACA (2006), 'the lack of reliable information from ...backyard ponds... currently limits the evaluation of rural aquaculture in the Asia-Pacific region' due to this production being frequently missed in national statistical surveys due to their small size, possibly being below the size required for registration, and not being considered as a significant economic activity.
- The Nha Trang workshop on the development of an indicator system discussed the contributions of SSA to both rural livelihood devlopment and global aquaculture production but recognized that there has not been a 'systematic assessment which clearly measures its contribution (Bondad-Reantaso *et al.*, 2009).
- Nor are there any reliable statistics concerning the many rural households involved in fish seed production as well as distribution (Siriwardena, 2007).

National governments which provide aquaculture data on which FAO statistics are based currently only on total farmed area and number of farms. Use of average farm size can only give an indication of the possible contribution of SSA to total national aquaculture production and value. Estimations based on average size, the most common means of representing farm size, are not statistically valid. As pointed out by Grigg (1966) in a paper on farm size,"to ask what the average size of farm is for the country as a whole is as absurd as to enquire 'how large are the animals in the London zoo'.

Furthermore, much of what is considered today to be SSA is probably medium-scale as it is only 'small' relative to larger-scale aquaculture so there is a boundary issue as discussed above.

Smallholders referring to agriculture were defined as operating a farm of 2 ha or less by the World Bank (2007). Farms in developing countries have also tended to decrease in size over time due to subdivision of the farm among the children; and most of the rural poor are landless with a small household plot on which it may be possible to do intensive livestock or fish farming. There was a great deal of variation in pond size and status of pond owners or operators in the past e.g. ponds in Southern China in the 1930s ranged in size from 'mere waterholes' to about 1 ha (Hoffmann, 1934). Ponds were also rented from private owners and village ponds were rented to the highest bidder based on the number of human inhabitants and the number of livestock as fertilization by manure was often the sole source of nutrition for the fish.

Production of relatively cheap fish in extensive and semi-intensive systems most appropriate for national food security and be affordable by the poor may be large ponds owned or controlled by large-scale farmers e.g. milkfish ponds (Yap, 1999). Conversely small ponds or cages managed intensively can be owned by relatively poor farmers. Thus there can be high-value, low-volume fish production in small intensive farms or farming systems by the poor for sale to better-off consumers or for export; and low-value, high-volume fish production in large-scale extensive and semi-intensive farms by better-off farmers for local markets and contributing to national food security. However, intensive SSA may require support for the farmers as it is capital intensive and risk-prone.

Trying to assess the relative contribution of SSA is also difficult because successful SSA is dynamic and may develop rapidly into medium and even large-scale aquaculture as farmers do not wish to remain 'small-scale' if aquaculture undergoes significant expansion as a livelihood.

It is unlikely that governments will be able to collect adequate statistics in the future to be able to assess the contribution of SSA because of the difficulty in collecting the various types of data required such as farm size, production, ownership and amount of hired labour. Rather an improved understanding of the nature of SSA may be used to improve targeted studies rather than nationwide collection of statistics.

SSA AND FAO'S MANDATE

According to FAO's 'Strategic Framework 2010-2019' (FAO, 2009):

- 'FAO's vision is a world free of hunger and malnutrition where food and agriculture contributes to improving the living standards of all, especially the poorest, in an economically, socially and environmentally sustainable manner'

Furthermore, a specific strategic objective relating to aquaculture is:

- 'The sustainable management and use of fisheries and aquaculture resources' with 'an increase in the production of fish from sustainable aquaculture... from sustainable expansion and intensification of aquaculture'.

Thus, FAO recognizes the important role of SSA and the need to provide this sector with the necessary assistance. A major issue is to what extent FAOs vision and mandate can be adequately addressed through the promotion of SSA and be 'grounded in pragmatism and rooted in reality' as called for in the Strategic Framework?

The issue of the future role of SSA is extremely important as the world will need 70-100 percent more food by 2050 to feed a global population of 9 billion people (Godfray *et al.*, 2010) and three-quarters of the world's poor are rural (Ashley and Maxwell, 2001).

However, questions have been raised as to whether the small-scale farmer model for agriculture can deliver poverty alleviation and food security (Ashley and Maxwell, 2001), and especially in Africa (Wiggins, 2009). Small-scale aquaculture is commonly identified as embodying alternative values of social and ecological sustainability in contrast to the dominant narrative of progress in the same way as small-scale fisheries (Johnson, 2006). Perhaps this 'idealization' of small-scale fisheries may also be said to apply equally well SSA and also be as problematic as they are also difficult to define and are increasingly becoming integrated into global markets. Ideally from an aquaculture perspective, it would be beneficial for SSA households to move from SSA Type 1 to SSA Type 2 or an aquaculture SME.

Perhaps the major contributions of aquaculture towards the improvement of human wellbeing and equity are to be found not in income and food security for SAA households (although these may be important), but in upstream and downstream employment in ancillary service provision, and (where aquaculture is strongly commercially oriented and produces small, low value species) in the enhanced provision of high quality animal protein at low cost to consumers (Hambrey *et al.*, 2008).

Small-scale rural aquaculture is far more readily adopted by relatively better–off farmers in rural communities as the poor who have usually been targeted by rural aquaculture programmes in the past are seldom early adopters as they face numerous constraints to entry into aquaculture (FAO, 1997) although there are recommendations for targetting the poor such as by an FAO/NACA expert consultation (Friend and Funge-Smith, 2002). Promoting SSA may also not be socially and economically sustainable because the poor resource base of most small-scale farms leads to relatively limited benefits from aquaculture which may not be attractive to farming households compared to alternative and possibly competing livelihood options, both on and off-farrm.

Thus the challenges remains to identify and address the best approach(es) to maximize the developmental impact of aquaculture and to identify the roles that SSA might play.

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Small-scale aquaculture and its contextual relationships with the concepts of poverty, food security, rural livelihoods and development

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ABSTRACT

The crisis in world food availability and the subsequent rise in food prices experienced between 2006 and 2009 has served to refocus world attention on the importance of investment in agriculture if food production is to keep pace with population growth. While the aquaculture sector has performed better than most food production sectors, the extent to which small-scale aquaculture (SSA) can contribute to both poverty alleviation, food security and rural livelihoods in general is only now being fully understood, although it continues to be constrained by lack of detailed information. In order to optimise the contribution of SSA, the importance of understanding the role of aquaculture in the wider context of rural livelihoods and the wider economy is highlighted. In this paper, some of the key concepts in poverty alleviation, food security and rural livelihoods are discussed in relation to SSA.

Keywords: small-scale aquaculture, poverty, food security, livelihoods, rural development.

INTRODUCTION

The food "crisis" experienced worldwide in 2006 –2009, accompanied by the dramatic effects of the near-collapse of world financial institutions and dramatic slowing in growth rates experienced over the last two years, has encouraged an important reassessment of the role of agriculture in underpinning economic growth worldwide.

Over the preceding decade, much faith has been placed by development agencies and governments worldwide in the capacity of economic growth, driven by movements of capital and investments, to drive the process of reduction of poverty through the provision of new jobs and new wealth. While agriculture, and development in rural areas in general, was recognised as playing a role in this, the center of attention for many of these processes of economic growth was largely on urban areas where the services and skills were available to support new developments in industry.

The worldwide food crisis began to take shape in 2006, driven by a combination of high energy prices, affecting in turn the cost of fertilizers and transport, depreciation of the US dollar, diversion of cereals and vegetable oil to bio-fuel production and changes in buffer stock policies in the United States of America (USA) and Europe (World Bank, 2008). As food prices rose dramatically through 2007 and 2008, reaching a peak in mid-2008, worldwide attention was suddenly drawn to how rural development (which had been at the centre of attention in efforts for poverty reduction up until the late 1990s) and food production in particular, had been given less and less attention by development agencies during the economic boom of the early part of the first decade of the 21st Century.

The prospect of continuing volatility in food and commodity prices, and the dramatic impacts already seen on rates of food insecurity, undernourishment and poverty in many developing countries, have served as an important wake-up call for the development community that agriculture and development in rural areas can only be ignored at great risk. While the rising food prices should represent an opportunity for rural producers, policies to deal with agricultural crises have often penalized exactly that sector which has the potential to help countries address the crisis by focussing on temporary food provision without investing in improving production and markets.

The World Development Report 2008: Agriculture for Development (World Bank, 2007b), highlighted how failures to exploit the growth potential of agriculture are the result of "*....policies that excessively tax agriculture and under-invest in agriculture ....., reflecting a political economy in which urban interests have the upper hand*."

The State of World Agriculture Report for 2009 by the Food and Agriculture Organization of the United Nations (FAO) summed up the situation as follows:

> *"There is a need to step up investment in agriculture with the dual purpose of stimulating sustainable productivity increases to expand supply and of exploiting the potential of agriculture to contribute to economic development and poverty alleviation in the LDCs. In this regard, high prices also represent an opportunity for agricultural producers and imply higher returns to investments in the agriculture sector, whether public or private. The fact that hunger was increasing even before the food and economic crises suggests that technical solutions are insufficient. To lift themselves out of hunger, the food insecure need control over resources, access to opportunities and improved governance at the local, national and international levels based on right-to-food principles." (FAO, 2010a)*

While the specific concern raised by the food crisis is related to the rise in food insecurity that it has generated, it has also had important impacts on progress in the broader fight to eliminate poverty.

Subsequent to these crises, it has been noted that economic growth led by investment in industry and services has often widened the gap between rural and urban areas in terms of the relative prevalence, depth and severity of poverty. The ways in which economic growth, left to its own devices, tends to focus on particular locations with growth there attracting more investment and more growth, while those areas which fail to attract that initial investment (often because they are more remote or inaccessible) become increasingly marginalised. In such areas, the role of agriculture as the principal potential driver of development has been re-emphasised. While earlier thinking seemed to assume that migration or remittances were probably the principal means by which some areas were likely to "catch up" (however slowly) with burgeoning non-agricultural development around urban centres, the persistence of acute poverty in many of these rural areas is now under the spotlight of attention, particularly as those displaced by the financial crisis affecting urban areas have had to return to their rural homelands.

Significantly, the importance of the rural and agricultural sectors in contributing to poverty reduction now seems to have assumed far more salience than it was previously afforded.

> *"....The large share of agriculture in poorer economies suggests that strong growth in agriculture is critical for fostering overall economic growth..... Broad-based growth in the rural economy appears essential for reducing both absolute and relative poverty......81 percent of the worldwide reduction in rural poverty during the 1993–2002 period can be ascribed to improved conditions in rural areas; migration accounted for only 19 percent of the reduction." (World Bank, 2007a).*

AQUACULTURE IN CONTEXT

The refocusing of attention on agriculture in the wake of the food and financial crises should represent an opportunity for aquaculture development. Aquaculture is already recognised as the fastest-growing food producing industry sector in the world. In 2010, aquaculture was credited with 40.3 percent of global fish production by weight and 47 percent of global food fish supply. Perhaps more significantly, it is one of the only food sectors worldwide where growth in production is outpacing growth in population, in spite of a slowing in aquaculture growth over the last decade. The proportion of fish provided by aquaculture in Asia is even higher than these figures, a significant factor as, in spite of rapid economic growth there, Asia remains the part of the world where almost 63 percent of the world's 1.02 billion undernourished people are concentrated (FAO, 2010a).

This highlights the potentially important role of aquaculture in contributing to the Millennium Development Goal 1 Target 1C of halving the number of people suffering from hunger between 1990 and 2015. However, there are already signs that the tremendous growth in aquaculture experienced in the 1980s and 1990s is beginning to slow somewhat. Between the decades 1985–1994 and 1995–2004 the rate of growth of aquaculture worldwide went from 11.4 percent annually to 7.1 percent.

In order to realize the potential of aquaculture in general, and small-scale aquaculture (SSA) in particular, proper mainstreaming into the broader context of rural development seems to be key. In this context, the current renewal of interest and concern regarding the agricultural sector as a whole represents an important opportunity. A sufficient body of evidence has now been developed to support the potential of aquaculture. Progress is being made in understanding more thoroughly than previously the conditions and context in which aquaculture can represent a viable option for rural development.

In particular, greater clarity seems to be emerging as regards to the role of aquaculture in addressing rural poverty. There was considerable debate until quite recently regarding the appropriateness of aquaculture as a livelihood option for the poor given the risks involved and the sometimes relatively high initial investment required. In particular, these contributions to rural poverty alleviation through aquaculture development have not always been well articulated. Information and data demonstrating impacts are frequently unavailable and technically-focussed programmes on aquaculture development have not always paid enough attention to their impacts at the levels of individuals, households and communities.

This lack of information restricts the extent to which SSA can be effectively mainstreamed in rural development.

This is unfortunate because experience has now been generated as to how the poor (although perhaps not the poorest) **can** actually engage in SSA, and the risks can be sufficiently reduced to make it a viable proposition. However, while this evidence is beginning to be available, it is not always articulated in ways that can easily be married with prevailing discourses regarding poverty, food security and rural livelihoods. To some extent, this reflects the dominance of largely technical discourses in relation to aquaculture development. Until recently, the literature on aquaculture in general, but including SSA, has been dominated by technical considerations regarding species, technologies, feeds and disease, and the means for extending this technical discourse to eventual aquaculture practitioners.

While these technical issues are of critical importance, consideration of aquaculture and its role and potential as part of wider processes of rural development, is also key. In discussions about poverty reduction, food insecurity and rural livelihoods, the role of specific technologies tends to come **after** broader analysis of the underlying causes and determinants of these phenomena as they are increasingly regarded as just one of a range of options that might represent potential tools for achieving broader goals. Often, it remains quite challenging to see how the technical issues surrounding aquaculture can easily be incorporated into these far broader discourses.

However, this situation is changing. There is increasing recognition that aquaculture needs to be addressed, not just in terms of technical potential and constraints, but looking carefully at the context in which it is being considered. Early discussions regarding the socio-economic dimensions of aquaculture have now been expanded to look in a far more holistic way at the social, economic, cultural, geographical, ecological and institutional setting. Constraints to aquaculture development generated by perceptions of aquaculture, cultural norms and rights over access and control of key resources are now far more widely recognised than was the case just 10 years ago (Hishamunda *et al*., 2009).

Significantly, recent consultations and research have also addressed the key issue of understanding how the contribution of aquaculture, and particularly SSA, can be better measured and understood so that its role in wider processes of rural development can be identified more clearly (Bondad-Reantaso and Prein, 2009). Means of assessing the sustainability of aquaculture as a development option for rural households has also received more attention in this regard.

The study of the World Bank in 2006 (World Bank, 2007a) on aquaculture potential defines 3 separate "pathways" for aquaculture development. Although these specifically relate to Asia, where the development of aquaculture has been most widespread and most experience has been generated, it is likely that they can be applied in other regions:

- The "static" pathway, involving poor smallholders integrating aquaculture into existing farming systems and generating sufficient income to at least improve their conditions, even though the levels of production will generally be insufficient to actually lift them out of poverty. Clearly, even this pathway has to be based on basic access to the land and/or water required to carry out aquaculture activities, and this will often exclude the poorest groups. In some circumstances (and it does seem to be very context-specific) even the very poor may be able to make use of small, underutilised water bodies or use group approaches to secure access to the resources they need to develop aquaculture. However, the viability of aquaculture as an option for the poorest groups in rural settings needs to be assessed almost on a case-by-case basis. Often, the best opportunities for these most vulnerable groups will lie in the provision of services to support aquaculture, e.g. fry production, fry transport and sales, pond construction, feed collection, etc.
- The "transition" pathway, where farmers with better and more secure resource access (and, in particular, access to the financial resources required for more intensive production) can develop aquaculture as an enterprise. They can also generate significant gains by engaging in markets for fisheries, improving production techniques and actually use aquaculture as a means of getting out of poverty and reducing their vulnerability. Clearly, the degree of capacity and resource access implied here probably means that those who can engage in this level of aquaculture, even if it is still small-scale, are probably **not** the poorest.

- The "consolidation" pathway, where more aquaculture producers are more organized, have better access to institutional resources and capital, can control access to larger land and water areas in order to develop aquaculture as an agri-business. While the direct beneficiaries of this level of development are likely to be rural business people or investors, important benefits are likely to be generated from this in terms of employment opportunities, value chain activities, food supply (including low-value species for local consumption) and broader economic growth.

(*Adapted from* World Bank, 2007 based on Ahmed, 2004)

Some of the key factors that enable the realization of the third pathway of more commercially oriented, large-scale aquaculture are clear and very similar to those factors that affect business development in other sectors. However, ways of realizing the potential around the first pathway, particularly SSA, are more challenging. Some possible factors are discussed below.

An "*enabling*" policy environment

While this is commonly identified as a key factor for all development, it is often less clear what it actually means in concrete terms, particularly for the small-scale sub-sector. At a basic level, secure access to land and/or water is essential. Therefore, measures and legislation, such as land registration which make this possible, are liable to contribute by ensuring that it is worthwhile for people to invest in aquaculture.

At the same time, the opportunities for the very poor to engage in aquaculture will often rely on access to open water bodies or areas where user rights are **poorly** defined because these are the only areas that they may be able to make use of. As user rights become better defined, the poor will often end up being excluded as they have little influence over the mechanisms that assign those rights. Ensuring that such access is sustained is extremely challenging. It requires very specific measures to guarantee that the rights of poorer groups are protected, often in the face of strong opposition from existing networks of power and patronage.

To make certain that there are synergies between the small-scale and rural entrepreneurs involved in aquaculture (e.g. rural fish hatcheries) is very critical.

Access to knowledge and technology

Great progress has been, and continues to be made, in developing a wide portfolio of viable and appropriate technical solutions for fish farming in different circumstances. The key challenge is to make sure that people, including the poor, have access to the information they require and the technology that is most appropriate for them. It needs to be explicitly recognised that lack of such access is often a key feature of poverty in many rural areas, and innovative approaches are likely to be essential. Efforts to develop formal systems of information dissemination and training, even where they include attempts to involve the poor, would often end up mirroring existing power relations and fail to reach the target recipients.

Producer organizations

Creating an environment where organizations of producers, whether they involve rural entrepreneurs or poor, small-scale producers, is liable to play an important role in supporting aquaculture development, particularly small-scale development for the poor. The challenges that this represents should not be underestimated. The poor are often poor because, at least in part, they tend to opt out or be actively excluded from most forms of organization. Even if they are part, their levels of participation and their voice within those organizations, are often very limited.

Pro-poor aquaculture development

As with the "enabling" environment, the term "pro-poor" has acquired considerable currency and acceptability, although the extent to which it actually goes beyond a rhetorical device is less clear. As in rural development as a whole, so in SSA development, the real challenges involved in working with the poor – the time and patience required, overcoming the difficulties in communication and even identification of the poor, the flexibility in time frames and high investment of development resources required, the adjustment to the capacities and capabilities of the poor – are rarely fully appreciated. For project interventions, especially when they are focussed on a particular sector like aquaculture, the poor will often seem to represent a bad option – it takes longer for them to achieve success, their failure rates are liable to be higher, and they require much more support compared to the less-poor. Not surprisingly, the ideal of pro-poor development often ends up being sacrificed on the altar of efficient project delivery.

Therefore, creating the space and flexibility required for pro-poor development in SSA is also likely to be key. This is always challenging for sectoral institutions, such as fisheries or rural development departments. They look for ways to make the best and most efficient use of their scarce resources. It will often require flexible funding streams and skill sets which may not be normally available within technical departments.

In particular, the realization of these key elements in supporting SSA will depend on a better understanding of some of the key issues surrounding poverty, food security and rural livelihoods. These are discussed in more detail below.

SMALL-SCALE AQUACULTURE AND POVERTY

Changes in concepts of poverty

The past two decades has seen a significant transformation in the definition of the concept of poverty. From an essentially economic definition of poverty, focussed on defining a minimum level of income as a "poverty line" and identifying those who fall below that line as "the poor", research into development processes has progressively widened our understanding of the concept of poverty.

The World Development Report of 2000/2001 by the International Bank for Reconstruction and Development (IBRD)/World Bank (2001) represented the "mainstreaming" of this new understanding of poverty. In particular, this report brought to a wider audience of development practitioners an understanding of the multi-dimensional nature of poverty and highlighted how poverty is the result of a complex set of interactions between resource access, health and educational status, capacity and opportunity to participate in and influence decision-making processes, and vulnerability to shocks and processes of change.

In terms of strategies to address this new multi-dimensional understanding of poverty, the report identifies three key areas: promoting opportunity for economic development (in other words, promoting overall economic growth as a tool for creating more opportunity for the poor), facilitating empowerment (by strengthening the participation of the poor in decision-making processes and making institutions more transparent and accountable), and enhancing security (by reducing the vulnerability of the poor to shocks and processes of change and putting in place appropriate safety nets).

In conjunction with this recognition of the multiple dimensions of poverty, the past decade of research on poverty has led to an increasingly sophisticated understanding both of the nature of poverty (for example, distinguishing between the depth, breadth and duration of poverty), and the different causes of poverty. Work by the Chronic Poverty Research Centre (CPRC, 2008) has highlighted how dangerous it is to talk about "the poor" as a generic group when, in fact, those often regarded as the poor represent a highly heterogeneous and diverse group. The combinations of factors that lead people into poverty, keep them in poverty, or prevent them from getting out of poverty are highly dynamic and complex and subject to many variations across regions, countries, local areas, within communities and even within households.

Five key dimensions to the "traps" that determine poverty have been identified (CPRC, 2008):

- Insecurity – being subject to shocks and stresses that tend to mean that livelihood strategies are focussed on short-term survival rather than longer- term positive change;
- Limited citizenship – incapacity to participate in or influence political and decision-making processes;
- Spatial disadvantage – living in remote, isolated areas where services are poor, political exclusion is the norm and the resource base is limited or degraded;
- Social discrimination – being trapped in social relationships of power, patronage or competition that are exploitative and limit access to goods and services.
- Poor work opportunities – living in areas where growth is limited and the opportunities to find regular employment that would enable investment in the future through education or asset accumulation. (CPRC, 2008).

While these specific features are related to the concept of "chronic" poverty – or poverty which is acute, prolonged, multi-dimensional and often transmitted across generations – it is important to recognise how any one of these elements can become a key determinant of poverty for different groups at different times. Often they will be manifested only temporarily, as a result of changes in local climactic, economic or social conditions, but understanding the dynamics of poverty and how they affect different groups of people is increasingly recognised as key in addressing poverty.

An all-important constraint which is consistently recognised in addressing poverty effectively is the widespread lack of data or detailed information to allow development workers to easily identify and understand who the poor are (whether in a particular community, area or nationally) and what dimensions of poverty they experience. It has increasingly been recognised by practitioners that there are no easy solutions to this issue – the poor are poor **because** they are often invisible, hard-to-reach and unlikely to participate effectively in development efforts without close, long-term support.

The role of small-scale aquaculture in poverty reduction

In spite of the diffusion of this more complex understanding of poverty, discussion of the contribution of SSA has often avoided an in-depth analysis of the interactions between aquaculture development and poverty. While there is a widespread desire to show that SSA development can play a role in poverty reduction, and that it can be productively undertaken by "the poor", this has rarely been accompanied by a detailed analysis of who the poor are, their different characteristics, the different dimensions of poverty they experience and the constraints they face, not just in engaging in SSA, but in creating viable livelihoods for themselves and their families.

Often, this reflects a lack of information which would allow such an analysis to be carried out. Edwards (1999) mentions the "...limited current documentary evidence that aquaculture helps to reduce poverty." Muir (1999) states similarly that "...information about poverty-associated aquaculture is generally inadequate." While much has been written since then on how aquaculture development has assisted "poor" households and on the **potential** contribution of aquaculture to poverty alleviation, there is still a distinct lack of resolution in the thinking about exactly how and for whom aquaculture is to play a role in poverty reduction.

Similarly, the discussion of the role of SSA in poverty reduction often fails to distinguish between three potential roles that it might play in the livelihoods of the poor:

- as a livelihood option undertaken directly by poor people and included in their livelihood strategies;

- as a source of employment for poor people;
- as a source of high-quality food for consumption and purchase by poor people.

Small-scale aquaculture as a livelihood option for the poor

In 2008, the Asian Development Bank (ADB) found out that numerous examples of successful adoption of SSA by “poor” rural households are available: cage culture in open-access water bodies, leasing in of ponds for fish raising by individuals or groups of poor households, exploitation of “micro”-water bodies for seasonal fish raising and raising of fish in rice fields are just some examples from Asia. However, it is noticeable that although these are promoted as examples of SSA initiatives that have contributed to poverty reduction, they are rarely accompanied by a detailed analysis of the poverty levels and characteristics of the individuals or households directly involved. The positive impacts of the activities are not in question, the question that is rarely addressed is just how poor those involved have been.

Some cases (e.g. cage-culture in Bangladesh by groups of poor women promoted by the international NGO CARE) have undoubtedly made specific efforts to target the poor and engage them in this type of SSA activity. However, it is also significant that most discussions of SSA for poverty reduction also identify a set of substantial constraints facing poor people who wish to engage in this activity.

In Table 1 below, some of these constraints most commonly identified are outlined along with corresponding commonly identified features of poverty. This highlights how many characteristics of SSA seem to be antagonistic to direct involvement of the poorest parts of rural communities.

Access of the poor to land and water resources that are required for aquaculture are typically limited. ADB (2008) identifies this as a key constraint in permitting the poorer sections of rural communities in directly benefitting from aquaculture as a livelihood option. As is often the case, the poor will tend to face a paradox in terms of their capacity to sustain aquaculture as a livelihood option. Because of their limited access to land and water, they often rely on the use of resources where ownership

TABLE 1
Constraints faced by the poor in engaging in small-scale aquaculture

Constraints faced by the poor in engaging in small-scale aquaculture (adapted from Muir, 1999)	Characteristics of poverty
The need for stable access to water and/ or land for cages or ponds.	Lack of stable access to water and/or land is a widespread feature of poverty in many rural areas
Possible market limitations – seasonal gluts/ high prices in other circumstances.	Poverty is often characterised by poor access to markets or access on terms which are disadvantageous to producers
Wealth creation dynamics may disadvantage poorest sectors.	A frequently encountered feature of poverty is the difficulty that the poor have in maintaining control of assets that acquire value. For example, open or underutilised water bodies may be of no interest to wealthier groups until their value is demonstrated, in which case the poor may have great difficulty in maintaining control.
The need to address potential resource access conflicts.	The poor are able to exert little influence over decision-making and conflict resolution mechanisms because of their lack of political capital. This often makes them vulnerable in conflict situations as they are more likely to be unable to influence how these conflicts are resolved.
Activities may depend on expensive seed, feed inputs.	Lack of working capital to invest in initial inputs is a common feature of rural poverty.
The technical skills involved may be relatively complex.	Because the poor are almost entirely engaged in ensuring their day-to-day survival, they have little time to invest in education and often lack the skills required for more complex activities. Similarly, access to information, including technical information on how to conduct aquaculture, may represent a significant challenge for the poor.
The risks involved in adopting a new activity may be perceived as (and on occasions actually are) high.	The poor tend to be, of necessity, risk averse as any increase in risk can have disastrous implications for those already living on the borderline of destitution.

Source: adapted from Muir, 1999.

is either ambiguous or undefined and which are regarded as marginal or high-risk by other segments of the population. Furthermore, if they are able to establish successful aquaculture operations in such areas, those same areas will immediately become attractive to other investors, with more resources and greater influence, who will almost invariably be able to establish control over the resources required for aquaculture to the exclusion of the poor. One of the reasons the poor are poor is that they have little or no influence over the decision-making and political mechanisms that decide on resource allocation.

Secure access and tenure rights are often identified as key elements that are required for successful aquaculture development. Unfortunately, these requirements will almost always represent an insuperable challenge for poorer groups. Even where attempts are made to ensure secure access, the political economy context in which the poor operate will often mean their long-term exclusion from such processes.

Underestimation of operating risks is also identified as a frequent constraint on aquaculture development activities. This is particularly grave for the poor who can ill afford to be exposed to such vulnerabilities. Risks can include flooding, pollution, storms, disease, lack of feed and lack of working capital to purchase key inputs at critical junctures in the fish culture cycle. All of these can have catastrophic results and poorer operators are likely to be particularly vulnerable in the face of such risks.

Access to sustained technical support and information is important in any new activity. Yet one of the characteristics of poverty is often that the poor have limited access to such information, either because those who provide it do not easily recognise the poor and deliver information to them in a form they can use, or because information is expressed in terms that they are unfamiliar with and have difficulty in using. This is critically important as the need to access such information will not be limited to the initial start-up period, when project specialists, support and training may be more readily available. To make SSA a **sustainable** option for the poor they need to have **sustained** access to such support. Significantly, some of the best practices in terms of sustainable provision to support have been where it is built into the basic networks of service providers involved in rural aquaculture networks, such as fish hatchery managers or fish seed suppliers, who have clear incentives for improving the quality and productivity of their customers' aquaculture activities.

Experience has shown that, in specific situations and with the right sort of support, at least some of these constraints can be overcome. It has been demonstrated that "niche" potential can often develop around aquaculture activities where poorer households may be able to identify opportunities for involvement. The development of indigenous, and often ingenious, arrangements for leasing of unutilised water bodies and borrow-pits in some areas of rural Bangladesh enabled many poor people to engage in small-scale aquaculture, at least for a period until more powerful non-poor interests became attracted to the activity (Shah and Townsley, 1994). Similarly, while grow-out of fish in cages might require long-term stable access to water areas that could be challenging to maintain for poor households, shorter term access to raise fingerlings represents a viable and appropriate option for them.

Awareness of these issues prior to promoting SSA as a livelihood option for the poor is very crucial. Also, importantly, the existence of these constraints for direct involvement of poorer sections of the community in SSA by no means affects the appropriateness of aquaculture interventions for less-poor households that may be able to overcome these constraints and, by doing so, generate other, often indirect benefits for the poor.

While there are frequently significant obstacles faced by the poor in becoming directly involved in SSA, the development of aquaculture in rural areas, even if it is dominated by the less poor, can and does create benefits for them. Small-scale aquaculture is not generally labour intensive (except for certain tasks such as pond excavation), but it does create demand for a series of services which can often be provided by poorer members of the community who may not be able to conduct aquaculture themselves. These can include feeding, fish marketing, fish fingerling transport and marketing, pond maintenance, work in hatcheries, etc. Experience from the fish fingerling marketing network in Bangladesh is indicative of how demand generated by SSA can drive an important service activity which provides widespread opportunities for employment for very poor households. Likewise, fish marketing activities may represent an important livelihood opportunity for poorer households.

Small-scale aquaculture as a generator of employment for the poor
Rather than "defending" aquaculture as a sector, it should perhaps be seen as one of a suite of options for rural agricultural development. This would encourage the careful assessment of the **comparative** advantages of aquaculture for rural producers: if a person has an area of land, or a pond, what is the best use of it that they can make, taking into account their capacities, their needs, their aspirations for the future, the markets available, the context in which they operate and the vulnerabilities to which they are subject. As it is, partly because of the institutional arrangements surrounding aquaculture development, the approach tends to be to go out and "promote aquaculture" and success is measured by how much of it takes place without necessarily considering whether this is achieving the best impact.

Small-scale aquaculture as a high-quality food for consumption and purchase by poor people
In the early days of rural aquaculture development, it was often assumed that anyone investing in aquaculture would tend to focus on the highest value product that was available in order to maximise returns. As rural SSA has expanded (particularly in Asia but also elsewhere), it is significant that this drive towards the high-end market is by no means universal. Many producers choose to focus on producing fish for local consumption and, where local consumers are mostly relatively poor. This may mean producing lower value fish that are accessible to poor consumers, this may also play an important role in replacing fish from wild stocks that are almost everywhere in decline but previously were important in providing cheap, high quality food for the rural poor.

Addressing poverty
Much discussion of the role of aquaculture in poverty alleviation centres on the potential role of aquaculture as an activity that can be taken up by the poor to either improve their access to food, generate income, or generate employment. In the light of recent analysis of poverty, it needs to be emphasised that poverty tends, overwhelmingly, to be a structural issue. The poor are poor because they are usually trapped in a web of social, political and economic relations which make it difficult for them to be anything else except poor.

In this respect, it seems important that the expectations surrounding a particular set of technologies – SSA– in terms of their capacity to address these underlying causes of poverty be realistic. No matter how well the intention may be, supporting the poor to engage in appropriate forms of aquaculture activity will only address a limited set of causes of poverty. It may help them make better use of resources that they have access to, it may improve their access to food and it may help them generate more income. However, these are unlikely to represent, by themselves, a means of addressing poverty in a sustainable way. Therefore, putting SSA in context, particularly in relation to poverty reduction strategies, is likely to involve regarding aquaculture as one possible option, however limited its applications may be. It needs to be part of a much broader suite of interventions that also help to address the wider issues that usually underlie poverty in rural areas of the developing world: restricted capacity among the poor, isolation from institutions and supporting structures, lack of voice in decision-making processes and lack of influence over factors that affect their lives, and ultimately, a lack of opportunities to make choices about their livelihoods. Providing people with **one** extra choice can be an important step, and even an entry-point, in some cases. However, to provide more sustainable solutions to poverty, far wider efforts are required.

SMALL-SCALE AQUACULTURE AND FOOD SECURITY

Concepts of food security

> *"Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (Special Progamme for Food Security (SPFS), FAO, 2003b).*

FAO's current estimate of the number of undernourished people in the world for 2010 is 1.02 billion (FAO, 2009), the highest number estimated over the past three to four decades. While technological advances in agriculture and improvements in markets and distribution have reduced the **percentage** of the world's population who are hungry since the 1970s, the recent financial and food crises have highlighted how vulnerable this progress remains.

Since the Universal Declaration of Human Rights in 1948, which included the right to adequate food as fundamental human right, concepts of food security have evolved significantly. The initial focus, reflecting the global concerns of 1974, was on the volume and stability of food supplies. Food security was defined in the 1974 World Food Summit as:

> *"availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices".*

In the 1980s, influenced at least in part by on-going analyses of poverty, the importance of secure access to food, as opposed to food availability, began to be recognised as of equal importance in securing food security for the poor and vulnerable (FAO, 1983).

In the mid-1980s, the temporal dynamics of food insecurity also began to get more emphasis with a distinction being made between chronic food insecurity, associated with problems of continuing or structural poverty and low incomes, and transitory food insecurity, which involved periods of intensified pressure caused by natural disasters, economic collapse or conflict (World Bank, 1986).

The 1990s saw a gradual expansion of the areas of concern included in the concept of food security to incorporate "sufficient" food, indicating continuing concern with protein-energy malnutrition and also food safety and nutritional balance, reflecting concerns about food composition and minor nutrient requirements for an active and healthy life. Food preferences, socially or culturally determined, also became a consideration.

This has led to a steadily more complex definition of food security reflecting current analysis of food security which incorporates an increasing realization of the difficulties inherent in identifying simple, generic indicators of food insecurity. Initially accepted indicators of food availability, food production and "apparent" consumption as proxy measures for food security have been increasingly called into question as they fail to take proper account of key issues of food **access** and **stability**. It has also been increasingly recognised that the lines between overall food security, chronic food security from "sub-nutrition", transitory food insecurity and vulnerability to food insecurity are often very difficult to define (FAO, 2003a). Localised factors, often at the intra-national level, often play a key role in determining these phenomena.

According to the Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS) of the FAO (2006), food security is increasingly widely recognised as a multi-dimensional phenomenon in which a broad set of important concepts interact:

– **Food availability:** The availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports (including food aid).
– **Food access:** Access by individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet. Entitlements are defined as the set of all commodity bundles over which a person can establish command given the legal, political, economic and social arrangements of the community in which they live (including traditional rights such as access to common resources).
– **Utilization:** Utilization of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met. This brings out the importance of non-food inputs in food security.
– **Stability:** To be food secure, a population, household or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (e.g. seasonal food insecurity). The concept of stability can therefore refer to both the availability and access dimensions of food security.

These four "pillars" of food security defined by the FIVIMS/FAO recognise the increasing currency of the rights-based approaches (the Right to Food recognised in the Universal Declaration of Human Rights in 1948). It also highlights the importance of temporal aspects of food security and the need to understand differences between chronic and transitory food insecurity. Significantly, as implied in the discussion of food access, the importance of placing food security issues in the context of people's broader livelihoods is also recognised, as food security or insecurity represents one key outcome of the complex interactions between different elements in livelihoods. This also opens the way to the analysis of food security as a "...social and political construct" (Devereux and Maxwell, 2001).

Food security and small-scale aquaculture

The potential for aquaculture to play a key role in supporting improved food security has already been mentioned above. Aquaculture is one of the fastest growing food production sectors worldwide, growing at an average annual rate (between 1984 and 1998) of 11 percent annually (compared with 3.1 percent annually for land-based animal protein production and 0.8 percent for capture fisheries production).

The ADB Special Evaluation Study of aquaculture, based on case studies in Bangladesh, the Philippines and Thailand, recognises that it is in terms of access to supplies of fish for food, especially in the face of declining resources of wild fish from capture fisheries, that aquaculture may make, and is already making, a key contribution. In Bangladesh, the estimated production from aquaculture was around 850 000 tonnes of fish, constituting 37 percent of total national fisheries production.

For SSA production, a key constraint in defining its contribution to food security is the lack of available information. As with many elements in rural livelihood strategies, this reflects the nature of small-scale production: it tends to be dispersed, difficult to identify, often seasonal and it will often involve people who do not easily engage with local institutions. The outputs of SSA are either consumed within the household or feed into local markets where measurement is challenging.

However, based on the expanding body of case study material (FAO, 2009; ADB, 2005; World Bank, 2007), it is steadily becoming clearer that SSA can and does make a contribution to food security, both for those undertaking it as a livelihood activity and for those who consume what it produces.

Fish has always played an important role in the diets of poor people worldwide because it generally represents the most affordable source of high-quality animal protein. The value of fish in diet is widely recognised, particularly as a source of vital micro-nutrients that aid in the absorption of other sources of nutrition. As capture fisheries production has stagnated or even declined in some areas, aquaculture has often stepped in to fill the gap. In spite of the expectation that aquaculture would inevitably tend to concentrate on high-value species, many producers do seem to consciously elect to produce low-value species for local markets, thus making direct contributions to local food security and food access.

Not surprisingly, as levels of production and investment increase, producers tend to shift to high-value products, but it is clear that small-scale fish production does fill the gap created by either seasonal fluctuations in wild fish availability or falling supply.

SMALL-SCALE AQUACULTURE AND RURAL LIVELIHOODS

Concepts of rural livelihoods

The concept of "livelihood" is by no means new and has gained importance in the wake of the emergence of the Sustainable Livelihoods Approach (SLA) as a means of better understanding and addressing the dynamics of poverty and the livelihoods of the poor in the 1980s and 1990s. This understanding was based on research and analysis by figures such as Amartya Sen (Sen, 1981), the World Bank-supported Voices of the Poor studies (Narayan *et al.*, 1999) and the experience of development workers worldwide, particularly those involved in action research approaches and participatory approaches to development.

There are many definitions of "livelihoods" in circulation and, even before the development of the SLA, there was a widespread appreciation among development workers that people's livelihoods were complex and needed to be understood and approached in a holistic way. However, what was particularly important in the development of the SLA was the attention paid to understanding what it is that makes livelihoods "sustainable", in reaction to the perception that many development efforts in the past, by focussing on specific sectors or failing to address wider contextual issues, has often failed to achieve sustainable poverty reduction. The definition of "sustainable livelihoods" adopted by the British Department for International Development (DFID) in 1998 has perhaps gained the widest acceptance and highlights this notion of sustainability.

> *"A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base." (Carney, 1998)*

From this definition, and the many others adopted by different organizations worldwide, several key elements that are commonly recognised can be noted:

- People's livelihoods are defined by their access to a certain set of assets. DFID commonly recognise five key livelihood assets: human, natural, social, physical and financial;
- According to their ability to access these assets, and convert one type of asset into another type, people are able to construct a livelihood strategy and achieve certain livelihood outcomes;
- Access to these assets is determined by many complex factors. These include the characteristics of the people concerned (gender, age, ethnic group, class or caste), and the institutions, policy processes and power relations that surround them;
- Depending on how effective these institutions, policy processes and power relations are in supporting people to have better access to the assets they need, people's livelihoods are likely to be more or less resilient in the face of the various factors that make them vulnerable – seasonal changes, shocks such as natural

disasters or loss of ability to work through injury or disease, and trends e.g. natural resource degradation or increasing competition because of population growth;

- The choices that people make (or, in the case of the very poor, their **lack** of choices) about their livelihoods will be determined by this web of interactions between who people are, the assets they can draw on, the policy, institutional and power relations that surround them, and the degree to which they are exposed to these vulnerability factors;
- The choices that they make and the outcomes that they are able to achieve through their livelihood strategies, will affect their future choices.

Figure 1 represents the most familiar livelihoods model developed for DFID.

It is important to recognise where the comparative "advantages" of the SLA lie compared to the range of development experience and approaches from which it was developed in the 1980s. While much attention has tended to be focussed on the livelihoods "pentagon", representing the five asset areas which people draw on for their livelihoods, this represents only one element in the overall picture of people's livelihoods. While the SLA has often been interpreted as focussing on improving people's access to these assets, this interpretation considerably reduces the added value of the approach as a whole. Development agencies have been working to provide the poor with "assets" for decades. The difference in the SLA consists in recognising explicitly, and attempting to address, the relationships and linkages between people and their assets with the policy, institutional and "processes" (or power relations) elements that influence their access to assets. This is where the element of "sustainability" in livelihoods lies. If these relationships are constructive and supportive for the poor, their livelihoods are likely to be more sustainable in the long-term and more resilient in the face of shocks, trends and seasonal change.

The livelihoods framework does not, in itself, suggest solutions – it is a framework for analysing livelihoods. The establishment of principles that guide action in addressing the understanding that a livelihoods analysis produces is equally important. Like the framework, it is important that these principles be "negotiated" in each context in which the SLA is being used, as much as anything to ensure that they are properly understood and applied (as opposed to be being purely rhetorical). Key principles which have been widely accepted in addressing sustainable livelihoods are shown in Table 2.

What is also different about the SLA is that it embraces the complexity of rural livelihoods from the perspective of the poor. It puts the poor at the centre of the development process because they are the ones most in need of support. Although it is not explicit in the DFID framework shown above, the SLA should also focus people's attention on understanding the specific characteristics of the people who are at the

FIGURE 1
The Sustainable Livelihoods Framework

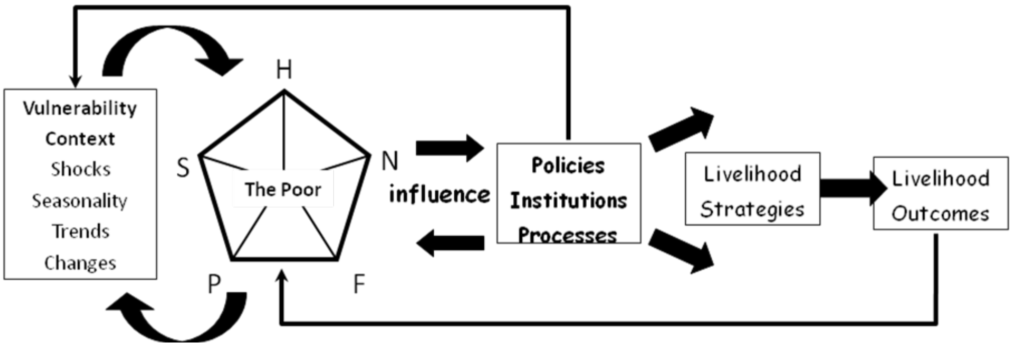

TABLE 2

Key SLA Principles	Discussion
People-centred	People, with their **characteristics**, their **capacities**, their **differences**, their **priorities**, and their **concerns**, should always be at the centre of every intervention. This means that any action for change undertaken must focus on what matters to the people at the centre of the intervention and appreciate the fact that different interventions are liable to be appropriate for different people.
Building on strengths	Interventions should aim to build on the strengths of the people they are working with (and not just satisfy their needs and give them what they lack). Everyone, even the poorest of the poor, has particular capacities or strengths and these should become the starting point for working towards sustainable, positive change.
Empowering	Any action aiming at promoting Sustainable Livelihoods of the poor should also aim to empower the poor by increasing their **voice** and **influence** and giving them greater **choice** about how they can make a livelihood for themselves and their households.
Implemented in partnership	Partnerships for SLA need to involve, firstly, the people who are the subject of the development process and, secondly, the diversity of agencies that are likely to be required to support them in improving their livelihoods. Because livelihoods are complex and are "multi-sectoral", addressing them is likely to involve a range of different agencies.
Holistic	Being holistic in development interventions means being aware of the **complexities of people's livelihoods** and the **complexities of poverty**. It doesn't necessarily mean trying to address **all** those complexities, but it does mean understanding how the different aspects of people's livelihoods, and actions at different levels, are linked and can affect each other.
Equitable	Equitability in development interventions means ensuring that people's rights are respected. In the case of the poor, this is often closely linked with the process of empowerment – the poor are often unaware of the fact that they have rights. Equitability also means attempting to identify interventions that will address the imbalances and failures in distribution and access that contribute to poverty.
Building linkages between different levels	SLA will inevitably involve working at a range of different levels: the individual, the household, the community, service delivery mechanisms, local and national institutions and with policy-makers. The key is to improve the quality of the linkages between these different levels, making them more effective and more supportive (particularly of the poor).
Dynamic and adaptable	Livelihoods are **dynamic**, **diverse** and **complex**. This means that responses have to be similarly dynamic and adaptable. There are no "blueprint" approaches to dealing with livelihoods. **Adaptive learning** based on experience will always be a critical part of interventions and needs to be built into interventions. **Planning** and **management** mechanisms have to be **adaptable** to deal with changing circumstances and priorities.
Sustainable	Sustainability should be generated by the proper implementation of the SLA. Attention should be paid to the key areas of social, economic, environmental and institutional sustainability. If the principles above are effectively implemented, sustainability should follow. In other words, sustainability is likely to be achieved if interventions will: put people at the centre, build on people's strengths, and empower these people by giving them voice and choice.

centre of the framework. Analysing these characteristics is critical if the strengths (and weaknesses) of different groups, whether they are poor or non-poor, are to be properly understood and the process of identifying potential solutions with those people is undertaken effectively.

Almost every different organization that has worked on the development of the SLA, and other organizations that have subsequently adopted the approach, have developed it in slightly different ways to reflect their particular concerns and priorities. There is no "definitive" version of the Sustainable Livelihoods Approach. It is important to recognise this, as it reflects a basic underlying principle of the SLA – that any development approach needs to be flexible and adaptable if it is to be effective. Thus many practitioners of SLA emphasise the need to "reinvent" the SLA each time it is applied, adapting to local circumstances and the specific conditions in which it is being used.

Small-scale aquaculture and rural livelihoods

Given the importance of understanding SSA "in context", the SLA offers important insights into how aquaculture might fit into the broader setting of rural development and poverty reduction.

In terms of livelihoods analysis, aquaculture represents one particular type of technology (which combines physical assets with new knowledge and skills – human assets) which makes use of a specific set of natural assets – water, fish, land. As with most rural livelihood activities, aquaculture involves a capacity to both access specific sets of assets and be able to convert and exchange one type of asset for another –

financial assets are important to be converted into key inputs (physical/natural assets); social assets (linkages with fry producers and fish sellers) may play a key role as well to enable the outputs (fish) to be reconverted into income (financial assets).

However, the real contribution of the SLA to a better understanding of SSA lies in what surrounds the "asset pentagon" – the context of policies, institutions and power processes and the vulnerability context. This part of the sustainable livelihoods framework focuses attention not just on the structures (organizations and institutions, administrative structures, and policy making mechanisms) that influence people's livelihoods, but, crucially, on the relationships between these structures and people. All too often in the past, it has been assumed that simply creating mechanisms is enough to ensure that people have access to the institutional support that they need. The SLA encourages development workers to pay greater attention to the quality of the relationships that link people to these sources of institutional support.

In the case of aquaculture, this means paying attention not just to the existence, for example, of technical services that disseminate appropriate knowledge and technical information, but ensuring that they can be easily accessed by people who need these information to support their existing aquaculture activities or enable them to take up new ones. Where these services are distant, unresponsive, expensive and unwilling to work with the poor, their mere presence is unlikely to have great impact on the livelihoods of the poor. In contrast, it has been shown that where they work closely with the poor and respond to the capacities and priorities that the poor themselves articulate, and where they are flexible enough to work at a pace and with technologies that the poor can make use of, these services can be made accessible.

Similarly, efforts by decision-making agencies to actively engage with different stakeholder groups in order to understand the issues they face and respond to them can significantly help to improve the policy environment in which small-scale fish farmers operate (Fisheries Administration of Cambodia (FiA), 2009)

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Contribution of small-scale aquaculture to sustainable rural development: a synthesis of case studies in China, Philippines, Thailand and Viet Nam

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Pongthanapanich, T. 2013. Contribution of small-scale aquaculture to rural developments: a synthesis of case studies in China, Philippines, Thailand and Viet Nam. *In* M.G. Bondad-Reantaso & R.P. Subasinghe, eds. *Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development,* pp. 81-92. FAO Fisheries and Aquaculture Proceedings No. 31. Rome, FAO. 255 pp.

ABSTRACT

The results of eleven case studies conducted in China, the Philippines, Thailand and Viet Nam are synthesized focusing on the contributions of small-scale aquaculture (SSA) that the studies indicate. Generally, all studies showed a relatively high contribution to social capital. The two types of SSA had different magnitudes of contribution to the livelihood capitals. Type I (polyculture and integrated fish-mulberry tree in China, polyculture and catfish in small plastic-lined pond in Thailand and the Vuon-Ao-Chuong (VAC) traditional farming system in Viet Nam provided a more balanced contribution to all livelihood assets, an strong indication of a sustainable livelihood system. Type II (tilapia and seaweed farming in the Philippines, shrimp-finfish, lobster, and tiger shrimp farming in Viet Nam) contributed significantly higher to financial and physical assets. Contributions of Type II to the human capital tended to be low in terms of household food security but relatively high in terms of food supply to society. There was no contribution to natural capital from Type II system. Based on the findings and recommendations of the case studies, implications are drawn for policy interventions that would improve the ability of SSA to contribute to the build up or conservation of livelihood capitals and to rural development.

Keywords: aquaculture contribution, rural development, aquaculture system, livelihood asset.

INTRODUCTION

The last ten years have seen an increasing recognition of the contributions of small-scale aquaculture (SSA) to global aquaculture production and rural livelihood development. These include food security and improved nutrition, efficient use of water, farm materials and other resources, diversification of livelihoods, generation of rural income and employment, utilization of family labor, fostering of social harmony, and women empowerment (Edwards, 1999). However, while these contributions have been recognized, there is little quantitative evidence of how SSA actually contributes to sustainable rural development (SRD) and no systematic measurement of the contribution. To address this, the Food and Agriculture Organization of the United Nations (FAO) organized an expert workshop at Nha Trang University (NTU) in Nha Trang, Viet Nam in November 2008 with a view to developing an indicator system for better assessment of the contribution of SSA to SRD. The workshop developed a working definition of SSA, proposed an indicator system and recommended to pilot-test the indicator system through several case studies (Bondad-Reantaso and Prein, 2000). After the Nha Trang workshop, a project was initiated, consisting of seven case studies in the Philippines, Thailand and Viet Nam in 2009, aimed to test and refine the indicator system proposed in Nha Trang. The procedure involved a pre-test of the indicators on which basis the seven pilot studies were developed and carried out. The results of the pilot studies were presented at a second workshop organized by FAO in Tagaytay, Philippines in August 2009. At this workshop the test results and methodology were evaluated, the indicator system was refined, and a recommendation was made for the wider testing and use of the indicators. The workshop also served as a learning forum for the participants. After the Tagaytay workshop, the practical application of the indicators was conducted in four case studies in China and Viet Nam in 2010.

This paper presents the analytical results of the case studies focusing on the contribution of SSA and the implications from measuring them. The characteristics of each case are concisely presented following the concept of Sustainable Livelihood Approach (SLA) that was used as basis for measurement of the contribution. The relative levels of contribution in terms of the five livelihood capitals or assets (i.e. natural, physical, human, financial and social capital) were evaluated based on a list of indicators compiled from all eleven case studies. The outcome from the case studies became the basis for drawing policy implications and recommendations to strengthen rural development planning and improve programmes.

SUSTAINABLE LIVELIHOODS APPROACH (SLA) AND INDICATORS FOR MEASURING THE CONTRIBUTION OF SMALL-SCALE AQUACULTURE (SSA)

The sustainable livelihood concept became widely acknowledged when it appeared in the report of an advisory panel of the World Commission on Environment and Development (WCED) in 1987. The WCED report links sustainable livelihood security to basic human needs, food security, sustainable agricultural practices and poverty, and describes it as an integrating concept (Espaldon, 2009). Ellis (2000) defined sustainable livelihood as, *"A livelihood comprises the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household."*

According to Allison (2004) the SLA originated in studies that were concerned with understanding the differential capability of rural families to cope with crises such as droughts, floods, or plant and animal pests and diseases. The SLA is clear about the expected characteristics of a sustainable livelihood which included a strategy where people are able to maintain or improve their standard of living, reduce their vulnerability to external shocks and trends, and ensure that their activities are compatible with maintaining the natural resource base. The SLA thus promoted policy and management interventions that give full consideration to the range of resources that people can access; and the factors that may influence positively or negatively the attainment of the set outcomes.

The Nha Trang indicator sytems for measuring the contribution of SSA are organized according to the five assets in the SLA (Annex 1). First, contribution to natural capital is a catch-all for the effects of SSA on the environment and the natural resource base. Second, contribution to physical capital involves the formation of built assets, both individual (private) and collective (public). Third, contribution to human capital involves improvement of human development outcomes, in particular nutrition and food security. Fourth, contribution to financial capital pertains to the sustained and increasing flow of earnings or consumption savings due to SSA. Fifth, contribution to social capital refers to, in part, the reinforcement of networks of trust and goodwill.

CHARACTERISTICS OF CASE STUDIES

This paper presents the outcomes of seven pilot case studies in the Philippines, Thailand and Viet Nam conducted between February and July 2009 and the practical application of four case studies in China and Viet Nam conducted between January and March 2010. Apart from key informant interview, farm survey using a questionnaire was the key method for collecting primary data. The characteristics of all case studies and the sample sizes of farm respondents from eleven case studies are shown in Table 1.

TABLE 1
Characteristics of case studies for measuring contribution of SSA

Cases	Description	Type[2]	Location	Study team and year	Sample size
Polyculture	Freshwater pond polyculture of carps	I	Suining, Jiangsu province, China	Xinhua and Yongming (2010)	122 (41%)
Fish *cum* mulberry tree	Integrated fish-mulberry tree for domestic market	I	Huzhou, Zhejiang province, China	Xinhua and Yongming (2010)	134 (27%)
Tilapia	Freshwater cage culture for domestic market	II	Leviste v Village, Taal Lake, Batangas province, Philippines	Espaldon *et al.* (2009)	25 (26%)
Seaweed (*Eucheuma* spp.)	Marine culture for export	II	Poblacion II village, Calatagan, Batangas province, Philippines	Espaldon *et al.* (2009)	25 (83%)
Polyculture	Freshwater pond polyculture of finfish integrated with orchards	I	Khlong Wua subdistrict, Ang Thong province, Thailand	Pongthanapanich *et al.* (2009)	17 (100%)
Catfish *(Clarias* hybrid)	Catfish culture in a small plastic-lined pond for flood-rehabilitation program	I	Ban Hae subdistrict, Ang Thong province, Thailand	Pongthanapanich *et al.* (2009)	34 (30%)
Shrimp-finfish	Rotational pond culture[1] of *Penaeus monodon* or *Littopenaeus vannamei* with finfish for export	II	Thanh Bac commune, Cam Lam, Khanh Hoa province, Viet Nam	Nguyen Huu Dung *et al.* (2009)	40 (26%)
Lobster (*Panulirus ornatus*)	Marine cage/pen culture for export	II	Xuan Tu village, Van Hung commune, Van Ninh, Khanh Hoa province, Viet Nam	Nguyen Huu Dung *et al.* (2009)	38 (8%)
Black Tiger shrimp	Pond culture for export	II	Binh Dai district, Ben Tre province, Viet Nam	Kim Anh Thi Nguyen *et al.* (2009)	102
Traditional VAC (TVAC)	Integrated farming with Vuon – garden, Ao – fish pond and Chuong – livestock sty.	I	Tu Ky district, Hai Duong, Viet Nam	Mai Van Tai *et al.* (2010)	30 (30%)
Improved VAC (IVAC)	Developed based on traditional VAC system in a low productive rice field or inundated land.	I	Newly established area in Tai Son commune, Tu Ky district, Hai Duong, Viet Nam	Mai Van Tai *et al.* (2010)	30 (50%)

[1] Tilapia (*Oreochromis mossambicus)* is stocked into shrimp ponds after shrimp harvesting for the fish to feed on accumulated organic matter. After a month, barramundi (*Lates calcarifer*) fingerlings are introduced into the ponds. Barramundi grazes on tilapia and feeds on trash fish supplement provided during the last five months of the crop.

[2] This is based on the agreed working definition and characterization of SSA from the Nha Trang workshop, SSA is a continuum of: 1) systems involving limited investment in assets, some small investment in operational costs, including largely family labour and in which aquaculture is just one of several enterprises (known as Type I or rural aquaculture); and 2) systems in which aquaculture is the principal source of livelihood, in which the operator has invested substantial livelihood assets in terms of time, labour, infrastructure and capital (this was labeled as Type II SSA system) (Bondad-Reantaso and Prein, 2009).

CONTRIBUTIONS OF SSA

The Nha Trang indicator system was modified to be applicable for measuring the contribution of SSA in each of the case studies. The relative levels of contribution were evaluated for all case studies. The results are presented in Table 2. The level of contribution from each indicator was normalized into 0, 1, 2 and 3 scale (none, low, medium and high level of contribution) and then summed within each asset. The case studies show diverse contribution of SSA in terms of livelihood assets as shown in Figures 1 to 11.

All the case studies show medium to high contribution to social capital especially in fostering social harmony from sharing of farm products and resources. Contribution to natural capital for efficient use of farm material and water is obvious for Type I SSA. The contribution to physical capital is significantly high in the case of tilapia farming in the Philippines, but lower in the case of seaweed farming – the same level of contribution from the Vietnamese rotational shrimp-finfish, lobster and tiger shrimp farming cases. Among the five livelihood assets, the contribution of SSA to human capital in terms of farmer's household food security is low. However, it is evident that SSA production contributes more to food supply and income of household particularly those oriented to the export market. This corresponds to the evidence from all Type II cases where contribution to financial capital was at high level especially in improving household cash income and enhancing household economic security.

The main findings from all case studies are summarized as follows:

China: freshwater pond polyculture and integration of fish and mulberry trees on pond dikes

- Fish farmers obtained quick and stable income from immediate sales of harvests. The systems recycled energy: they improved the material flow and re-use of wastes and by-products.
- To improve the efficiency of aquaculture in the rural area, investment on infrastructure is encouraged.
- Longer contracts assured the long-term utilization of the natural resources and investments in pond maintenance and farm improvements.
- Training of younger family members would help improve the production skills and technical management of the farm. More training and assistance to the women labour will enhance women's role in aquaculture.
- There is a trend to shift from small to bigger farms in order to improve technical and management efficiency. Farmers suggested that a larger area would improve production efficiency; they would associate and work together in pond management and share their knowledge and resources. With the organization of an association, college graduates were expected to join and improve the level of management.

Philippines: Eucheuma seaweed farming and tilapia cage culture

- Seaweed farming was clearly contributing to the household income of the family and to the development of the community.
- As seaweed farmers use coastal water for free, it is important that they see the need to keep the coastal waters clean and be on guard against activities that deteriorate water quality. Mariculture activities and land-based sources of pollution are threats to the sustainability of seaweed farming.
- A stable seaweed price would be helpful to the small-scale seaweed growers.
- Seaweed growing households should be encouraged to establish a savings group and women be trained to manage such a mutual savings association.
- While seaweed farmers that have permit become members of the government fishery and aquatic resources management council, many were not aware of

this. The council can be a strong social asset for lobbying for assistance and implementing community projects.

- Tilapia cage farms, because of their high density, have been a threat to themselves and to wild fishery because of the pollution they cause on the lake waters. An order has in fact been issued to decrease the number of cages, which now impacts on the livelihood of those whose cages will be dismantled as well as on the community's income flow. A study of its impact on fishery, environment and livelihoods would better inform lake development policy.

Thailand: freshwater pond polyculture and catfish culture in small plastic-lined ponds

- Contributions to social and human capitals were relatively high. The contribution to social capital stems from the farmers' sharing of products and inputs such as labour and seed and the social harmony and bonding that sharing builds.
- Polyculture farm households placed prime importance the self-sufficiency objective over making a profit. Cost and return analysis indicated that households were more interested in the availability to sell fish to generate the needed for children's school expenses; and of fish to consume when needed, during times when captured fish are scarce and prices high. This emphasis on self sufficiency is a good example of developing resilience against sudden economic shocks.
- As farms did not have much savings, easy access to capital as well as a well-designed financial assistance program would give the small scale producers greater ability to recover from shocks, resume sustainable livelihood, and avoid further indebtedness.
- The catfish in small pond system showed that short-term and well-planned livelihood rehabilitation programme after a disaster can evolve into or be used as a platform for a long-term livelihood development strategy.

Viet Nam: shrimp-fish rotation system and lobster on-growing in cages

- SSA in Viet Nam has changed from a subsistence to a market-driven endeavour.
- SSA labour force comes not only from household members but also from rural "freelance" workers, particularly during pond/cage preparation and harvesting. Professional shrimp and/or finfish harvesting groups earn reasonable incomes from contracting these jobs.
- SSA also resulted in the establishment of service and supply business demonstrating how SSA had created new and stable jobs for the SSA households and the rural communities.

Viet Nam: tiger shrimp culture

- Shrimp farming contributed to increased employment, directly for farm jobs and indirectly for support services and downstream activities.
- Local market is a part of infrastructure required for SSA. The study site (Binh Dai district), had no local market for SSA input supplies and for selling farm output. The provincial government should invest in a local market.
- Most of the farming households sell their shrimp to middlemen instead of directly to seafood processors. The government should work with the farmer unions to establish mechanisms to strengthen cooperation between the farmers and seafood processing companies.

Viet Nam: Traditional and improved Vuon-Ao-Chuong (VAC) systems

- Land use policies, credit and market are critical to the sustainability of the farming system and the security of the household.
- Farmers' unions particularly aquaculture cooperatives play an increasing role in SSA to meet a higher market demand and improve production efficiency.

TABLE 2
Relative levels of SSA contribution among case studies in China, Philippines, Thailand and Viet Nam

Contribution	Indicators	China		Philippines		Thailand		Viet Nam				
		1. Poly-culture	2. *Fish cum mul.*	3. Tilapia	4.Sea-weed	5. Poly-culture	6. Catfish	7. Shrimp-finfish	8. Lobster	9. Tiger shrimp	10. TVAC	11. IVAC
Natural capital		**6**	**6**	**0**	**0**	**6**	**4**	**0**	**0**	**0**	**6**	**5**
1. Efficient use of materials and energy saving	Types and Number of nutrient flows	***	***	None	None	***	**	None	None	None	***	**
2. Efficient use of water	Number of farm production uses of water	***	***	None	None	***	**	None	None	None	***	***
Physical capital		**5**	**5**	**8**	**5**	**2**	**4**	**5**		**5**	**3**	**6**
3. Build up of SSA farms and farm assets in rural area	Number of SSA farms and farm areas increased over 3 years in the study area	*	*	***	*	*	-	*	**	None	None	None
	Number of SSA farms established under the flood-rehabilitation programme	-	-	-	-	-	***	-	-	-	-	-
4. Build up of rural physical assets	Types and number of rural infrastructure investment induced by SSA	***	***	**	*	None	None	***	None	***	None	***
5. More efficient use of built physical assets in rural area	Types and number of rural infrastructure investment made not purposely for SSA but also benefit SSA	*	*	***	***	*	*	**	***	**	***	***
Human capital		**4**	**4**	**1**	**0**	**5**	**5**			**0**	**6**	**6**
6. Food and nutrition security	Per capita annual consumption of fish in SSA household. (Only fish from their own SSA harvest.)	*	*	*	None	*	***	**	None	None	***	***
	SSA production contributes to food supply to society	***	***	-	-	***	**	-	-	-	***	***
7. Seasonal food security	Is there a season in a year when household relies much more on their own harvest than on fish from other sources?	None	None	None	None	*	None	None	None	None	None	None
Financial capital		**4**	**6**	**11**	**8**	**3**	**3**				**7**	**7**
8. Household cash income	% of cash income from SSA to total household cash income	**	***	***	**	*	-	***	***	***	***	***
9 Household saved expenditure on protein food items	The value of SSA harvest contributing to household's saved expenditure on protein food items.	-	-	**	-	-	**	-	-	-	-	-
10. SSA serves as a source of household economic security	Economic return from SSA to household	**	***	***	***	*	*	**	***	***	***	***
11. Contribution to provincial economy	% of economic value from SSA production to the value of production from all aquaculture in the province	-	-	***	***	*	-	-	-	***	*	*

TABLE 2 (Cont.)

Contribution	Indicators	China		Philippines		Thailand		Viet Nam				
		1. Poly-culture	2. *Fish cum mul.*	3. Tilapia	4.Sea-weed	5. Poly-culture	6. Catfish	7. Shrimp-finfish	8. Lobster	9. Tiger shrimp	10. TVAC	11. IVAC
Social capital		**11**	**10**	**12**	**10**	**12**	**16**				**16**	**17**
12. Social participation	% of farm households are active members of SSA programmes/ associations/ organizations	***	***	***	*	*	***	*	**	**	**	***
13. Women empowerment	% of number of SSA farm activities in which women take the major decision-making role	*	*	*	*	***	***	**	**	**	***	***
14. Fostering social harmony	Number of SSA households that share fish products and other farm resources	***	***	***	**	***	***	**	***	**	***	***
	Number of activities in which farmers work together as to improve the shared resources in the community (such as water system, road and reservoir)	*	*	**	-	*	*	*	***	**	**	**
15. Providing fallback employment	% of SSA farms benefit from SSA as an alternative and fallback employment and to secure the household economy.	*	*	***	***	**	-	-	-	-	***	***
	% of family labor that previously worked solely or mainly in non-SSA (incl. off-farm jobs) but now work in SSA to total family labor	*	*	-	***	**	-	***	***	-	-	-
16. Employment	Annual growth rate of employment in SSA sector.	-	-	-	-	-	-	-	-	-	***	***
17. Part of a long term livelihood strategy	% of households still farming	-	-	-	-	-	***	-	-	***	-	-
	% of households still willing to farm if the assistance of farm inputs (e.g. seed, feed and plastic lining) from government ceased.	-	-	-	-	-	***	-	-	-	-	-
18. Providing leisure	% of farmers derive leisure from SSA, as a hobby	*		-	-	-	-	-	-	-	-	-

[1] "None" is zero (scale = 0), * is low (scale = 1.0), ** is medium (scale = 2.0), *** is high contribution (scale = 3.0); "-" is not measured/ not relevant.
[2] The lists of contribution and indicators here are mainly based on the Nha Trang indicators (Nov 2008). Some were modified and/or added after the Tagaytay workshop (Aug 2009).

FIGURE 1
Contribution of SSA to Rural Development: A Case of Polyculture in Suining, Jiangsu Province, China

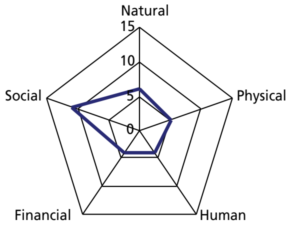


FIGURE 2
Contribution of SSA to Rural Development: A Case of Integrated Fish-Mulberry Tree in Huzhou, Zhejiang Province, China

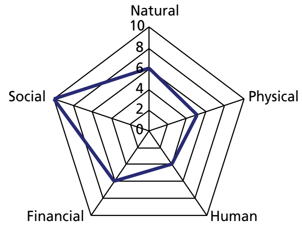


FIGURE 3
Contribution of SSA to Rural Development: A Case of Tilapia Farming in Taal Lake, Batangas Province, Philippines

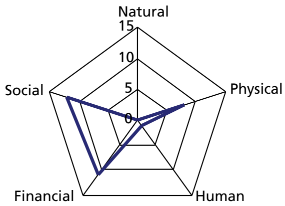


FIGURE 4
Contribution of SSA to Rural Development: A Case of Seaweed Farming in Calatagan, Batangas Province, Philippines

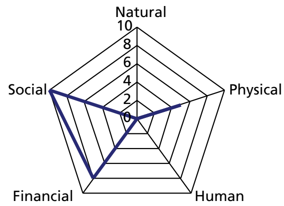


FIGURE 5
Contribution of SSA to Rural Development: A Case of Polyculture in Khlong Wua, Ang Thong Province, Thailand

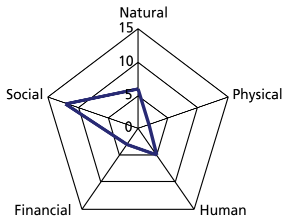


FIGURE 6
Contribution of SSA to Rural Development: A Case of Catfish Farming in Ban Hae, Ang Thong Province, Thailand

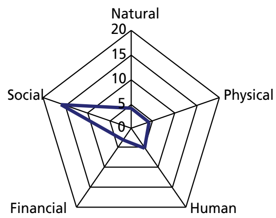


FIGURE 7
Contribution of SSA to Rural Development: A Case of Shrimp-Finfish Farming in Cam Lam, Khanh Hoa Province, Viet Nam

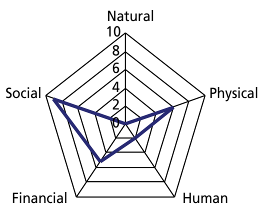


FIGURE 8
Contribution of SSA to Rural Development: A Case of Lobster Farming in Van Ninh, Khanh Hoa Province, Viet Nam

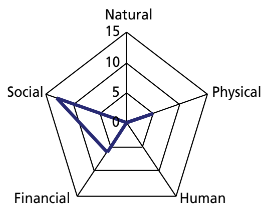


FIGURE 9
Contribution of SSA to Rural Development: A Case of Tiger Shrimp Farming in Binh Dai, Tre Province, Viet Nam, Viet Nam

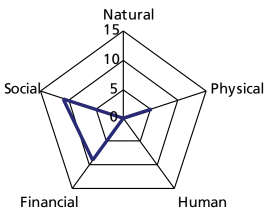


FIGURE 10
Contribution of SSA to Rural Development: A Case of Traditional VAC in Tu Ky District, Hai Duong, Viet Nam

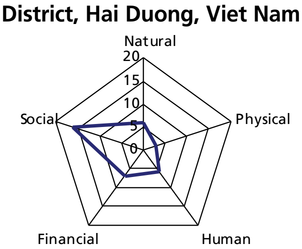
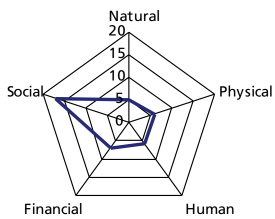


FIGURE 11
Contribution of SSA to Rural Development: A Case of Improved VAC in Tu Ky District, Hai Duong, Viet Nam



CONCLUSION

The eleven cases studies confirm the usefulness of the SLA framework to measure and analyze the contributions of SSA to sustainable rural development (SRD). The results support the recommendations of the Tagaytay workshop to modify the Nha Trang indicator system. The 14 indicators does not apply across systems, but the ones that apply are robust. The SLA framework, as shown by the results, can identify threats to and weaknesses of the SSA. It does so, not in terms of the farm as a management unit, but in terms of its being part of a livelihood strategy of the household and a component of community development.

An important observation from the case studies was that some of the contributions were hardly captured by conventional evaluation techniques. The Nha Trang SSA indicator system and SLA framework would thus provide more precise and appropriate results on which to base decision-making for interventions and for identifying investments that could give the best social and economic benefits to the community.

Especially for Type I SSA, the build-up of social, natural and human capitals are important contributions that can increase access to government services through strengthening community's ability to seek support from government and being able to use the assistance more effectively. Sharing of resources and knowledge is especially high, which is a reaffirmation of the tendency of traditional societies to rely on usually overlapping social relationships and networks for security. Because social capital reduces vulnerability, a good stock of this capital would release the energy of the community for productive activities. The significance of social, natural and human capitals raise an important issue of whether a programme to intensify and develop SSA Type I farms to a more commercial orientation may also shift the social value of sharing, prevalent in social systems where social bonds are strong, to that of competition for resources, which would probably be the dominant feature in a highly market-oriented system.

On the other hand, the more market-oriented Type II SSAs contribute significantly to financial and physical capital build up. The financial security that it provides to the households reduces vulnerabilities and increases their ability to invest more in either intensification or expansion of farm operations or both. The case of seaweed farming in the Philippines and shrimp farming in Viet Nam demonstrated that income can also be invested in other enterprises that generate more employment and more economic activities for and in the community.

The lesson for policies and programmes from the above highlighted the need to fully understand the livelihood objectives of the small-scale farmers.

It would be critical to understand their perceptions of the various risks to their livelihoods and of the strategies that they tend to adopt to manage the risks. Their risk management and mitigation options are limited by their social and economic circumstances and their livelihood assets. Knowing why they are limited would then present an opportunity to help them acquire the appropriate knowledge, skills and the practical tools to manage risks more effectively.

Equally important is to understanding problems of SSA by knowing their strengths and building on them, and understanding the opportunities that their current resources and livelihood options offer so that these could be enhanced. The case studies presented in this paper outlined some of these strengths and opportunities.

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ANNEX 1

Nha Trang small-scale aquaculture indicators

Contribution	Indicators	Explanation	Means of Verification	Methods and Data collection
Natural capital				
1. Efficient use of materials and energy saving	1. Types and Number of nutrient flows	Recycling of household and farm waste and by-product among various farm enterprises improve material use and save energy.	Farm survey - questionnaire	- Ocular observation of farm - Developing a schematic diagram with farmer that depicts material flows in the farming system - Use the RESTORE model as a template (FAO, 2009)
2. Efficient use of water	2. Number of farm production uses of water	Reuse of water in a farm indicates an efficient use of water resource. This contributes to environmental sustainability.	Farm survey - questionnaire	- Ocular observation of farm - Developing a schematic diagram with farmer that depicts the flow of water uses in the farming system.
Physical capital				
3. Build up of SSA farms and farm assets in rural area	3. Number of SSA farms and farm areas increased over 3 years in the study area	Increase of SSA farms and expansion of farm areas indicate growth in physical capitals due to SSA Remarks: - This contribution can be induced by programs not solely targeted at SSA. - The trend might be contraction.	- Key informant survey - Farm survey - questionnaire	- Discuss with village head on Number of SSA farms and farm areas increased over 3 years in the study area - Ask farmer about farm enterprises and land use changes over 3 years (2006-present)
4. Build up of rural physical assets	4. Types and number of rural infrastructure investment induced by SSA	SSA induces a building up of rural physical assets (such as water system, rural market, rural road, and energy distribution system).	- Key informant survey - Farm survey – questionnaire	- Discuss with village head on number and types of rural infrastructure investment induced by SSA - Cross-check by asking farmer about types of rural infrastructure investment induced by his/her SSA business
5. More efficient use of built physical assets in rural area	5. Types and number of rural infrastructure investment induced not purposely for SSA but benefit SSA	More sectors including SSA using the built infrastructure would lead to a more efficient use of the assets.	Farm survey - questionnaire	Ask farmer about the village infrastructure being used and shared with other households.
Human capital				
6. Food and nutrition security	6. Per capita annual consumption of fish in SSA household. (Only fish for their own SSA harvest.)	The high per capita consumption indicates a more food and nutrition security that SSA provides.	Farm survey - questionnaire	Ask farmer about the amount of fish harvest and the allocation of the harvest for household consumption that included fresh and processed products.
7. Seasonal food security	7. Is there season in a year when household much relies on their own harvest than on fish from other sources?	SSA contributes to seasonal food security if there is a season that household consumption much relies on their own fish harvest rather than on buying or fishing.	Farm survey - questionnaire	Ask farmer: - Which months in a year when farmer harvests fish for household consumption and how much for each month - Substitution fish or protein sources when farmer does not harvest fish (processed fish, get from friend and relatives, fishing, eat other proteins, etc.)

ANNEX 1 (Cont.)

Financial capital				
8. Household cash income	8. % of cash income from SSA to total household cash income	This indicates reliance of the household on SSA for its cash income i.e. liquidity	Farm survey - questionnaire	Ask farmer to indicate the percentage rather than the absolute amount of income.
9. SSA serves as a source of household economic security	9. Economic return from SSA to household	This indicates the household economic value obtained from SSA when both cash and non-cash returns/opportunity and economic forgone are considered.	Farm survey - questionnaire	- Ask farmer on economic costs and revenue from SSA operation. Cash (tangible costs and revenue) and non-cash (intangible costs and revenue) data are classified. - Cost-return analysis (PhP/ha/year)
10. Contribution to provincial economy	10. % of economic value from SSA production to the value of production from all aquaculture in the province	This measures the relative importance of SSA in provincial aquaculture sector.	Government statistics	- From the statistic data, classify the SSA systems and species in the study province - Estimate the SSA production value by systems and species - Calculate the sum of the SSA production value and the percentage can be calculated.
Social capital				
11. Social participation	11. % of farm households are active members of SSA programs/ associations/ organizations	The higher the percentage indicates the higher social participation brought by the SSA programs/ associations/ organizations	- Key informant survey - Farm survey – questionnaire	- Discuss with local official and village head on the SSA programs/ associations/ organizations existing - Ask farmer about program/ association/ organization participation and then ask about type of activities, time spent, number of meeting per year participated, cost and benefit from being member. - From the above information, the active SSA household members can be noted for the calculation of the percentage.
12. Women empowerment	12.1 % of number of SSA farm activities in which women take the major decision-making role 12.2 Role in community and community organizations	The degree to which the women are involved in various activities associated with SSA and in decision-making pertaining to SSA operations and household management; Contribution to supply chain	Farm survey – questionnaire by checklist of activities	Develop a checklist of decision-making in farm and household operation activities: 1) starting the farm business 2) taking care of the farm operation 3) buying/procuring farm inputs 4) Selling/distributing of the harvest 5) keeping income and record 6) allocating household expenses 7) borrowing money
13. Fostering social harmony	13.1 Number of SSA households that share fish products and other farm resources 13.2 Number of activities in which farmers work together as to improve the shared resources in the community (such as water system, road and reservoir)	Sharing of farm products, farm resources and cooperating in community activities foster social harmony	Farm survey – questionnaire	Interview farmer on: 1) share of the fish products and other farm resources with other community members 2) types of activities in which farmers help each other to improve the shared resources in the community
14. Providing social safety net	14. Ratio of family labors who previously worked solely or mainly in non-SSA (incl. off-farm jobs) but now work in SSA (X) to total family labors (Y)	Increase family labor in SSA indicates the importance of SSA as a fallback employment/ an opportunity to non-SSA and off farm jobs and an alternative source of income.	Farm survey - questionnaire	- Check list of family members and employment status over 3 years - Calculate X:Y ratio

Note: The Nha Trang Small-Scale Aquaculture Indicators was developed by some 25 experts who participated in the FAO Expert Workshop on Methods and Indicators for Assessing the Contribution of Small-Scale Aquaculture to Sustainable Rural Development, held from 24 to 28 November 2008 at Nha Trang University (NTU) in Nha Trang, Viet Nam. The indicator system was further developed in March 2009 and elaborated to include a detailed indicator definition (name, brief description, unit of measurement) description as well as information on its importance and relation to sustainability, what it measures and how it can be measured, now reflected in this table and which became the basis for the FAO-commissioned pilot tests carried out in the Philippines, Thailand and Viet Nam between February and July 2009.

Source: Bondad-Reantaso and Prein (2009).

Small-scale aquaculture, development and poverty: a reassessment

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Belton, B. 2013. Small-scale aquaculture, development and poverty: a reassessment. *In* M.G. Bondad-Reantaso & R.P. Subasinghe, eds. *Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development,* pp. 93-108. FAO Fisheries and Aquaculture Proceedings No. 31. Rome, FAO. 255 pp.

ABSTRACT

The potential of small-scale aquaculture (SSA) to contribute to development goals including poverty reduction and improved food security has been widely discussed. These accounts emphasize the following characteristics of SSA: the relative poverty of practising households; the subsistence or semi-subsistence nature of the activity; its role as a means of agricultural diversification; its contribution to food security; family ownership and operation of production or reliance on predominantly family labour; and utilization of small areas of land and/or water. This paper presents case studies of four systems of Asian aquaculture, all of which possess more than one of the commonly identified characteristics of SSA. Analysis of these cases suggests that conventional representations SSA have overemphasizsed certain characteristics with respect to its potential to meet development goals. At the same time, these accounts have tended to overlook other positive contributions that aquaculture can make to development, particularly through employment generation in associated value chains.

Keywords: poverty, food security, land ownership, value chain, non-farm employment.

INTRODUCTION

The term 'small-scale aquaculture' (SSA) has been used to refer to a range of production systems with very variable characteristics. The aim of this paper is to lend greater clarity to discussions surrounding SSA and its implications for poverty, development and food security among producers, consumers and actors in associated value chains in a range of geographical locations. This is achieved by reference to empirical data drawn from four case studies of inland aquaculture production in South and Southeast Asia. The author has conducted extensive research on these systems over the past seven years, and the case studies draw primarily on survey data relating to each. The systems described span a broad spectrum in terms of physical size, capital investment and operating costs, management strategies, productivity and output, ownership patterns and employment generation, their role in producer livelihood portfolios, and their impact on economic growth. The function of presenting data in this manner is to highlight the complexity of Asian inland aquaculture, catalyze clearer understandings of the activity, and encourage reconsideration of conventional characterizations of SSA and its implications for human development.

The following section of the paper gives a brief summary of the arguments advanced in favour of extending support to SSA and an overview of six of the main features identified in previous work on SSA. The third section briefly describes four Asian pond-based fish culture systems, all of which display at least some features generally understood to be indicative of SSA. These are: carp polyculture in homestead ponds in Bangladesh; Nile tilapia culture in Central Thailand; Pangasius catfish culture in Mymensingh district, Bangladesh; and Pangasius catfish culture in the Mekong Delta, Viet Nam. In the fourth section, selected empirical data derived from studies of these systems are presented with reference to each of the six features of SSA identified in section three. The final section of the paper then offers some interpretations of the role of inland Asian aquaculture in alleviating poverty, providing food security and contributing toward socioeconomic development.

CONVENTIONAL PERSPECTIVES ON SMALL-SCALE AQUACULTURE

Small-scale forms of aquaculture have received considerable attention and institutional support over the years as a means of alleviating rural poverty, improving household food security, and contributing to socioeconomic development more generally. In its most basic form, the logic for believing that SSA can accomplish these goals proceeds as follows: Aquaculture is an activity which produces food-fish and can generate cash incomes. Small-scale farmers are generally poor. Therefore, if small-scale farmers are able to adopt fish culture or to increase the technical efficiency of existing fish production, concurrent increases in levels of income and fish consumption should result and, consequently, their poverty and food insecurity should be reduced. In addition, the poor may also benefit from aquaculture through employment on the farms of better-off households or companies and in value chain activities such as seed supply and fish harvesting (Edwards, 1999). Because this argument has such a coherent logical structure, it is rarely ever questioned.

Various authors have attempted to define SSA or have written about its characteristics. These include: the relative poverty of those who practice it; its subsistence or semi-subsistence nature; its potential as a means of agricultural diversification; family ownership and operation of production; a reliance on predominantly family labour; it's potential contribution to food security and logically, given the name, utilization of small areas of land and/or water. These features and their sources are summarized in Table 1. Some of the authors listed in the table, e.g. Martinez-Espinoza (1995) and Edwards *et al.* (2002), use the alternative descriptor 'rural aquaculture', but there is much overlap between the two categories and all the authors listed have a shared interest in the potential of aquaculture of this type to generate positive development outcomes.

Most recently, an FAO workshop (Bondad-Reantaso and Prein, 2010) reworked Martinez-Espinoza's original typology (1995), concluding that SSA is a continuum

TABLE1
Characteristics of small-scale aquaculture

Characteristic	Source
Relative poverty of practising households	Edwards *et al.*, 2002; Edwards, 2000; Martinez-Espinoza, 1995; Friend and Funge-Smith, 2002
Subsistence or semi-subsistence activity	Martinez-Espinoza, 1995; Prein, 2002; Edwards and Demaine, 1997
Potential means of agricultural diversification	Martinez-Espinoza, 1995; Friend and Funge-Smith, 2002; Prein, 2002
Contributes to food security	Prein, 2002; Ahmed and Lorica, 2002; FAO, 2003
Family ownership and operation of production or reliance on predominantly family labour	De Silva and Davy, 2010; Subasinghe and Phillips, 2008
Utilization of small areas of land and/or water	Subasinghe and Phillips, 2008; Bondad-Reantaso and Prein, 2010

from, 'Type 1' systems 'involving limited investment in assets, some small investment in operational costs, including largely family labour and in which aquaculture is just one of several enterprises', to 'Type 2' systems 'in which aquaculture is the principal source of livelihood, in which the operator has invested substantial livelihood assets in terms of time, labour, infrastructure and capital' (Bondad-Reantaso and Prein, 2010). This is indicative of a recent shift under which the definition of 'small scale' has broadened to include a range of systems displaying features not previously consistent with the traditional view of what constituted rural aquaculture. De Silva and Davy's (2010) definition of SSA as 'family owned, managed and operated' also reflects this change in emphasis as it is broad enough to include nearly all operations except those owned by corporate agribusiness.

POND-BASED AQUACULTURE IN SOUTH AND SOUTHEAST ASIA: FOUR CASE STUDIES

This section briefly describes salient technical, financial and social dimensions of the four fish culture systems listed above, all of which have features which appear qualify them as either Type 1 or Type 2 SSA.

Homestead pond carp polyculture in Bangladesh

Extensive fish culture is a traditional activity in Bangladesh. Ponds were originally constructed close to homesteads for multiple purposes including drinking, bathing and other domestic uses, irrigation, watering livestock and providing earth to elevate houses above the level of flood waters. Declining availability of wild fish coincided with increasing availability of hatchery produced seed, improving transport links and market access, and promotional efforts by a number of institutions and projects during the 1980s and 1990s. These factors have contributed to a general increase in the numbers of such ponds brought under fish culture, and their deliberate management for this purpose. The uptake of improved management strategies such as regular application of feeds and fertilizers and the stocking of fish species in complementary combinations and at optimal densities and sizes remains somewhat patchy however, with producers adopting a variety of strategies depending to their knowledge, resources and inclinations.

Belton *et al.* (2012) report the median area of ponds devoted to homestead carp culture in Mymensingh to be 0.08ha. Table 2, which contains data on fish ponds from various areas of Bangladesh indicates similar findings. Ponds of this size can be adequately managed by the owner in approximately an hour or less each day, as a result of which, homestead carp culture generates no primary on-farm employment. Operating costs are comprised mainly of fingerlings and, if improved management techniques are used, small quantities of inorganic fertilizers and 'raw' feeds, most commonly rice bran and mustard oil cake purchased from off-farm. Rent is rarely incurred since ponds are normally borrow pits dug on homestead land and pond construction costs are therefore usually also incidental. Table 3 provides approximate budgets for homestead carp culture in Mymensingh. Rice cultivation usually represents the most important livelihood activity of rural households producing carp in homestead ponds (see Table 2). The activity is normally practiced for either partially or completely subsistence purposes (as opposed to being entirely commercially oriented), and therefore usually contributes only a minor, albeit potentially important, portion of household income among those who practice it. Carps produced in these systems which are not consumed at home are sold primarily through local auction markets. Despite the fact that quantities produced by individual households are small, aggregate production is very substantial because of the large numbers of producers involved. Total recorded carp production in Bangladesh in 2008 was 696 053 tonnes (FAOstat, 2010), of which a large portion would have originated from homestead pond systems.

TABLE 2
Characteristics of homestead carp culture in Bangladesh

Average pond size (ha)	Aquaculture as a % of income	Fish consumed at home (%)	Source
0.1	2.8	41	Thompson *et al.* (2006)
0.09	3	37	Thompson *et al.* (2006)
0.08	13.2	–	Winrock International (2004)
0.1	10	26	Khondker *et al.* (2010)
0.1 - 0.2	15.5	47	Karim (2006)
0.04	10	29	Hossain *et al.* (2010)
0.06	–	–	Belton *et al.* (2011a)

TABLE 3
Approximate budgets for homestead pond carp culture, Phulpur Upazila, Mymensingh

Item	Extensive	Improved-extensive	Semi-intensive
Extrapolated yield (kg/ha)	527	1860	2890
Actual yield (kg/household)	42	149	231
Per unit farmgate value ($/kg)	1.44	1.44	1.44
Operating costs ($/household)	58	163	216
Actual cash equivalent gross income ($/household)	66	215	337
Net cash income ($/household)	0	52	121
Net fish consumption (kg/household)	42	75	116

Source: Belton *et al.*, 2012.

Tilapia culture in Central Thailand

Nile tilapia was introduced to Thailand in 1965 and has since become the most important cultured fish species, accounting for 41 percent of total freshwater aquaculture production in 2007 (DOF, 2009). A large portion of this takes place in ponds located in the provinces of Central Thailand, where a suitable agroecology, good market access and a ready supply of low cost agro-industrial byproducts for use as feeds and fertilizers make for ideal culture conditions (Belton and Little, 2008). Virtually all tilapia producers in Central Thailand have a very strong commercial orientation. Management regimes are extremely diverse, but production systems falling under the semi-intensive umbrella dominate output, accounting for perhaps 75–80 percent of tilapia produced. These are managed as polycultures in which tilapia comprise the greatest percentage of stocked fish, and are fertilized, normally with pig or chicken manure. Supplementary feeds including a diverse range of cheap food processing byproducts and wastes, are widely used, but intensified production using manufactured feeds including pig pellets and formulated fish feeds for part of the growout cycle in conjunction with greenwater have emerged in the last decade in response to increasing demand for large live tilapia which command a higher value than small dead ones (Table 4). Farms span a range of sizes which reflect the resources and aims of their owners, from operations around 1ha to much larger enterprises of over 100 ha. Farms in the order of around 2–3 ha are most commonplace, with a pond area of approximately 3ha being the minimum required to maintain a reasonable standard of living for a household if fish culture represents its main source of income. The labour effort required to manage farms at the smaller end of the spectrum is quite low, being in the order of several hours per day. Larger farms employ permanent workers, often families of Burmese migrants who live on site, but overall primary employment intensity is low. Most of the fish produced is destined for urban and peri-urban markets in the Greater Bangkok Metropolitan Area. These are now quite diversified, with small (300–400 g) dead tilapia with providing cheap food for low-income-bracket consumers, and larger fish selling to a somewhat different set of customers (Belton *et al.*, 2009).

TABLE 4
Partial budgets for semi-intensive and intensified pond-based tilapia culture in Central Thailand

Item	System Type	
	Semi-intensive pond	Intensified pond
Farm area (ha)	1	10
Yield/ha (t)	6.25	7.5
Actual yield/farm (t)	6.25	75
Per unit farmgate value ($/kg)	0.47	0.73
Total costs/farm ($)	1681	37,998
Net farm income ($)	1257	16,752

Source: modified from Belton *et al.*, 2009.

Pangasius catfish culture in Mymensingh district, Bangladesh

Commercial production of non-native Pangasius catfish (*Pangasianodon hypothalamus*) began in Mymensingh in 1993, and has expanded rapidly, with estimated annual production reaching 300 000 tonnes in 2008 (Belton *et al.*, 2011b). This has caused the fish's value to decline to a present level approximately 40-50 percent lower than that typically obtained by the traditionally popular Indian major carps, and makes it the cheapest widely available fish species in Bangladesh (Little *et al.*, 2009). Pangasius are cultured intensively using artificial diets comprised of sinking pelleted feed, manufactured either in commercial feed mills or by farmers themselves using purchased machinery. Carps are also stocked in Pangasius ponds to exploit algal blooms which occur in the nutrient rich water, and account for around 15 percent of the total weight of fish harvested, thereby insulating production of the main crop of catfish against downward fluctuations in market value. Yields of Pangasius range from 15-65 tonnes/ha depending on the stocking density and length of growout cycle, which may be strategically adjusted by farmers in line with available operating capital, averaging 36.9 t/ha (Ali *et al.*, 2012) . Carps are harvested regularly during the course of grading Pangasius and are sold in local auction markets from which they are distributed both locally and throughout the country to urban centres such as Dhaka. Regular harvest of carps in this manner by netting teams provides a source of operating capital with which farm owners may purchase additional Pangasius feed. Pangasius farms create approximately two permanent on-farm jobs per hectare, and generate a great deal of additional work in ancillary activities such as pond harvesting, soil cutting and transport of feed by trishaw (three wheeled cycles). One study in a village with just 17 Pangasius farms reported the main source of income of one third of household heads to be associated with Pangasius culture in some way (Belton *et al.*, 2012). Mean pond area is 1.37 ha, although farms up to 30 ha in size exist. Fish culture almost always represents the first or second most important income stream for Pangasius farm operators, with agricultural activities often absent from, or comprising a minor component of, livelihood portfolios. The high input demands of Pangasius culture are reflected in average per hectare production costs of USD 23 790 (Haque, 2009). Per hectare net profits are USD 8 025 (see Table 5).

TABLE 5
Comparative partial budgets of Pangasius culture in Bangladesh and Vietnam

	Vietnam	Bangladesh
Mean farm area (ha)	1	1.37
Farm size range (ha)	0.1-50	0.1-30
Yield/crop/ha^{-1} (t)	370	36.9
Farmgate value/kg ($)	0.82	0.84
Production cost/crop/ha^{-1} ($)	250,000	23,790
Net return/crop/ha^{-1} ($)	45,000	8025

Source: Belton *et al.*, 2011b.

Pangasius catfish culture in the Mekong Delta, Viet Nam

Pangasius catfish have been farmed in the Mekong Delta since the 1960's. Pond-based production, of which more than 90 percent is for export (Loc *et al.*, 2009), has expanded dramatically since 2003, and has become a significant source of export earnings for Vietnam. Production now approaches the total global output of farmed Atlantic salmon, with an estimated 1.2 million tonnes with an export value of approximately USD 1.45 billion recorded for 2008 (Dung, 2008). The industry reportedly supports the livelihoods (directly and indirectly) of 105 535 individuals and provides an additional 116 000 jobs in the processing sector (Lam *et al.*, 2009). It is of particular economic importance to the Mekong Delta Region due to its geographical concentration there. Primary employment intensity generated by Vietnamese Pangasius farms is approximately 2.75 jobs per hectare. Extremely high per unit area yields of Pangasius can be obtained due to its ability to breath air, coupled to production in deep ponds (≈4m) located close to major branches of the Mekong River which allow for water exchange of around 20-30 percent daily. The average yield per crop from farms located in inland provinces of the Mekong Delta is 369.7 tonnes/ha (Sinh and Hien, 2009). If market conditions favour the production of two crops in a year it is therefore entirely feasible for a single farmer to produce well in excess of 600 tonnes of catfish per annum from a single hectare of ponds (Wilkinson, 2008). Achieving such high productivity depends upon the use of massive quantities of fish feeds, and results in operating costs of approximately USD250 000/crop/ha^{-1} (see Table 4). Margins are very slim, but the scale of investment is so great that it is still possible to achieve net returns averaging ≈ USD45 500/crop/ha^{-1}. Large losses are frequently incurred however as a result of very low per unit margins. The mean size of Pangasius farms in the Mekong Delta is variously reported at between 1 ha and 2.67 ha (Sinh and Hein, 2009; Lam *et al.*, 2009) but covers a huge range from <0.1ha to 50 ha or more. Data from the Department for Agriculture and Rural Development of An Giang Province published in Loc *et al.* (2010) suggest that very small farms predominate, with 94 percent sized less than 0.5 ha, 3 percent sized 0.5^{-1} ha, and only 3 percent of more than 1 ha. However, many of these very small farms (less than 0.1ha) produce largely or partly for domestic markets and are subject to somewhat different production economics than the export-led operations, and farms of less than 0.5 ha cumulatively contribute just 10.3 percent of total output (Loc *et al.*, 2010). Loc *et al.* (2010) also showed a 61 percent reduction in the number of farms under 0.1 ha in size between 2006 and 2008, and a 247 percent increase in those over 2 ha for the same period in An Giang Province (2010), and recent evidence suggests that the industry is undergoing a major period of consolidation in which small producers are increasingly switching to production of other species or being forced to abandon aquaculture altogether (Kheim *et al.*, 2010).

DO THE CASE STUDY SYSTEMS MATCH THE CHARACTERISTICS OF SSA?

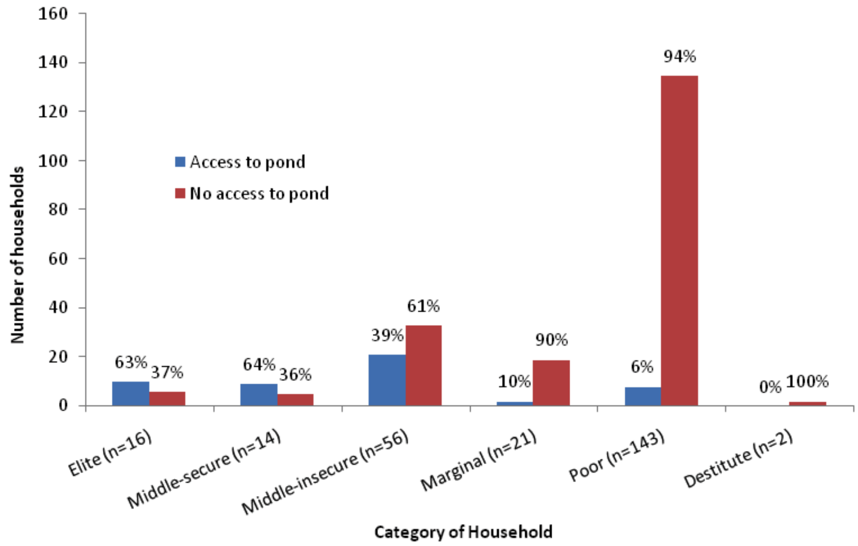
This section addresses each of the features identified in the second section of the paper as characteristic of SSA in turn, with reference to features of each of the production systems described above.

Relative poverty of practising households

Carp polyculture in homestead ponds has been widely promoted by development agencies in Bangladesh as a means of providing food and income to the rural poor. However, close to 60 percent of population is functionally landless (defined as owning <0.2 ha land). As a result, many of the poorest households own insufficient land to construct even very small ponds. This tendency is indicated in Figure 1 which details homestead pond ownership for all the households in a single village, disaggregated by wellbeing status. This shows clearly that a majority of those in higher wellbeing groups own homestead ponds, as compared to only a small proportion of those in the

FIGURE 1

Distribution by wellbeing group of households with access to a homestead pond in a Mymensingh village (n=252)



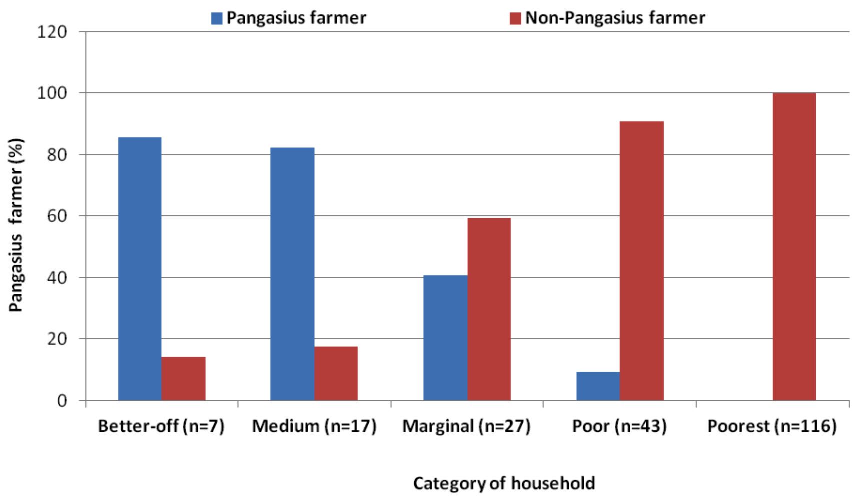
Source: Belton *et al.*, 2012.

more populous low-income groups. Thus, for the most part, conventional pond based aquaculture practiced on even this very small scale cannot be generally be considered the preserve of the "poorest of the poor".

Given that the poor in Bangladesh have difficulty in participating in even very low input homestead pond based aquaculture, they have even fewer options for direct participation as producers in Pangasius aquaculture due to the larger areas of ponds and much higher input costs involved. This is clear when one considers that the average cash equivalent net annual income from 1ha of double cropped rice would be in the order of just USD 400, as compared to per hectare operating costs of USD23 790 per crop of Pangasius. Data from one study of a village in Mymensingh shows that no households considered 'poorest', and less than 10 percent of those considered 'poor' practice Pangasius culture, whereas more than 80 percent of those in the 'better-off' and 'medium' categories do so (Ali *et al.*, 2012; see Figure 2). In Vietnam, extreme stocking

FIGURE 2

Well-being category of Pangasius and non Pangasius-farming households in Moddhovatipara village, Mymensingh, Bangladesh



Source: Ali *et al.*, 2012.

densities and associated levels of feed use mean that operating costs per ha are in the region of USD 250 000. These costs are clearly sufficient to preclude direct participation in Pangasius aquaculture by any poor households. This has led Mantingh and Dung (2008) to state that, 'Pangasius farmers cannot be considered as poor smallholders'.

The range of management options employed by tilapia farmers in Central Thailand is much more varied, ranging from small low-input ditch/dyke systems integrated with fruit production or horticulture and directly-integrated livestock/fish operations, to intensified monoculture practiced on a very large scale. General standards of living are higher than in either Bangladesh or Viet Nam, as is the availability of agricultural land. Thus there is some scope for households in relatively low income brackets to engage in fish culture, for instance for elderly former crop farmers who find it easier to manage ponds of around a hectare than to continue with more labour intensive forms of agriculture. Larger and more intensive tilapia culture tends to be practiced by moderately well-off households, although in some cases these have been able to expand from a small initial base by reinvesting profits.

All these cases tend to suggest that, contrary to one of the key assumptions in the SSA literature, in many instances only those who are at least relatively moderately well off stand a reasonable chance of participating in conventional pond based aquaculture as producers. However, for those who do participate, the benefits may be substantial. Even the lowest intensity forms of Thai tilapia culture provide average per unit area incomes approximately twice as high as those possible from rice cultivation, and Pangasius culture in Bangladesh and Vietnam generates net incomes approximately 20 times and 100 times greater than those possible from paddy.

A subsistence or semi-subsistence activity

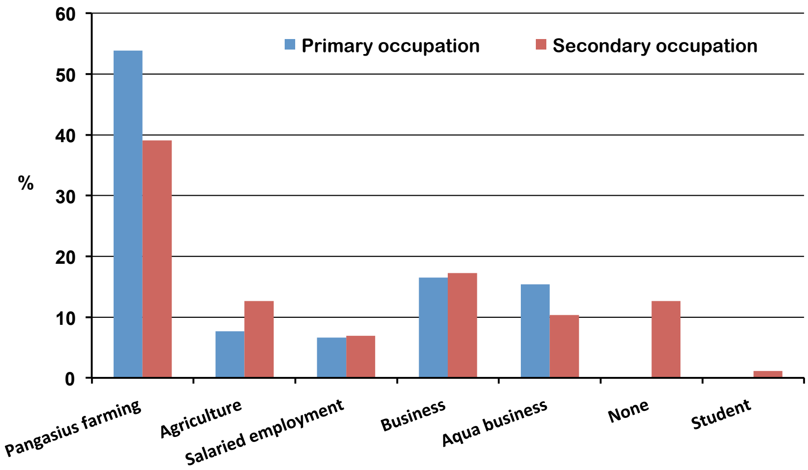
Tilapia culture in Central Thailand and Pangasius culture in Bangladesh and Viet Nam are practiced for entirely commercial purposes, with the majority of product destined for urban and international markets in the two first and final cases respectively. In contrast, production of carp in homestead ponds in Bangladesh may range from completely subsistence to largely commercial, but the household consumption of around one quarter to one half of the fish produced is probably most common (Table 3). Contributions to household incomes of this type of aquaculture are generally rather limited, amounting to less than 15 percent of the total (Table 3). Even these relatively small sums may play an important role in smoothing seasonal cash shortages associated with rice cultivation however, and can act as a form of insurance for moderately well resourced families that may reduce the likelihood of their slipping into transient poverty (Belton et al, 2012). Subsistence consumption of fish is also attractive to relatively comfortably off households in rural Bangladesh who often prefer to consume a large portion of the fish they produce for reasons of convenience and taste. This suggests that production for entirely subsistence purposes is not necessarily indicative of aquaculture practiced by the very poor as some accounts propose (e.g. Martinez-Espinoza, 1995). In fact, some evidence from Bangladesh suggests that the very poorest adopters of very small scale forms of aquaculture such as tilapia seed production in rice fields are more likely sell the fish they produce in order to generate cash incomes with which to purchase more essential items (Haque, 2007).

A potential means of agricultural diversification

A very substantial majority of homestead carp pond operators in rural areas of Bangladesh practice rice cultivation as their primary livelihood activity. For these households, the addition of aquaculture as a new activity offers a means of agricultural diversification which has the potential to increase resilience to seasonal pressures (e.g. through sales of fish to cover part of the costs of irrigated rice cultivation) and, perhaps, to other less predictable forms of stress such as the illness of a family member. Graduation from semi-subsistence homestead pond based aquaculture to more commercial forms practiced on a larger scale is relatively rare however due both to constraints (most importantly limited land and capital), and disincentives to intensification (the limited opportunity costs and risk associated with low-input homestead pond aquaculture and complementary role that this plays in rice dominated livelihood portfolios) (Belton *et al.*, 2012).

For the farmers operating each of the three other production systems discussed here, engaging in aquaculture typically represents a form of 'upgrading' in which a lower value livelihood activity is exchanged for a more profitable one, rather than a form of horizontal diversification. Contrary to what might be expected, the case studies show that many fish producers did not practice any form of agricultural activity prior to entering into aquaculture. Figure 3 suggests the relatively low importance of agriculture in the livelihood portfolios of Pangasius farmers in Bangladesh. A similar pattern also exists in Vietnam, where only 37 percent of Pangasius farmers surveyed by Belton *et al.* (2011c) had engaged in any kind of aquaculture or agriculture prior to starting catfish culture; the substantial majority of market entrants being engaged in either entrepreneurial activities or managerial positions before hand. For many of these, aquaculture represented an opportunity to expand a portfolio of business activities. In Central Thailand, shifting from rice cultivation or other types of agriculture into tilapia culture was a common pathway, but even here close to 40 percent of all market entrants had non-agrarian livelihoods before taking up fish culture, with some opting to do so as a lifestyle choice in preference to office work, or following unemployment during the financial crisis of the late 1990s. This suggests that commercial forms of aquaculture are often either entered into as entrepreneurial business opportunities, or as a form of upgrading in which one activity is deliberately exchanged for another, rather than as a means of diversifying a limited on-farm resource base. It is noteworthy that aquaculture usually occupies an important place in producer livelihood portfolios for all three of these commercial fish culture systems. Pangasius culture in Bangladesh is indicative of this tendency, representing the primary income generating activity for 54 percent of producers, and the second most important activity for 38 percent (Figure 3).

FIGURE 3
Primary and secondary occupations of Pangasius farmers in two villages in Mymensingh, Bangladesh (n=90)

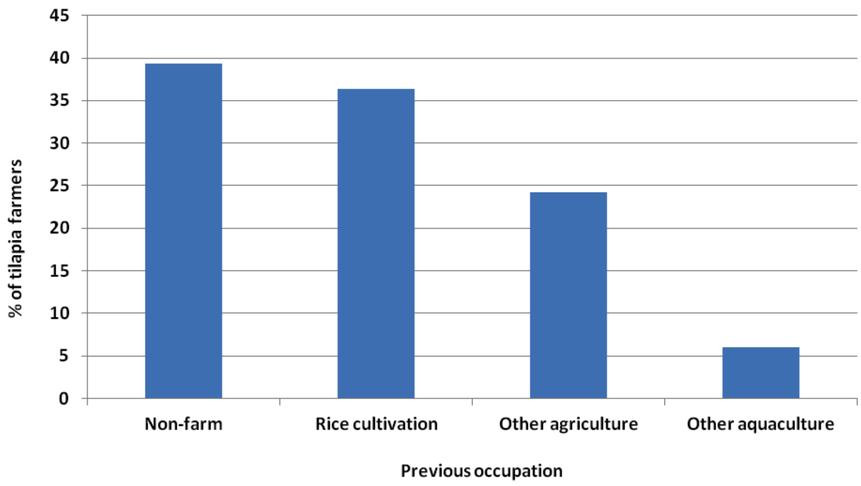


Source: Modified from Haque, 2009.

Contributes to food security

The homestead carp culture practiced in Bangladesh produces only limited marketable surpluses of fish per producing household, estimated at between 0 and 116 kg for a

FIGURE 4
Previous occupations of tilapia producers in Central Thailand



Source: Modified from data in Belton, 2006.

typical household depending on management and consumption strategies employed (see Table 2). Despite this, aggregate production is extremely large due to the huge number of borrow pits brought under fish culture. Fish produced in these systems is typically marketed locally however, possibly in part due to difficulties associated with assembling the large quantities of product required to cost-effectively export to distant urban markets from so many dispersed producers with small individual amounts of fish. Furthermore, with the exception of silver carp, the large major carps which dominate homestead polycultures are highly priced relative to other cultured fish species (although as Table 6 shows, species of wild origin now tend to be even more expensive due to diminishing supplies). This suggests that the observation of Lewis (1997) that under most circumstances the carp species produced in homestead ponds are too expensive for poor consumers to afford remains valid.

In each of the three other case studies presented here virtually 100 percent of output is produced for commercial purposes, and farms are often located in highly concentrated geographical clusters. Figure 5 indicates a downward trend in the real value of tilapia in Thailand in almost every year in which production increased. This

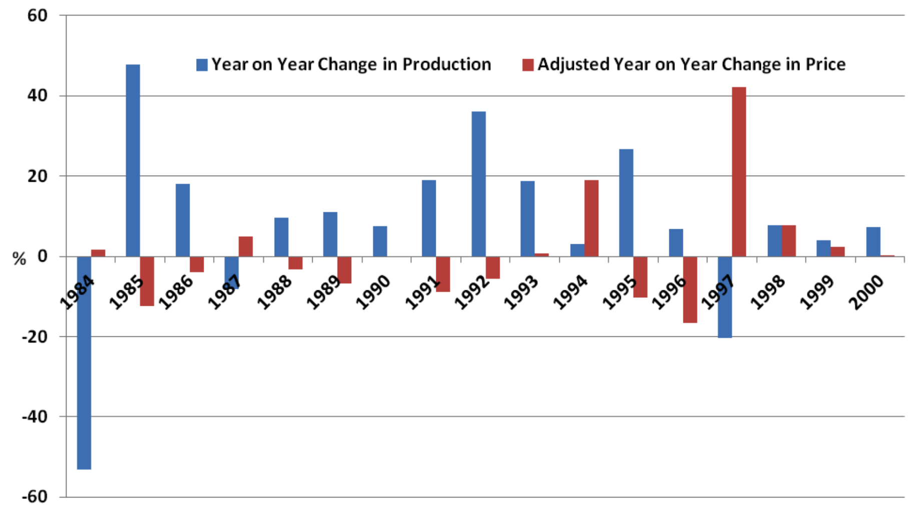
TABLE 6
Origin and average price of farmed and wild fish species from 15 markets across Bangladesh

Source*	Species	Average price (USD/kg)
Wild	Walking catfish	3.76
Wild	Stinging catfish	3.24
Wild	Climbing perch	2.85
Wild	Striped snakehead	1.77
Farm	Rohu	1.73
Wild	*Mystus tengara*	1.65
Farm	Catla	1.58
Wild	Indigenous barbs	1.19
Wild	Spotted snakehead	1.19
Farm	Mrigal	1.18
Farm	Tilapia	1.01
Farm	Silver carp	0.92
Farm	Pangasius	0.85

* Although some species reported of wild origin are also farmed (and vice versa) the designation reflects the common source in each case.

Source: adapted from Little *et al.*, 2009.

FIGURE 5
Year on year change in Thai tilapia production and inflation adjusted price/kg (1984-2000)



Source: Adapted from Belton *et al.*, 2005.

has resulted in declining real farmgate values and retail prices, greater production efficiencies on the part of producers (Belton and Little, 2008), and rising consumer demand because demand for fish is highly price elastic (Dey *et al.*, 2008). As a result, fish such as small dead tilapia in Thailand and Pangasius in Bangladesh are now among the cheapest and most widely available products nationally (Table 6), and are destined primarily for urban markets where they provide ‘fuel’ for workers in the productive sectors which make major contributions to GDP growth and may therefore contribute indirectly to the livelihoods and wellbeing of families of urban migrants from rural areas who receive remittances. At the same time, Vietnamese Pangasius has become the cheapest internationally traded whitefish, and has now diversified beyond traditional European and American markets to supply, among others, Latin America, the Middle-East, and the former Eastern Bloc countries, with the result that it thus now arguably contributes to global food security.

Family ownership and operation of production and reliance on family labour

Homestead carp culture in Bangladesh, is almost by definition, exclusively family owned and operated. The vast majority of tilapia farms in Central Thailand are also family managed, though Belton (2006) reports that it is quite common for tilapia farm owners in some in land-constrained areas close to Bangkok to construct ponds on large parcels of rented land in more distant Central Region provinces and to install live-in labourers to take care of day-to-day management activities. Ownership and management oversight by household members is also the predominant pattern for Pangasius producers in Vietnam and Bangladesh. Large operations belonging to absentee investors occur in both countries however, particularly in Viet Nam where there is a clear tendency towards greater levels of absentee ownership on larger farms, as indicated in Table 7. There is also an increasing trend toward the establishment of

TABLE 7
System of Vietnamese Pangasius farm management by size of farm (n=33)

Farm size	System of farm management		
	Self-managed (%)	Absentee owner (%)	Operated by company (%)
<1ha	79	14	7
1-3ha	50	50	0
>3ha	0	71	29

Source: Belton *et al.*, 2011c.

vertically integrated catfish farms by seafood processing companies. Although the majority of farms are owner operated, current trends suggest that large corporately owned or professionally managed farms are on the increase in Vietnam, whilst the smallest purely family operated farms are in sharp decline (Kheim *et al.,* 2010).

With the exception of harvesting, all the labour inputs into homestead carp ponds in Bangladesh are provided by household members. This is also true of smaller Thai tilapia farms, with only those farms sized 15 ha or more typically needing to employ permanent hired labour. The management intensive nature of the Pangasius culture practised in Bangladesh and Vietnam means that operations of 0.5 ha typically employ at least one permanent worker to supplement the labour of the farm owner, while larger farms employ considerably more, generating approximately 730 and 1000 man days of labour per hectare per year respectively, with family labour deployed less frequently as farm size increases.

Utilization of small areas of land

The size of homestead ponds used for carp aquaculture in Bangladesh is typically less than 0.1ha. Whilst this is certainly small in absolute terms, it must be remembered that well over half of the population possesses landholdings of 0.2 ha or less. As a result, even owners of ponds in this size class tend to possess larger total landholdings than the average for the communities where they reside. There is a great deal more variability in the areas devoted to Thai tilapia, and Vietnamese and Bangladeshi Pangasius culture, making mean farm sizes potentially misleading, and median area is a more reliable indicator of what is typical. Table 8 shows both the mean and median size of Central Thai tilapia farms and Bangladeshi Pangasius farms to be considerably larger than average agricultural landholdings in the areas where they take place. Vietnam is the exception in this regard. Productivity varies very widely between the four systems, from less than one tonne per hectare for extensive homestead carp polyculture, to around 7 tonnes/ha/yr^{-1} for Thai tilapia, and up to a possible maximum of 700 tonnes/ ha/yr^{-1} for Vietnamese Pangasius. This makes physical area a poor indicator of the scale of investment and level of production if it is considered alone.

TABLE 8

Areas under agriculture and aquaculture in three case study locations

Species and location	Mean agricultural landholding (ha)	Mean fish farm area (ha)	Median fish farm area (ha)	Fish farm area range (ha)
Tilapia, Central Thailand	3.8	21	6.2	0.2-160
Pangasius, Mymensingh	0.6	3.7[1]	1.2	0.1-50
Pangasius, Mekong Delta	1.2	1	-	<0.1-50

* This figure differs from that given in Table 5 because it includes figures from a sub-district of Mymensingh in which production takes place in large natural water bodies (beel), as well as from other sub-districts where, as is more typical, production takes place in ponds.

Source: BBS, 2002; NSO, 2004; own survey data.

DISCUSSION: TOWARD A CLEARER UNDERSTANDING OF ASIAN AQUACULTURE

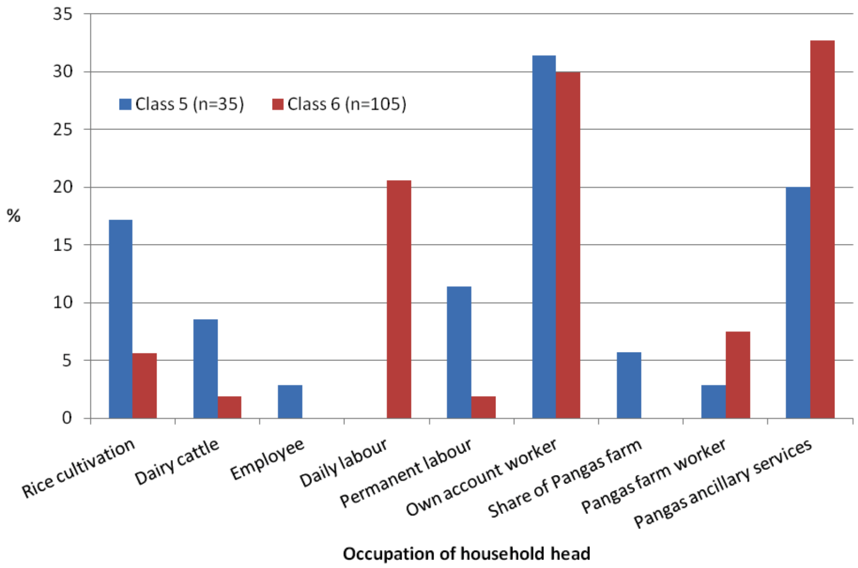
The four case studies presented above give an indication of the diversity of Asian inland aquaculture, both within and between systems and in relation to a variety of technical and economic characteristics. Despite this diversity, a number of general lessons may be drawn with respect to the degree of fit between characterizations of SSA outlined in the second section of the paper, and the empirical descriptions provided in the third and fourth sections.

One important observation arising from the four case studies is that direct entry into conventional pond-based aquaculture as producers is rarely feasible for the poor. Fish culture does not therefore usually offer a means for people to escape poverty, but rather way in which already moderately well-off or wealthy households are able to accumulate additional wealth, to maintain their position in the face of seasonal stresses, or to enhance levels of well-being conceived of in terms of satisfaction as well as in purely monetary or calorific terms. This is not to suggest that engaging in aquaculture cannot have a transformative effect on a household's socioeconomic status and security, but rather that it is most likely to leverage significant improvements for those who start from a better than average asset base.

Given that this is the case, far greater potential for the poor to benefit from aquaculture is to be found by providing services or gaining employment in associated value chains. It should be noted however that direct primary employment opportunities generated by aquaculture (i.e. on-farm labour) are generally somewhat limited. Whilst this feature makes aquaculture particularly attractive to adopters it also means that on-farm employment generation is cumulatively quite low; the entire Vietnamese Pangasius industry generating probably less than 20 000 paid farm jobs. Multiple employment opportunities are created elsewhere in the value chains of highly commercial forms of aquaculture such as the three described in this paper however, especially where farms have been established in dense geographical clusters. Figure 6 presents data on the poorest (Class 6) and second poorest (Class 5) groups of inhabitants of a village in Mymensingh in which only 17 households farm Pangasius. There is almost no participation in catfish culture as farm operators among members of Classes 5 and 6, and quite limited employment on catfish farms. However, approximately one third of all members of the poorest (and most populous) group in the community (Class 6), and 20 percent of those in Class 5 derive a significant portion of their income by providing ancillary services to Pangasius farm owners.

The size of fish culture operations documented in the four case studies that inform this paper is highly variable but, where aquaculture represents a major livelihood strategy, landholdings devoted to the activity are often larger than average agricultural landholdings. Per unit area productivity and operating costs of ponds under different systems of management also span a wide spectrum. These factors indicate that farm or pond area is a poor analog for scale of production if considered in isolation from contextual factors. The case studies presented here also show that entrants into commercial aquaculture come from a variety of backgrounds including both agriculture and the non-farm sectors, and that it is usually adopted as means to upgrade

FIGURE 6
Occupation of household heads from the two poorest well-being groups in a Mymensingh village



Source: Belton *et al*., 2012.

existing livelihood activities, or is a form of entrepreneurial investment. Contrary to what might be expected, the expansion and intensification of low intensity or semi-subsistence forms aquaculture by households already devoting small areas of land to the activity is not one of the main routes by which commercially oriented fish farmers enter into production.

Management oversight of farm operation by the farm owner and/or family members is common for all the systems described in this paper, and in many instances labour will be provided by the farming family or some of its members. However Pangasius farms of 0.5ha or more in both Bangladesh and Vietnam typically also employ hired workers; in part due to the fact that households wealthy enough to participate in this form of aquaculture can also afford to educate their children to a level where higher status forms of off-farm employment become available. It should also be noted that absentee ownership is common on larger farms for each of the three commercial systems described here. These commercial systems all produce large volumes of relatively affordable fish in areas that are well connected to urban and, in the Vietnamese case, international markets. Fish produced in these systems therefore contributes to food security at the national level. In contrast, homestead pond aquaculture in Bangladesh (which is in many respects the quintessential 'small-scale' production system) is dominated by higher value carp species. Because both consumers and producers of these species tend to be relatively better-off the impacts on wider food security may actually be somewhat limited despite very high aggregate production volumes. It is also ironic that the latter system has received substantial donor support and promotion on the basis of its theoretical capacity to alleviate poverty, whereas development of the three commercial production systems described here has occurred with limited external assistance but appears to bring a range of more significant and wider reaching societal benefits.

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Global fishery trade and its benefit to small-scale aquaculture producers

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ABSTRACT

International fishery trade crossed the USD100 billion mark and is estimated at about USD 120 million in 2011. Global fishery production (including aquatic plants) in 2011 reached 168 million tonnes, according to FAO statistics; aquaculture accounted for 47 percent of this supply while the remainder came from capture fisheries. Growing aquaculture production has supported higher food fish supplies in the domestic and international trade in Asia. Meanwhile, the strong economic growth in Asia and the on-going financial crisis in traditional developed markets are encouraging imports of food fish into Asia. While developed economies grapple through the financial crisis, developing Asia takes it in stride, making the most of the circumstances with its stronger currencies. Developed markets are turning to cheaper alternatives particularly for tropical species like pangasius and tilapia for which imports continue to grow in these markets.This works in favour of small-scale aquaculture producers.

Keywords: fishery trade, small scale producers, domestic markets, tropical species, Asia.

INTRODUCTION

Globally, consumers are becoming more frugal in their spending amidst the economic slowdown, which axed their purchasing power during the last few years. Major western markets and Japan cut back on food fish imports in 2009. Consumers in cash crunched developed economies have reduced their food budgets, making imports non-profitable under the current economic crisis. High value imports such as shrimp, non-canned tuna, salmon, cod etc suffered during the last two years. Appreciation of currencies in some exporting countries against the US dollar is also a factor making imports more expensive in the US and European markets. International fishery trade crossed the USD100 billion mark and is estimated at about USD120 million in 2011. In 2011, world aquaculture production reached 79 million tonnes. Global fishery production (including aquatic plants) in 2011 reached 168 million tonnes, according to FAO statistics, up 2.5 percent from 2010. Aquaculture contributed 47 percent to that total while the remainder came from capture fisheries. Growing aquaculture production has supported higher food fish supplies in the domestic and international trade in Asia.

OPPORTUNITIES FOR SMALL-SCALE AQUACULTURE PRODUCERS

In general, fish prices increased in the producing countries and remained high throughout 2011. As a result, many markets bought less but paid more. Quantitative imports increased marginally (+0.25 percent) in the US market but were lower in Japan and in the EU, compared with 2010. In these three markets, import bills were 13–17 percent higher than the previous year which is a reflection of higher prices for food fish worldwide. China remained the world's single largest fishery importer in quantitative imports.

In contrast, imported supplies increased significantly in most of the non-traditional/emerging markets – ranging from the largest, China to the youngest India. Supported by local demand, many of these markets also imported more high value live, fresh and prepared seafood. Malaysia's seafood imports touched almost one billion US dollar last year and crossed USD500 million each in Mexico and Indonesia.

Interestingly for many Asian domestic markets, there appears to be no real lull in demand for fishery products, despite the rising fish prices. This works in favour of small-scale aquaculture producers since imports from developed markets are slowing down. The home food budget in developing Asia, in which fish is an important protein source, was not as much affected as compared with the developed countries. High preference for fish and seafood remains a major contributing factor. A recent survey carried out by Nielsen Retailer Services, Asia Pacific revealed that consumers are not yet targeting groceries as an area to make significant savings. The strong domestic demand and better prices in Asian markets are taking away products otherwise meant for exports. The appreciation of many Asian currencies against the US dollar also supported higher prices in Asian domestic markets and imports to supplement the supply gap, a stark contrast to the trend in the US and European markets.

Regional trade agreements have been instrumental in fishery trade among Asian countries. Urbanisation and an increasing number of working women have transformed the food market in Asian developing countries. With the rise in household spending power, development of supermarkets and the cold chain, more people are having access to fishery products than before. In China, a USD585 billion stimulus fund from the government for the domestic market encouraged better access to fishery products. China imported higher quantities of Australian rock lobster last year.

Fish prices in India are rising along with increasing consumption, although it is considered not a fish-eating nation. In the 2011, Indian fishery imports increased by nearly 95 percent to USD114 million, compared with the previous year. Nearly 77 percent of these imports originated from Bangladesh. The growing hospitality industry in India continues to demand more fishery products including pangasius fillet from Vietnam for which imports are growing as well. The urban food market in India is estimated at USD70 billion and following reports of higher demand for fish in the local market recently, prices have increased. Similarly, the freshwater prawn is an important item for exports in Bangladesh, but the domestic market pays a much better price for large sizes.

SOUTHEAST ASIA – BUSINESS AS USUAL

The financial crisis has affected the high-end restaurant trade in Southeast Asia. However, business has been as usual in casual restaurants and food stalls. In addition, demand for fresh fish has increased from consumers who still prefer to cook at home where Asian seabass, tilapia, pangasius catfish, *Penaeus vannamei* shrimp, and freshwater prawn continue to be in demand. The retail price of fresh tilapia in Malaysia doubled from USD2.00/kg to USD4.50 /kg in three years. The trend is similar in the other Southeast Asian countries.

Safe and high quality aquaculture products have been in the limelight in recent years. There is now a growing demand for organic and organically grown fishery products in

Asian markets particularly among health conscious consumers. These products fetch a 30 to 40 percent price premium depending on the species. Sustainable supplies of certified chemical–free and organic fishery products can support domestic and regional fishery trade where small-scale aquaculture producers can have a bigger market share. Certified organic fishery products and chemical-free products have been successfully introduced in China, Malaysia and Thailand. Moving with consumer demand for convenience products, the cheap walking catfish *Clarias* that has always been marketed live throughout Asia is now available in cans and in several tastes and flavours.

Small-scale aquaculture in Thailand: farmer groups and aquaculture certification

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ABSTRACT

Aquaculture is a fast growing sector in Thailand with a total production of 1.29 million tonnes and valued at USD2.8 billion in 2010 (FAO, 2012a). Whiteleg shrimp is the most valuable species in the country followed by Nile tilapia, and hybrid catfish. More than 75 percent of the total aquaculture value (USD2.1 billion) comes from three shrimp species: (1) whiteleg shrimp (*Penaeus vannamei*), (2) giant tiger prawn (*P. monodon*), and (3) giant river prawn (*Macrobrachium rosenbergii*).

It is often said that the majority (80-90 percent) of shrimp farms in Thailand are considered as small-scale aquaculture (SSA). However, there are various definitions for “small-scale”. The definitions can be based, for example, on farming area (e.g. less than 10 rai[2] [1.6 ha], less than 5ha, less than 50 rai [8 ha], or production volume (e.g. production of less than 25 tonnes/year, or family based farming where production operations are handled by the family members). Therefore, shrimp SSA in the country is not clearly defined. The cost of production for SSA is often considered much higher than that of large-scale farms. However, the cost of production varies between different systems of farming, and it could be said that those less competitive farms have discontinued operations, while many other farms that are operating efficiently and profitably have increased their production.

There is a strong drive towards “Sustainable Seafood” by society which includes consumers, retailers and non-governmental organizations (NGOs). The need for certification has become increasingly important to address food safety and sustainability of aquaculture products. For this reason, various measures and schemes have been introduced to the industry in Thailand such as national regulations, private industry/ schemes, and farmer group-originated schemes. From the Thai producers’ point of

1 Author was an affiliate of Network of Aquaculture Centres in Asia-Pacific (NACA) at the time of workshop (April 2010) but transferred to FAO since November 2010.
2 Rai is Thai unit for the land measurements and equal to 1 600 square meters.

view, aquaculture certification is turning out to be a difficult issue to accept because of proliferation of schemes, cost of certification, and lack of incentives. It is important to prevent the certification scheme that would result to additional cost to farmers and become barriers to trade. Ways by which resource-poor SSA producers can participate in certification schemes should be sought to protect their livelihoods and rural communities. The Department of Fisheries (DOF) and other government agencies are providing various support to farmers in the country. One of these ongoing efforts is through a project under FAO's Technical Cooperation Programme (TCP) aimed to upgrade existing governmental certification scheme to ensure international acceptance, and to establish and implement group certification for shrimp and tilapia SSAs.

There are few promising pilot cases in the country and in the region demonstrating SSA being organized into groups to improve their technical capacities and achieving access to profitable markets. It is expected that such partnerships with producers, private sectors, and support from government establishes a sustainable business model for SSA, and shares experiences and encourages the wider adoption of group certification in Thailand and other countries in the region.

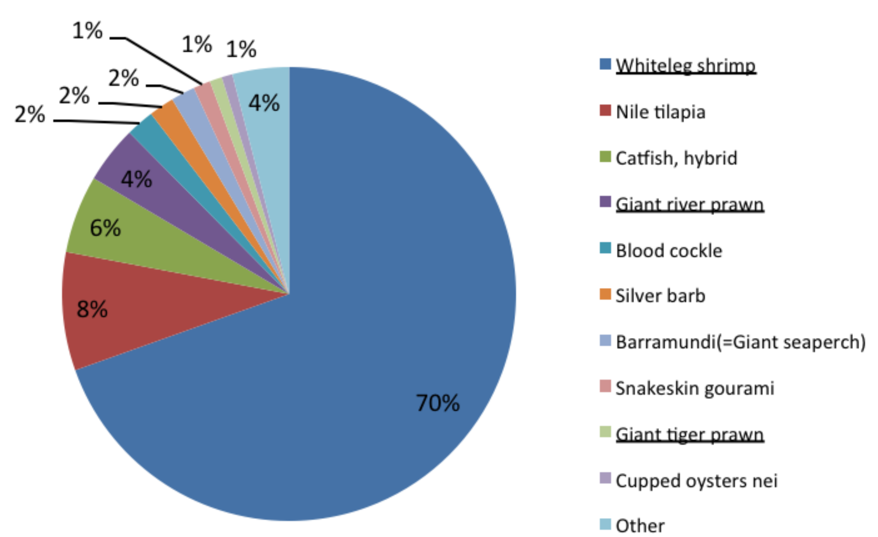
Keywords: small-scale aquaculture, farmer groups, aquaculture certification, Thailand.

INTRODUCTION

Thailand is the world's largest exporter of fisheries and aquaculture products. The value of earnings is more than USD6.2 billion in 2009 (FAO, 2012b), and it is an important contributor to economic growth of the country accounting 2.9 percent of the gross domestic product (GDP), of which 1.3 percent is from aquaculture.

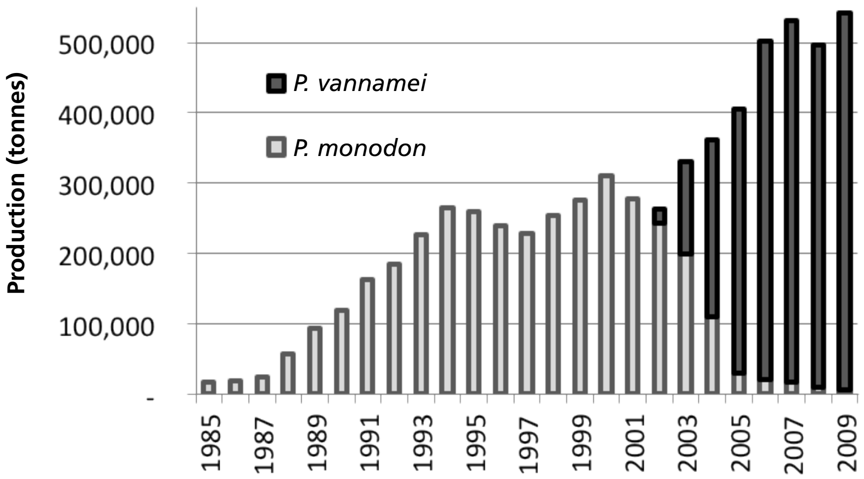
Thailand is the seventh largest aquaculture producing country in Asia, with a total production of 1.29 million tones, and value of USD2.8 billion in 2010 (FAO fish stats). Whiteleg shrimp (*Penaeus vannamei*), the most valuable species in the country, accounted for 70 percent of the total value, followed by Nile Tilapia (*Oreochromis niloticus*) – 8 percent, and hybrid catfish (*Clarias gariepinus* x *Clarias macrocephalus*) – 6 percent (Figure 1). More than 75 percent of the total aquaculture value (USD1.5 billion) comes from three shrimp species: (1) whiteleg shrimp (*Penaeus vannamei*), (2) giant

FIGURE 1
Top 10 important aquaculture species by value [percentage] in Thailand in 2012a



Source: FAO Fishstats.

FIGURE 2
Annual aquaculture shrimp production in Thailand (FAO, 2012a)



Source: FAO Fishstats.

tiger prawn (*P. monodon*), and (3) giant river prawn (*Macrobrachium rosenbergii*). Shrimp and tilapia are two important aquaculture species for Thailand, and this paper will focus extensively on shrimp, and tilapia to a lesser extent.

Thailand has a long history of shrimp farming. It started in 1943 when salt and fish farms were converted to extensive shrimp farming. In 1972, the Department of Fisheries (DOF) succeeded in breeding *P. monodon* and the culture system evolved to semi-intensive farming with the use of hatchery produced juvenile, and application of feeds in smaller ponds. Intensive shrimp farming started in the mid 1980s and coastal areas were rapidly converted to shrimp farming. The production of *P. monodon* increased significantly in the early 1990s. However the production decreased as a consequence of viral disease outbreaks. Due to sustainability issues, the Thai shrimp industry switched to the production of *P. vannamei* over the last 8 years, and the conversion was reported to be 99 percent *P. vannamei* by 2009. As a result of this species shift, intensification of the system, development of technologies and adequate support structures in the country, annual production had almost doubled in the past 8 years and total shrimp production was over 500 000 tonnes in 2009 (Figure 2).

Although there are frequent disease related mortalities, shrimp farming system and technologies are well developed in Thailand compared with other shrimp producing countries in Asia. Particularly, SSA follows sound shrimp health management which has led to the development of culture techniques that allow SSA to coexist with shrimp viruses in the culture environment. The application of extreme biosecurity measures with its consequent high investments that is often practiced in large scale aquaculture in the country is avoided.

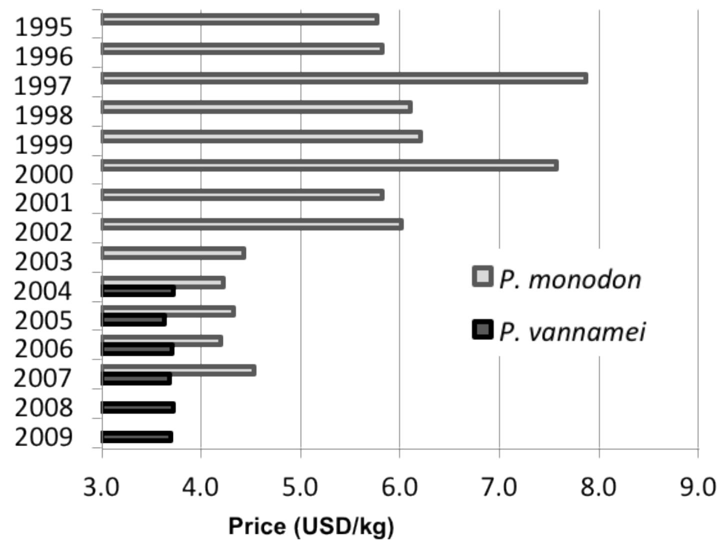
Historical shrimp price data will show a significant reduction of shrimp prices after 2002 (Figure 3). Shifting of the species cultured from *P. monodon* to *P. vannamei* has exacerbated this situation of low prices and low margins.

It is widely acknowledged that research and technology is strongly related to improving production and reducing cost of production. However, as the historical shrimp price indicates, economic aspects such as low price of shrimp and high costs of production played important roles as well.

Although there was some political instability in Thailand in 2009, the outlook on the economy has remained positive. This is reflected in the stronger Thai currency (Baht) thereby resulting to difficulties in the export of commodities which includes shrimps.

FIGURE 3

Fresh shrimp auction price at Mahachai market in Thailand



Source: Thai Union Feed mill and Thai National Center for Genetic Engineering and Biotechnology.

SMALL SCALE AQUACULTURE

According to the Department of Fisheries (DOF) in Thailand, the estimated number of operating shrimp farms in 2009 had decreased to 13 000, or even 8 000, from the registered number of 30 311 farms in 2007. The number of shrimp SSA regularly fluctuates because SSA producers often rest their ponds when economic conditions are not favorable (e.g. low market price). During this period, they focus on other livelihoods activities, and in some cases, even grow other species (e.g. Asian seabass, Tilapia) or agriculture products (e.g. palm oil tree) in the ponds.

Meanwhile, the total shrimp production of the country was slightly increasing until it reached 500 000 tonnes per year in 2009. It could be said that a large number of small-scale farms had stopped operating, while large-scale farms produced more volume. However, there are many components to be considered to prove this assumption.

It is often said that the majority (80-90 percent) of shrimp farms in Thailand is small-scale. The most common definition for "small-scale farms" is a production area of less than 10 rai (1.6 ha)[3], which is corresponding to the national effluent standards. It was common to have 3 to 4 rai shrimp ponds in Thailand during *P. monodon* dominated period. However, at present, with *P. vannamei* culture, 5 to 6 rai pond is often referred as more efficient and productive size (i.e. aeration and energy efficiency, and labor cost). Driven by the increasing average area of production per farm, other definitions for small scale farms in the country are now in use (e.g. 5 ha or 8 ha).

The Federation of Shrimp-farmer Cooperatives of Thailand (FOSCOT) defines the scale of farming by its annual production volume, and small-scale farm to be less than 25 tonnes. The middle scale is 25-250 tonnes per year, and large scale is more than 250 tonnes per year. The FOSCOT estimated that the number of farms classified into small scale is 20 percent, middle scale is 50 percent, and large scale is 30 percent.

Small scale shrimp farms in Thailand play an important role in providing livelihoods to the people, particularly in the countryside. However the local and national economic contribution of SSA is not definitive or difficult to quantify because of the

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[3] According to DOF, there is a discussion to potentially expand the area of this definition to be 15 rai (2.4 ha).

involvement of the SSA operators in other economic endeavors (e.g. agriculture and other services).

Operations of SSA are often considered as inefficient when compared with large scale farms. Large vertically integrated shrimp business operations have stated that their operation technologies have enabled them to produce shrimps with an average size of 70 pieces/kg within a 70 day culture period with a production cost of 70 THB/kg. Although this information is subject to verification, it suggests potential gaps in SSA operations since the cost of production of SSA for similar sized shrimp is at 95-100 THB/kg. On the other hand it is important to note that species alternation started in 2002, and continuous improvements of genetic application and farming technologies (e.g. biosecurity) has led to the improvement of shrimp growth and survival and consequently a reduction of cost of production.

The Thai government has supported SSA in the country through implementation of various measures (e.g. Movement Documents [MD] and Good Aquaculture Practices [GAP], regulation on water pollution, zoning to control use of salt water in inland area, protection of mangrove). The government also provides support services (e.g. disease diagnoses service, antibiotic residual test of the products, extension officers at the provincial offices, government purchasing shrimp when shrimp price is low, water quality monitoring, and subsidies of fuel).

GROUP FARMING

There are a number of aquaculture farmer groups operating in Thailand. These groups are: (1) farmer club, (2) community entity, (3) cooperative, (4) association, and (5) contract based group. Descriptions of farmer groups are detailed in Box 1. The groups conduct joint activities and complement many shortfalls that SSA normally faces. Four subject heads listed below are the summary of key functions and benefits that farmer group is bringing to the farmers.

BOX 1

Types of aquaculture farmer groups in Thailand

1. **Farmer Club** – Group formed by farmers without any legal registration. Each province has its provincial farmer clubs. Activities of these provincial clubs include regular meeting and inviting DOF and industry representatives for information concerning market trends. There are also district level farmer clubs which are located geographically close to each other and exchange information regarding water management and harvest.
2. **Community Entity** – First level of legal entity, registered with the provincial office.
3. **Cooperative** – A legal entity owned and controlled by its members and registered formally with the Ministry of Agriculture and Cooperative. It follows specific regulations including financial auditing. Agriculture cooperatives have been established for many commodities (e.g. rice, rubber, etc.).
4. **Association** – A legal entity group registered under Ministry of Interior. Association can be formed, not only by farmers, but may or may not include other segments of the industry in the same association such as processors, packers, feed manufacturers and exporters.
5. **Contract-based Group** – Number of farmers forming a group under a specific contractual agreement. Agreement could be signed between farmer groups and processors, or farmer groups and feed suppliers. These groups are increasing in number. Integrated Operation Module (IOM) by Aquaculture Certification Council (ACC) is an example where farms are centered around a processing plant.

FIGURE 4
Sun–drying shrimp pellet feed made by a shrimp farmer cooperative in the Chachoengsao province

PHOTO CREDIT: K. YAMAMOTO

FIGURE 5
Feed mill and semi-floating pellet feed extruder owned and operated by a group of tilapia farmers in Chonburi Province

PHOTO CREDIT: K. YAMAMOTO

Reducing cost of inputs

An effective measure for a group to minimise the cost of production is to jointly conduct farming activities. Feed is the most significant cost for many aquaculture operations (especially shrimp farming), and by acting as a group, SSA operators can reduce costs through the bulk purchase of feeds, use of common storage, and secure favorable credit terms with feed suppliers. There are very few farmer groups in Thailand. Figure 4 shows the members of a shrimp farmer cooperative in Chachoengsao Province sun-drying shrimp pellet feeds that they produced and sold to the members. According to the members, the price is lower and the performance is better than commercially manufactured feeds. Shown in Figure 5 are feed mill and semi-floating pellet feed extruder owned and operated by a group of tilapia farmers in Chonburi Province that manufacture pellet feed for their own use. Other cost reducing strategies include common ownership and use of equipment such as heavy machinery for pond preparation or seasonal farming equipment such as hapa for tilapia nursery.

Improve market access

Marketing linkages is a vital component for creating a strong farmer's group. Group marketing enables SSA operators to benefit from economies of scale and improves stable supply capabilities as compared with an individual SSA operator. In addition it bestows to the group greater bargaining power when negotiating with buyers. One noteworthy success story is a commercial partnership of a group of shrimp farmers (mostly SSA) that entered into a contractual arrangement with a processing plant which made it possible for the group to establish a direct supply chain to international buyers utilizing their own brand name. This, among others, not only resulted to an increase in the average price of the shrimp that the SSA operators produced but also more stable prices (20 THB/kg premium).

Another example of mutually beneficial marketing arrangements is of a tilapia farming group in Chonburi Province that owns the transporting trucks with equipment for marketing of live tilapia from farm to market (Figure 6).

Accessing services

FIGURE 6
Live tilapia transporting equipment (modified truck with plastic sheet and oxygen tank) owned by a group of tilapia farmers in Chonburi Province

The group approach can create economies of scale and volumes that enable members to be more accessible to service providers because it reduces transaction costs. Moreover, when the group is registered as a legal entity (e.g. cooperative of the Ministry of Agriculture and Cooperatives) it confers on the groups the capability to access services provided by the government and banks for loan, credit scheme, price pledge scheme (i.e. shrimp purchasing by the government at the summer periods when there is over supply), and aquaculture insurance scheme. It is important to note that the group approach has empowered the FOSCOT to actively advocate policy development (such as insurance scheme) to Government, and thus make SSA's voice heard.

Last but not least, group farming can bring and facilitate technical resources to SSA. The group can attract extension services with low transaction cost, and also set up group rules and regulations regarding farm management aimed at improving the production system. Groups also develop the financial capacity to employ a technician who, in addition to giving technical advice, can provide monitoring of water quality not only of the farming areas but also common water sources. Many groups in Thailand establish office facilities with computers to handle record keeping in digital format, which is one of the most important capacities leading to traceability and aquaculture certification.

AQUACULTURE CERTIFICATION

There is a strong drive towards "Sustainable Seafood" by the society including consumers, NGOs and especially retailers. As a way to assure buyers of the quality of the products or the conformity of processes and production methods, a number of aquaculture certifications schemes have been developed and/or adopted for implementation in Thailand.

International regulatory framework are already in place for fish health, safety and quality, such as World Trade Organization (WTO) agreements – (Sanitary and Phytosanitary [SPS] and Technical Barriers to Trade [TBT] Agreements), and Thailand has incorporated international standards such as the Codex Alimentarius Commission, International Organization for Standardization (ISO) 14001, and other FAO Code of Conduct for Responsible Fisheries Technical Guidelines into the public certification scheme. Thai quality shrimp complies with two guidelines:

1) Good Aquaculture Practice (GAP)[4] and
2) Code of Conduct (CoC).

These governmental schemes played a significant role in improving the sector, particularly on food safety issues, and went through an upgrading process in 2009 where shrimp GAP (Thai Agricultural Standard [TAS] 7401-2552) strengthened environmental standards and certification systems by separating roles between DOF and the National Agricultural Accreditation Body (ACFS) following as a model

[4] GAP standards were revised in 2009 (Code: TAS 7401-2552) and strengthen the components of environment and social responsibilities, in addition to food safety.

international instruments such as ISO65 and the FAO Technical Guidelines on Aquaculture Certification[5]. The Thai government is also providing various support to producers, particularly SSA, in the form of extension services, audit and residual testing.

In addition to the public certification schemes, a numbers of private certification schemes have been introduced (or are under development) in the aquaculture industry in Thailand. These are: Aquaculture Certification Council (ACC), GlobalGAP, Aquaculture Stewardship Council (ASC), Naturland, Sustainable Shrimp Program (SSP) and Bioshrimp. The description of existing aquaculture certification schemes in Thailand are detailed in Box 2.

The role and responsibility of public and private certification schemes are important subjects to be considered. Ideally, schemes should be coherent and complementary rather than compete with each other. Benchmarking studies (e.g. by World Wildlife Fund [WWF] in 2007[6]) and initiatives (e.g. Global Food Safety Initiative) have been developed and are addressing the issue and attempting to improve the situation. Some of the certification schemes expressed the interest to work together towards harmonization of the standards or reducing the transaction cost. For example, WWF and GlobalGAP made an agreement that aquaculture operations can be audited against Aquaculture Dialogue Standards (coordinated by WWF) by GlobalGAP accredited certification bodies in the period before the ASC is fully established and operating. Related to such harmonization efforts, the Thai DOF is participating in a pilot program to establish a mutual recognition agreement with the United States Food and Drug Administration to be a third party certification body.

For producers, particularly SSA in Thailand, aquaculture certification is not considered favorably due to proliferation of schemes, and a more substantial component of the cost of certification tends to be borne by producers rather than the retail end of the supply chain. Depending on the status of farm operations, producers need to cover not only the certification and audit costs but also a considerable amount for upgrading infrastructures and its farm management (e.g. water treatment, biosecurity, and record keeping). In addition, those certified producers are not often awarded with premium price for all the extra work and costs. However, it is important to note that there are some cases where groups of producers obtained such premium prices through contract arrangements with specific buyers.

In response to issues related to the cost of certification, ACC initiated the Integrated Operation Module (IOM) programme - a group approach consisting of a number of farmers with similar production methods and combined total annual production of less than 4 000 tonnes. The IOM arrangement enables farmers to minimize administrative requirements and its certification cost. There are dozens of IOMs established in Thailand for shrimp[7], however, it is subject to further inquiry whether SSA is participating in the aforementioned IOM. The number of farmers participating in the existing IOM are between 2 to 14, and the maximum volume set by the ACC could accommodate 14 large-scale farmers in theory, following the earlier definition given by FOSCOT (i.e. the definition for large scale is >250 tonnes production).

It is important to note that Thai DOF is working on developing and implementing group/cluster certification system in collaboration with the FAO Technical Cooperation Programme (TCP) on Certification for Small-Scale Aquaculture.

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5 FAO Technical Guidelines on Aquaculture Certification, Roma, FAO. 2011. 122 pp. www.fao.org/docrep/015/i2296t/i2296t00.htm

6 WWF. 2007. Benchmarking Study: Certification Programmes for Aquaculture: Environmental Impacts, Social Issues, and Animal Welfare.

7 List of IOM and their farms are listed at ACC website: www.aquaculturecertification.org/

BOX 2

Existing shrimp certification schemes in Thailand (as of December 2009)

GAP/COC

Department of Fisheries (DOF) of the Government of Thailand initiated Codes of Conduct (CoC) and Good Aquaculture Practice (GAP). The schemes initial commodities was shrimp, however, the coverage of GAP expanded to freshwater prawn, finfish, crabs, mollusks and frog. Development of labeling program (Q-mark) started in 2004 to identify the products that were produced from the supply chain that holds CoC.GAP for shrimp was revised in 2009 as GAP (TAS 7401-2552) and strengthen environmental standards and also certification system by separating roles between DOF and National Agirbelow Accredation Body (ACFS) following as a model the international instruments such as ISO65 and the FAO Technical Guidelines on Aquaculture certification.

Sustainable Shrimp Program (SSP)

The scheme, formally known as Surat Shrimp Program (SSP) is developed by the Surat Thani Shrimp Club in the Surat Thani province. The shrimp club, together with the Thai shrimp farmer association (the largest association in Thailand consists of shrimp farmers, processing plants, feed mills), conducts the scheme to guarantee that the product was produced by the member of the club following their standards and audited by a special committee. The SSP standards include: 1) Food safety standards to make sure there is no use of unauthorized chemicals and drugs, 2) Social standards to support local communities, 3) Environmental standards to protect mangrove and 4) Traceability and preserved frozen product specimens kept at the club's office.

Bioshrimp

The scheme was originally initiated by the Federation of Shrimp-farmer Cooperatives of Thailand (FOSCOT). In addition to the baseline provided by the GAP, the scheme has standards such as culture of shrimp with aquatic plants/seaweed in culture pond, and organic and environmental concerns in the production system. The scheme was started as a private certification for the Japanese market, however it is expanding the scope and there is an ongoing discussion towards registering under ACFS.

Best Aquaculture Practices (BAP) Program

One of the earliest and widely used Aquaculture certification scheme, Global Aquaculture Alliance (GAA) sets the Best Aquaculture Practices (BAP) standards which addresses social, environmental and food safety of shrimp aquaculture. Aquaculture Certification Council (ACC) certifies the aquaculture production system for hatcheries, feed mills, farms and processing plants for Tilapia and shrimp based on the BAP standards. A vertically integrated approach, a three star label is granted, when the products are from a BAP certified hatchery, farm and processor. Large retailers such as Wal-Mart and Darden in US and Lyons Seafood Ltd in UK are some retailers supporting the program.

GlobalGAP

GlobalGAP is a business to business arrangement, i.e. pre-farm-gate-standard and the label is therefore not directly visible for consumers. It sets voluntary standards for the certification of agricultural products. Integrated Aquaculture Assurance (IAA) is a sub group of GlobalGAP which currently certifies aquaculture salmon in Scotland and Ireland. IAA

BOX 2 (Cont.)

group has set standards for shrimp, salmon, *Pangasius,* Tilapia and other works in progress. A number of studies have been conducted to determine the feasibility in Thailand but there are no aquaculture farms in compliance with GlobalGAP standards as of 2009.

ThaiGAP

ThaiGAP is a voluntary private certification for safe and sustainable agriculture products that have passed GLOBALGAP benchmarking process. The Board of Trade of Thailand and a number of partners supported the development of this certification scheme and covers a number of fruit and vegetable products, with aquaculture products also in the pipeline. It is also important to note that there is an ongoing discussion on benchmarking ThaiGAP with the BAP program (mentioned above).

Aquaculture Stewardship Council (ASC)

ASC is one of the newly established certification and labeling program for responsibly farmed seafood. The voluntary aquaculture standards have been developed through several roundtable discussions called "Dialogues" lead by the World Wildlife Fund (WWF) with producers, buyers, nonprofit organizations and other stakeholders. The standards are aimed toward minimizing or eliminating the main environmental and social impacts caused by aquaculture. Tilapia Dialogue were completed in December 2009, and a number of dialogues are ongoing for several species such as salmon, shrimp, mollusc, and Pangasius. Number of farms in Thailand provided feedbacks towards development of Shrimp Dialogue standards, however the implementation has not been started yet.

Organic Aquaculture Farm and Product Certification Center (OAPC)

OAPC is a Thai Governmental scheme for Organic product certification, which includes aquaculture. Department of Fishery, FAO and INFOFISH conducted ajoint project that began in 2007 in Malaysia, Myanmar and Thailand to further strengthen the application of organic aquaculture, and achieved certification of black tiger shrimp (*P. monodon*), freshwater prawn (*Machrobrachium rosenbrrgii*), tilapia, and *Pangasius*.

Naturland

This organic certification scheme was founded in Germany for various agriculture products including several aquaculture commodities (trout, salmon, shrimp, tilapia, and *Pangasius*). In Thailand there are two shrimp farms that operate with well established farm design and management that are certified by this scheme (as well as OAPC) and exporting their products overseas.

CONCLUSION

Thailand is one of the leading aquaculture countries in the region. Aquaculture production of shrimp and tilapia have increased dramatically in the past decades and the value of these two commodities represents 80 percent of the national aquaculture production value in 2008. The contributing factors for this successful growth of the sector could be characterized as:

1) government commitment and political will in providing an enabling environment;

2) technological advancement led by the private sector;
3) availability of resources such as land, water and coastal fisheries;
4) entrepreneurial attitude of farmers; and
5) development of groups and associations of producers and processors with influential leaders.

It is often quoted that the aquaculture sector in Thailand is dominated by SSA that significantly contributes to socio-economic benefits for rural communities. However, this statement needs to be considered carefully because there is no official or uniform definition of SSA in the country. In addition, the sector is highly dynamic since it is being transformed rapidly by a thriving private sector and becoming more complex because of the resilient and flexible character of rural communities.

Marketing and certification schemes are increasingly discussed in the country. The Thai governmental certification scheme has significantly contributed to the improvement of the sector relative to food safety and other sustainability issues. Finally, due to the increasing pressure from the retailer end of the value chain, private certification schemes are expanding its presence in the export-oriented commodities, and domestic products to a lesser extent. With or without certification schemes, it is vital that SSA differentiate their products and integrate value-added supply chains so that they become identified as long-term business partners, as opposed to anonymous, irregular suppliers of products.

ACKNOWLEDGEMENTS

The authors would like to thank the Government of Viet Nam for hosting the expert workshop, and Food and Agriculture Organization of the United Nations (FAO) for supporting the expert workshop and the review. We are particularly grateful to the organizer Dr. Melba Reantaso for her conscientious encouragement and coordination of the work. We also acknowledge the contributions made by officers of Thai DOF, Mr. Somboon Laoprasert and Mr. Ongpat Boonchuwong, and FOSCOT President Mr. Pinyo Kiatpinyo.

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Lessons learned from the "Sustainable Aquaculture for Poverty Alleviation (SAPA)" strategy in Viet Nam

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Luu, L.T. 2013. Lesssons learned from the SAPA strategy in Viet Nam. *In* M.G. Bondad-Reantaso & R.P. Subasinghe, eds. *Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development,* pp. 125–129. FAO Fisheries and Aquaculture Proceedings No. 31. Rome, FAO. 255 pp.

ABSTRACT
The Sustainable Aquaculture for Poverty Alleviation (SAPA) strategy, formulated by national and international expert groups under the support of the Norwegian government, was aimed at enhancing the livelihoods, through aquaculture, of the poor and vulnerable people in Viet Nam, especially in the northern mountains, central highlands, north central coastal provinces and the Mekong Delta. The strategy fit well into Vietnam's Socio-Economic Development (VSED) strategy and the Hunger Eradication and Poverty Reduction (HEPR) strategy. This paper briefly describes the various policies and major achievements with the fisheries and aquaculture sector under the SAPA strategy playing a significant role. The strategy generated multi-donor support and the impact was a four-fold increase in aquaculture production to which small-scale aquaculture approximately contributed 65-70 percent to this total. Some of the important lessons include a clear pro-poor policy framework, institutional strengthening, cross-sectoral linkages and targeting the poor in terms of building their capacity and their access to public support services.

Keywords: Sustainable Aquaculture for Poverty alleviation (SAPA); small scale aquaculture, policy.

INTRODUCTION
Poverty rate in Viet Nam was dramatically decreased during the last two decades. In 1990, poverty rate in Viet Nam was around 70 percent, reduced to 58 percent in 1993 and down to 37 percent in 1998 (Center for International Economics/Australian Agency for International Development, 2002). After 10 years, the poverty rate was again decreased to 11.86 percent. Poverty reduction was the outcome of the implementation of a number of government policies, particularly the Vietnam's Socio-Economic Development (VSED) strategy in which goals for 2010 were set as: a) economic: sustainable and rapid development as a globally integrated and competitive socialist market economy and b) societal: a high quality, just and stable life for all, to be industrialized and knowledge-

based by 2020 while maintaining the best of Vietnamese tradition (WB/ADB/UNDP, 2010). The strategy "Hunger Eradication and Poverty Reduction (HEPR)" under the Ministry of Labour, Invalids and Social Affairs (MOLISA), followed by programmes and projects that support the poor to ensure food security, increase income and create employment were developed to materialize the goals of the VSED strategy. Aquaculture, especially small-scale, is considered as an effective means for poverty alleviation of the coastal, lowland and mountain communities. The sectoral fishery policies and strategy "Sustainable Aquaculture for Poverty Alleviation (SAPA)" was fitted into the HEPR and served as a tool to motivate and promote aquaculture development in the potential areas aiming to significantly increase fish production to meet domestic demand especially in the rural and mountain regions.

POLICIES IN FISHERY SECTOR AND "SUSTAINABLE AQUACULTURE FOR POVERTY ALLEVIATION (SAPA)" STRATEGY

For the last decade, the former Ministry of Fisheries had formulated a number of policies followed by development programmes and projects to fulfill the VSED strategy and HEPR. Some of them are listed as:

- Decision No. 224/1999/QD-TTg dated 08 December 1999 by the Prime Minister approving the programme for aquaculture development period 1999-2010
- Decision No. 103/2000/QD-TTg dated 25 August 2000 by the Prime Minister on some policies to support seed production of aquatic animals
- Decision No. 18/2003/QD-BTS dated 05 August 2003 by the Minister of Fisheries on function, responsibilities and organizational structure of the National Extension Center for Fisheries and Aquaculture
- Fisheries Law approved by the National Assembly on 26 November 2003
- Decision No. 257/2003/QD-TTg dated 3 December 2003 by the Prime Minister on support for investment in the construction of essential infrastructures of 157 communes in coastal fronts and islands
- Decision No. 112/2004/QD-TTg dated 23 June 2004 by the Prime Minister on approval of the programme for aquatic seed production until year 2010
- Decision No. 126/2005/QD-TTg dated 01 June 2005 by the Prime Minister on some policies to support aquaculture development in sea and islandsDecision No. 150/2005/QD-TTg dated 20 June 2005 by the Prime Minister approving the planning, restructuring agriculture, forestry, fisheries sectors throughout the country until 2010 and Vision 2020

The SAPA strategy was formulated by national and international expert groups under the support of the Norwegian government. The strategy was submitted to the Office of the Prime Minister for approval. Upon authorization of the Deputy Prime Minister, the Minister of the Ministry of Fisheries approved the strategy under decision 657/2001/QD-BTS, dated 22 August 2001. In line with the poverty alleviation goal of the HEPR, the purpose of SAPA was to enhance the livelihoods of the poor and vulnerable people through aquaculture. Specifically, the outputs of SAPA were:

- Capacity of institutions was strengthened, particularly local institutions and communities, to understand and support the livelihood objectives of the poor and vulnerable people who depend on, or who could benefit from aquaculture;
- Access of poor people to materials, information, financial and extension services and markets was improved;
- Communication among stakeholders (at all levels within and outside the sector) was improved through promotion of awareness and knowledge sharing, networking, inter-sectoral/sectoral and donor coordination, introduction of participatory planning, implementation, monitoring and evaluation approaches and informing policy development;

- Environment friendly, low-risk, low-cost aquaculture technologies and management practices were developed and adopted.

The SAPA strategy also proposed an implementation scheme and action plan with a list of proposed projects for funding.

The target groups of SAPA were the poor people in rural areas where opportunities exist to diversify and improve livelihoods through aquaculture, especially in the northern mountains, central highlands, north central coastal provinces and the Mekong Delta. An implementation scheme for the SAPA strategy has been developed to facilitate the support of various donor agencies to the aquaculture sector via multi-donor coordination (Anrooy and Evans, 2001). The strategy completely fits in the global and regional context as quoted: a)*"aquaculture should be pursued as an integral component of development, contributing towards sustainable livelihoods of poor sectors of the community, promoting development and enhancing social well-being"* and b) *"aquaculture can be an entry point for improving livelihoods, planning natural resource use and contributing to environmental enhancement"* (NACA/FAO, 2000).

SOCIO-ECONOMIC IMPACT OF THE IMPLEMENTATION OF SAPA AND OTHER POLICY IN AQUACULTURE FOR POVERTY ALLEVIATION

The clear policy framework of the sector has stirred interest among many donors and state agencies to support aquaculture development which have helped a number of the poor in rural and remote areas move out of poverty situation. Some of the donor agencies which focussed on poverty alleviation for the poor farmers through small-scale aquaculture (SSA) were the United Nations Development Programme (UNDP), the Food and Agriculture Organization of the United Nations (FAO), Swedish International Development Assistance (SIDA) and the Danish International Development Assistance (DANIDA) through the Asian Institute of Technology (AIT), the Norwegian Agency for Development Co-operation (NORAD), the Spanish Ayuda Intercambio y Desarrollo (AIDA) and Agency for International Cooperation and Development (AECID), the Australian Agency for International Development (AusAID), the Australian Centre for International Agricultural Research (ACIAR), the Finland Department for International Development Cooperation (FINIDA), the United Kingdom Department for International Development (DFID), among others. From the government side, development programmes and projects were initiated and implemented such as building infrastructure for aquaculture in the mountain provinces, special extension programme for remote areas and small scheme credit from the bank for the poor. Information about these projects can be found in several publications (UNDP, WB).

It is difficult to evaluate separately or measure the socio-economic impacts of each policy or programme on poverty alleviation and aquaculture development. The evaluation could be done indirectly through the indicators or recognition of the stakeholders. For example, a case study by Nguyen *et al.* (2004) recognized that aquaculture development (in Viet Nam) has provided good opportunities for many farmers to diversify their production and improve their living standard. The Viet Nam Household Living Standard Survey (VHLSS) conducted by the General Statistics Office (GSO) in 2002 revealed that fish ponds are increasingly common in Viet N and by now, 15 percent of rural households, both rich and poor, have at least one pond (World Bank, 2003). Many poor households, particularly in the Mekong River Delta managed to capture these new income generating opportunities and as a result have escaped from poverty. In the Annual Progress Report of 2004–2005 of the International Monetary Fund (IMF), it was also noted that the fishery sector has developed comprehensively both in terms of fishery catching and fishery cultivation. The value of fishery sector continues to grow at a strong rate and contributes over 21 percent to the total value of agriculture, forestry and fishery sector.

The annual growth rate of aquaculture production for the last decade has achieved over 10 percent, increasing from 600 000 tonnes in 1999 to 2 450 000 tonnes in 2008, SSA is approximately contributing 65-70 percent to this total.

The most prominent achievements during this period were:

- Aquaculture centers/agencies in all provinces in Viet Nam were established.
- Provincial extension centers were set up with clear function and responsibilities; different activities were conducted to support aquaculture farmers.
- Poor people in most areas were able to access small-scale credit (through the bank for the poor, foundation for employment of the rural population, training programme for rural population, etc.) and information and extension services (e.g. special extension programme for rural and remote areas).
- Infrastructure for fish seed production was constructed in the northern mountain provinces providing quality seed for farmers.
- Development projects in the northern mountains, central coastal and central plateau and Mekong Delta were funded by different donors such as UNDP, FAO, NORAD, DANIDA, FINIDA, AECID and the Vietnamese central government and provincial governments.
- On- farm research projects were funded by the central and provincial governments, as well as donors such as NORAD, DANIDA, AECID, FINIDA, ACIAR, and DFID and carried out in targeted areas.

Lessons learned

Important lessons from the SAPA strategy were:

- Clear pro-poor policy framework from the government side is in place to guide the development towards the right direction.
- Capacity of poor in addressing their poverty problems is built so that the poor can make their own solution and action plan to overcome their situation
- Implementation capacity of the involved institutions and stakeholders is sufficient to ensure that the policies are implemented to support the poor
- Strong cross-sector link (agriculture/fishery/bank/) is built to ensure that all efforts from the sectors will support the poor.
- Capacity of the poor to access public services is improved so that the poor themselves will gain benefits.

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Small-scale aquaculture in Papua New Guinea: examination of entry points for international aid donors

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ABSTRACT

Papua New Guinea (PNG) is a tropical country which is rich in resources and fertile soils, but all the key health indicators for PNG are of extreme concern. Fish farming was introduced to PNG in the 1960s, and today there are 15 000 small-scale fish farms with a production value of PNG Kina 20 million per annum. Fish farming helps improve nutrition of the family, reduces the burden on women, and provides new forms of employment for youths and communities. However, there are problems which have been holding back the industry. Substantial international programs have attempted to provide technical and scientific support to overcome bottlenecks. Programs by the Fisheries Improvement through Stocking Higher Altitudes for Inland Development of the Food Agriculture Organization of the United Nations, Japan International Cooperation Agency, Economic Union, Australian Centre for International Agricultural Research and Asian Development Bank (ADB) have been noticeable and these were carried out in collaboration with government agencies such as Na derstanding (MOU) and Memorandum of Agreement (MOA) be executed so that the roles of NFA and NDAL are clearly defined. Also, the roles of all participants and the process for transferring funds need to be determined in a collaborative way so that all participants have clear guidelines on how to implement future programs.

Keywords: Papua New Guinea, fish farming, FISHAID, HAQDEC, Aiyura, Lake Yonki, GIFT, tilapia, *Oreochromis niloticus*, common carp, *Cyprinus carpio.*

INTRODUCTION

The context of small-scale aquaculture in Papua New Guinea

Papua New Guinea (PNG) is the largest member of the tropical Pacific Island Countries (PIC) and is prominent for its rich natural resources and fertile soils. Of the 6.5 million population, more than 85 percent live in remote rural communities. Farmers generally live on about 0.1 ha of community-land (1 000 m^2) and from this they need to supply their family's entire food supply (Smith *et al*., 2007b).

Food security, poverty reduction and socio-economic development are key concerns for the people of PNG. Protein is deficient in the diet of most rural people. Local statistics from health clinics reveal that 80 percent of children are malnourished – the weight-for-age of children is 19.4 percent below the norm (Smith and Mufuape, 2007). The severity of malnutrition in rural populations is commonly expressed in high rates of infant mortality, low birth weights, slow growth and small adult body size. The recent data from the State of the World Population 2008 (United Nations Population Fund [UNFPA], 2008) confirms that all the key indicators for PNG are of extreme concern. Key indicators are low life expectancy (54.7 male, 60.4 female), high maternal mortality ratio (470), high levels of illiteracy (37 percent male, 49 percent female), high rates of births per 1000 women 15-19 yrs (51), high rates of HIV prevalence 15-19 yrs (1.8/2.0 percent), high densities of population per ha (5.1), low Gross National Income per capita ($1630), high rates of mortalities for under-5 years per 1000 (90 male/ 76 female), and poor access to improved drinking water (39 percent).

Small-scale freshwater fish farming has grown in PNG in recent times because of the introduction of genetically improved farm tilapia (GIFT), training programs and the enthusiasm and excitement among farmers (Smith *et al.*, 2009). Small-scale aquaculture (SSA) is assisting PNG by reducing poverty, providing employment for the youth, improving gender equity, providing improved nutrition and better family health, giving education opportunities, and distributing wealth in a fairer way. Farmers see fish farming as a means of improving their family's diet and as a cash crop to gain extra income. Governments in PNG also recognise that small-scale fish farming is capable of producing high quality protein and essential oils which are generally lacking in the diet of rural people. Thus, small-scale fish farming is a key component of the Food Security Program of PNG (NADP, 2007; Challacombe and Challacombe, 2007).

This paper examines the status of small-scale freshwater fish farming in PNG and the potential for providing nutritious food, socio-economic benefits and poverty alleviation. The main aim of this paper is to investigate the impacts of previous interventions by international aid donors and then outline possible entry points for donors in the future. The bottlenecks and impediments, which have often spoiled good intentions, are also analysed.

METHODOLOGY

Data was gathered from two surveys of fish farmers. The first survey of 119 questions was carried out with 313 farmers in 2001–2003. At that time common carp (*Cyprinus carpio*) was farmed in 90.7 percent of the 5400 active farms in PNG (Smith and Mufuape, 2007). A similar survey with 50 questions was carried out with 350 farmers in 2006–2008. The second survey was carried out after the distribution (in 2003) of GIFT strain of tilapia (*Oreochromis niloticus*) to fish farms and selected water bodies.

Also, information was gathered from a desktop study of the literature (Smith, 2007, Smith, 2009) and from the main fingerling production and distribution centres of Highland Aquaculture Development Centre at (HAQDEC) at Aiyura, and the National Department of Agriculture and Livestock (NDAL) Aquaculture Station at Erap.

RESULTS AND DISCUSSION

Status of fish farming in Papua New Guinea and contribution of Small-scale Aquaculture

The history of aquaculture in PNG began more than 50 years ago (Soranzie *et al.*, 2007). A total of over 25 fish species have been introduced to the rivers of PNG in order to supplement the perceived scarcity of indigenous freshwater fish species and provide food for rural communities (Coates, 1986). Common carp, rainbow trout and GIFT strain of tilapia are the three species that are currently farmed.

Survey work revealed that in 2003, there were approximately 5400 active fish farms in PNG and the annual production was valued at PNG Kina (K) 5 million (Smith *et al.*, 2007b). Common carp was farmed in 90 percent of farms and it took an average of 18 months to grow to plate size. Since the introduction of GIFT strain of tilapia to farms in 2003, there has been a rapid expansion of the fish farming industry to 15 000 active farms. In 2008, GIFT species was farmed in 80 percent of farms. The surveys indicate that the "farm gate" value of small-scale fish farming in PNG grew to K20 million in 2008 (Smith, 2009).

Most farmers were found to be inexperienced and had never received training in fish farming (Smith *et al.*, 2007b). Three kinds of fish farmers were identified in the surveys: (i) inexperienced who had not harvested (45-55 percent of farmers), (ii) established farmers (40-45 percent) and (iii) experienced, pioneer farmers (5-10 percent). Home consumption accounted for 40 percent of harvested fish, indicating that fish was an important source of protein for small-scale farmers. The median farm had only two ponds with a total area of just 60 m^2 (Figure 1). Over 70 percent of farmers have high or very high intention to construct more ponds.

The demand by small-scale farmers for common carp fingerlings currently exceeds one million per annum but HAQDEC, the only significant hatchery in PNG, is not able to meet the demand. Hence, GIFT fish has filled the gap. GIFT has significant advantages of being able to grow to plate size in five to six months, to reproduce in ponds and to grow by feeding on plankton blooms.

Because of the high percentage of lack of experience in the rapidly growing aquaculture industry, the main income of small-scale fish farmers came from sale of coffee, vegetables and a variety of other farm products (Figure 2). Off-farm income was vital for some farmers. More importantly, the survey revealed that off-farm income and fish farming were the only two variables that correlated with improving nutrition of farmers (Smith *et al.*, 2007b). When off-farm income represented 50 percent or more of the farmer's weekly income, the median frequency of eating protein (meat) was daily. When the off-farm income was 20 percent of the income, the frequency of consuming meat fell to weekly or fortnightly. For inexperienced, small-scale farmers with no off-farm income, the frequency of consuming meat was monthly. However, the frequency of eating protein increased significantly to weekly when small-scale fish farmers became experienced (Smith *et al.*, 2007b). Other activities, such as growing coffee, vegetables and coconuts, did not increase the frequency of meat in farmer's diet. In fact the data showed the opposite. Hence, fish farming was found to be a superior activity for improving the nutrition of small-scale fish farmers.

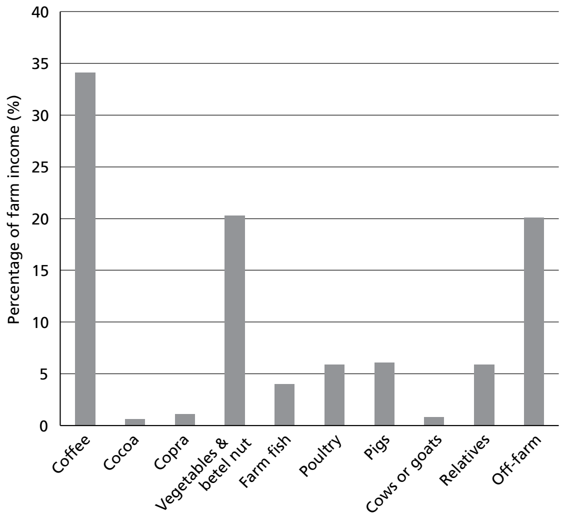
Key needs of small-scale fish farmers

From a general perspective, small-scale farmers need to access knowledge and skills that have been developed for pond-based, small-scale fish farmers in China and other Asian countries. The culture of Chinese carps, GIFT tilapia and other freshwater species is well established in those regions. Farmers need training in a husbandry package for farming GIFT and common carp. It should include appropriate knowledge and skills for breeding, fingerling transport, pond management, animal husbandry, feeding, fertilising, harvesting, post-harvest handling and marketing.

From a more specific perspective, the survey in 2001-2003 found that the culture of common

FIGURE 1
A representative small-scale fish farm in the Eastern Highlands Province of PNG. The median farm has a total area of just 60 m^2

FIGURE 2
Sources of income for small-scale fish farmers in PNG



carp was constrained by lack of husbandry training, inadequate supply of carp fingerlings, poor growth rates of common carp and the need for fish feed (Kolkolo *et al*., 2007).

Those bottlenecks still exist today, because of the lack of productive carp hatcheries (Smith *et al.*, 2006). The problem with the supply of carp fingerlings was either highly or very highly significant for 63 percent of farms in the survey. Since HAQDEC is the key provider of carp fingerlings to small-scale farmers in PNG, it is essential that fingerling production increase significantly from current levels of 25 000 fingerlings per annum in 2008 to at least 100 000 fingerlings per annum in order to at least partly meet the demand of over one million fingerlings per annum. The surveys showed that women fish farmers were eager to become trained and skilled as small-scale hatchery operators (Smith, 2009). This would be a sustainable process, independent of HAQDEC, for production and distribution of carp fingerlings throughout PNG.

The culture of GIFT fish also has its specific needs. An appropriate training program for farming GIFT is essential because tilapia are prolific breeders. Even the improved strain known as GIFT (Super tilapia), breeds at 3 months (Gupta, 2005; Anon, 2005). In PNG where GIFT fish is farmed, when farmers are not trained, there is uncontrolled breeding, poor growth and low productivity (Smith, 2009).

With regards to feed and nutrition for fish, only 10 percent of small-scale farms used manufactured pellet feeds. Further to the problem, very few farms (less than 2 percent of those surveyed) could be classified as integrated (*i.e.* using either animal or organic wastes and fertilisers to enrich blooms and improve fish nutrition). In fact, 59 percent of the farms that were surveyed did not use fertilisers at all. And when fertilisers were applied, it was done haphazardly and this occasionally resulted in fish deaths (i.e. due to high concentrations of ammonia and rapid decreases in dissolved oxygen). Also, 7 percent of farms used continuous flow-through system with the mistaken belief that clear water was good for carp and tilapia, when in fact the organic material and algal blooms were unnecessarily lost to the environment.

It is clear that there is a need for farmers to receive training on preparing and applying feeds and fertilisers. Small-scale fish farmers generally have very little disposable income, so they need to be able to prepare feeds that are based on ingredients that they can provide without expenditure or compromising the family's nutrition. The survey revealed that farmers could use a broad range of available ingredients (e.g. sweet potato, avocado, cereal, grass, banana, etc) but were uncertain as to how to prepare the feed (e.g. boil, bake, dry, etc) and when to feed. Also, the preparation of a farm-based feed requires an understanding of the nutritional value of the various ingredients that are available within the range of climates of inland PNG. Research and development (R&D) can assist in enhancing pond productivity of small-scale farms by improving existing production methods and developing strategies for enhancing pond productivity.

Poor roads, lack of infrastructure and lack of disposable income are the major reasons why farmers in the distant regions of PNG do not receive adequate extension and support. Poor infrastructure cannot be overcome in the short term. However, the approach of using farm-based training at key rural locations was recently successful in training 1450 farmers at 14 workshops across six provinces (Smith, 2009). The use of demonstration farms in remote areas has been a particularly successful technique for assisting the National Agricultural Research Institute (NARI), NDAL and other research organisations in PNG to extend R&D to small-scale farmers (rice, vanilla, coffee, etc). Local extension officers were employed and trained to coordinate activities at demonstration farms. This type of program would address the need of small-scale fish farmers in remote communities.

History of impacts of interventions by international aid donors in Papua New Guinea

In the last 50 years international aid donors have carried out substantial projects to overcome technical and scientific bottlenecks (Smith *et al.*, 2007b). The projects have: a) enhanced freshwater fish stocks and provided new species for aquaculture, b) developed infrastructure for broodstock management and fingerling production, c) improved human capacity and d) improved fish nutrition (Table 1). Programs by Food and Agriculture Organization of the United Nations (FAO), Japan International Cooperation Agency (JICA), European Union (EU), Australian Centre for International Agricultural Research (ACIAR) and Water development board (WDB) have been visible and these were carried out in collaboration with government agencies such as NFA, NDAL, Eastern Highlands Provincial Government (EHPG) and provincial governments (Smith, 2007).

TABLE 1
History of key interventions by agencies to assist fisheries and small-scale aquaculture in PNG

Period	Agency	Purpose
1949	Sir Hudson Fysh	Introduced brown trout to Western Highlands Province as a sporting fish
1955-70	Australian Colonial Administration through DASF	Build aquaculture infrastructure (eg Bonama in Pt Moresby, Dobel in Mt Hagen, HAQDEC at Aiyura) and provide various trouts, carps and tilapias to small-scale farmers. Common carp (*Cyprinus carpio*) introduced in 1958-59.
1987-89	Lutheran Development Service	Aquaculture training for farmers in Morobe, Madang and Highland Provinces
1987-93	FAO	SRFSEP (Project No. PNG/85/001) Fish stock enhancement of the Sepik River Basin
1995-7	FAO	FISHAID Project No. PNG/93/007) Introduction of 9 new species of freshwater fish
1998-2002	JICA	Cage culture of carp and GIFT in Lake Yonki
1999	Worldfish	Introduce GIFT strain of tilapia from Philippines
1995-2002	JICA	Expand HAQDEC as the national centre for fingerling production
1996-99	JICA	Running of 10 Wokabaut Skul to train 318 fish farmers.
2000-2007	ADB	Small-scale project partnership training programs in Lae (Morobe) and Goroka (EHP)
2003-5	JICA	Research fish diets based on high-protein content
2001-4	ACIAR	Determine the status of aquaculture in PNG and key issues for research
2002-2008	European Union	Set up aquaculture infrastructure at Erap, Morobe Province and assist with training
2004-2010	ACIAR – Ok Tedi	Research into farming of indigenous species in Western Province
2005-6	SPC-ACIAR	Research into fish feed and cage culture at Yonki
2005-2009	Briskanda, New Zealand	Aquaculture training
2005-2008	ACIAR	Improve fingerling production and fish nutrition: "Halpim han long pis" and 14 workshops trained 1,450 farmers.

Fish stock enhancement programs and species for aquaculture

Introductions of freshwater fish species through fish stock enhancement programs began in PNG in the 1950–1960s when brown trout and rainbow trout were introduced for sport fishing (Smith, 2007). The colonial Australian Administration encouraged villagers to construct ponds and carp fingerlings were distributed from government hatcheries, such as Bomana fish ponds in Port Moresby and Dobel fish ponds in Mt Hagen (Soranzie *et al*., 2007; Smith, 2007).

Two major fish stock enhancement programs were carried out under FAO. The Sepik River Fish Stock Enhancement Program (SRFSEP) was carried out in 1987–1993 (Zwieten, 1990). A larger program known as FISHAID introduced nine new species of freshwater fish to the rivers of PNG (Coates, 1997). There were problems which occurred in the implementation of the FISHAID project because of lack of cooperation between agencies in PNG (summarised on p. 23 Smith and Mufuape, 2007). Also. there was a lack of training and extension for officers and locals on how to catch the species that had been released into the rivers. The main species that have become widespread include snow trout (*Schizothorax richardsonii*) and redbreast tilapia (*Tilapia rendalli*), though other species are also present throughout rivers of PNG (Smith and Mufuape, 2007; Goitom, 2009).

In 1999, GIFT (also known as super tilapia) was brought to quarantine at HAQDEC. It was released to the industry in 2002–2003, though there were some preliminary trials in 2001 at Morobe Province (Smith and Mufuape, 2007). The farmers have reacted very positively to GIFT because of its fast growth rate and ability to breed in ponds.

There have been few studies of the impacts of fish stock enhancement programs or introduced species in PNG. One exception was the study of the fish species in Yonki Reservoir by Goitom (2009). Yonki is significant because it is the largest water body in the Highlands of PNG and it was the site of the release of most of the fish by FISHAID. Yonki Reservoir formed after the hydro-electric dam was constructed across the Markham River at Yonki town in 1992.

The fishery that has developed at Yonki Reservoir has a value of K2–3.5 million per year where K1 = USD0.50 (Goitom, 2009). All fish in the catches were introduced species and the species that are most commonly caught were GIFT, Golden Masheer, common carp, red-breasted tilapia and tilapia Mozambique (Goitom, 2009). Selling fish was the main source of income for fishers at Yonki Reservoir (greater than 85 percent) and fish farmers reported that the reason they fish was to mainly gain cash income. The average income of fishers was K60 to 100 per week. All fishers said that they had no formal training on fishing, and more than 75 percent said they trained themselves (Goitom, 2009).

Infrastructure projects

At Aiyura in Eastern Highlands Province, four large fish ponds were constructed in the 1960s and these were dedicated to carp farming. These facilities were known as the HAQDEC and they were expanded in 1995–1996 by JICA. Under the direction of Kiyoshi Masuda, the number of ponds increased from 4 to 40. A hatchery was constructed and carp fingerling production dramatically increased from less than 10 000 per annum to 250 000 in 1998 (Figure 3).

HAQDEC is the most important aquaculture facility in PNG. It is the last remaining aquaculture facility from the colonial days. The facility was transferred from National Fisheries Authority in 1998 to Eastern Highlands Provincial Government (EHPG) under the Organic Law. Unfortunately, funding was cut by various administrations and international donors (JICA and ACIAR) in the last decade. Fingerling production has stabilised at 50 000 fingerlings per annum (Mufuape *et al.*, 2007). In mid-2010, the administration of HAQDEC was transferred from EHPG to the District level. A public-private partnership has begun with the Kainantu community farm. The aim of the partnership is for the community to benefit through employment of youth, generation of income, support of health services, counter-funding for community projects and support for education.

Another major piece of infrastructure was built by EU and it includes 10 ponds at Erap, near Lae. These facilities are maintained by NDAL. However, the ponds rely

FIGURE 3
Views of quarantine ponds at HAQDEC, Aiyura in Eastern Highlands Province (a); Views of the hatchery used for raising common carp fingerlings at HAQDEC, Aiyurae (b)

on the underground watertable, so they dry out annually for several months. The ponds are regularly re-stocked at the start of each wet season with fingerlings from HAQDEC. Hence, HAQDEC is important to aquaculture in PNG because it is the only aquaculture facility in PNG that is capable of maintaining families of carp and GIFT broodstock and mass production of carp and GIFT fingerlings. It is also true that HAQDEC has the most experienced aquaculture staff in PNG who have worked with FAO, JICA and ACIAR from 1995–2010.

Training and improving human capacity

The remote, mountainous terrain and lack of infrastructure have made it difficult to carry out training programs for SSA in PNG, but there have been noteworthy programs. In 1987–1989, the Lutheran Development Service (LDS), with Johnney Soranzie as master trainer conducted trainings to church members in Morobe, Eastern Higland Provinces (EHP), Simbu, Western Highland Provinces (WHP), Southern Highland Provinces (SHP) and Madang Provinces.

At HAQDEC, Petrus Sagom was the officer in charge and he ran the training for integrated, subsistence farmers. Following the expansion of HAQDEC, JICA trained farmers through the "wokabaut skul" which travelled from location to location. It started in 1996 with 30 farmers and in the period 1996–1999, 10 training sessions were held and 318 farmers were trained. From 2000–2008 the Asian Development Bank (ADB) funded training through small-scale partnership programs in Morobe and EHP. Training was contracted to experienced farmers who trained the inexperienced farmers.

ACIAR began its programs in 2001 and involved HAQDEC, NFA, NDAL and the University of Western Sydney (UWS). The projects focused on developing and extending training programs in the form of a "fish husbandry package" for small-scale fish farming of GIFT tilapia and common carp. Results and achievements of the project occurred in three main themes: 1) improvements in human capacity and skills through training, 2) improvements in fingerling production and husbandry of broodstock and 3) improvements in fish nutrition. Skills were extended through 14 workshops attended by 1460 small-scale farmers (Table 1). This contributed to the expansion of the fish farming industry from 5 400 to more than15 000 in 2005–2010 (Smith, 2009).

At the workshops small-scale fish farmers were shown how to manage breeding of GIFT at their farms (Smith, 2009). Also a breeding program for common carp based on "natural spawning" eliminated the need for injecting hormones and was appropriate for the facilities of a small-scale hatchery. A total of 175 women fish farmers were trained in the technique at a Final Workshop (Smith, 2009). Farmers were encouraged to return to their villages and train their families and village communities. In essence they became "extension officers". This provided a strong multiplier effect. Therefore, training of women fish farmers should provide the greatest multiplier effect in their villages.

Improvements in fish nutrition

Prior to the expansion of HAQDEC in 1995–1997, integrated fish farming was encouraged in the Highlands of PNG. It was based on integrating ducks and other animals with pond-based culture of carps. Production of common carp in ponds fertilised with chicken manure was measured at 985 kg/ha (Smith, 2007).

The surveys showed that in many remote parts of PNG, the only sources of ingredients for fish feed are organic wastes, weeds and other alternative organic sources (Smith *et al.*, 2007b). Also, the surveys revealed that fish farmers in PNG have small ponds without aerators, water pumps or electricity (Figure 1). These factors combine to constrain the productivity of small-scale fish farms. Importantly, experience worldwide shows that fish farming without aeration and low rates of water exchange have low productivity of 1 000 kg/ha/yr (less than 5 000 kg/ha/yr).

After the expansion of HAQDEC, JICA carried out trials with fishmeal-based feeds from 1996 to 2002 in ponds at Aiyura and and cages at Yonki Reservoir (Table 1). It renewed its feed program in 2002–2005 at Goroka. Results were reported but not published (Smith, 2007; Minimulu and Yada, 2004). The growth rate of controls was approximately 40-50 percent of those for fish fed with experimental diets with high levels of protein.

ACIAR also carried out a project with experimental feed in 2005 at Yonki Reservoir. Growth rates of GIFT fish in cages was tested with various percentages of fishmeal (Hair *et al.*, 2006). In that study the control diet was mainly chicken pellets, and the experimental diet was a formulated trial feed containing 27 percent fishmeal plus other high-protein ingredients and an imported vitamin mineral pre-mix. They reported that GIFT under these conditions had "slower than expected growth and a lack of difference between experimental treatments". Also feed conversion ratios (FCR) were between 2 and 3 for both diets (Hair *et al.*, 2006). Nevertheless they concluded that the formulated experimental diet was cost effective for farmers.

Their conclusion is highly questionable because they reported that the cost of the formulated trial feed was only K1 430/tonne while the cost of chicken pellets was higher at K1 550/tonne (Hair *et al.*, 2006). This appears to be incorrect because the ingredients in the experimental diet are quite expensive. Also, the sale price of that experimental feed was really K3 200/tonne when sold by the ACIAR project at Goroka to farmers of GIFT fish. Thus, the subsidised price of ACIAR's formulated fish feed is almost K2 000/tonne higher than stated in the report.

Further, in PNG the market price of GIFT and carp is approximately K6-K8/kg (in 2009). The cost of high-protein feed for GIFT fish is K3.20/kg (current price of ACIAR's feed in the Highlands). Assuming a feed conversion ratio (FCR) of 2:1 or 3:1, it would mean that the farmer would be spending more on the feed than the farmer receives when the fish are sold.

Another project by ACIAR was carried out with various feeds and fertilisers from 2005–2008 (Smith, 2009). The project found that experienced farmers with non-aerated ponds and using fertilisation and agricultural by-products without fishmeal, produced 3 000–4 000 kg/ha/yr when fish were stocked at 2 pc/m^2. The study found that husbandry based on fertilisers and farm-based feed is economically profitable and sustainable for the small-scale fish farmer because very few ingredients need to be purchased and the farmer does not have to remove food from the family's table. The productivity could be improved by incorporating commercial chicken pellet in the last month of growout if the farmer could afford the extra expense. The findings for organic farm-based feeds are consistent with recommendations for growing fish in published reports by experts (Anon, 2006; Gupta, 2006).

In summary, all evidence demonstrates that R&D programs which have encouraged the use of fish feeds based on fishmeal, have not benefited small-scale fish farmers in PNG. Our surveys repeatedly show that high-protein feeds have not been adopted in PNG for ponds or cage culture because of the economic cost. Today there are no active cage-culture farmers at Yonki reservoir and the farmers state that they do not have money to spend on the commercial feed (Goitom, 2009). This is consistent with earlier findings that only a small percentage of farmers (about 10 percent) have enough money to buy chicken pellets to feed their fish (Smith *et al.*, 2007b). In fact it seems to be perverse to encourage small-scale fish farmers to spend scarce funds on fish feed containing 40 percent protein, when their family's diet mainly consists of carbohydrates and less than 5 percent protein.

Possible opportunities for future international aid programs

The previous sections have shown that small-scale fish farming is growing rapidly in PNG, but there are chronic problems and bottlenecks which are impeding sustainable development. Previous studies (Kolkolo *et al.*, 2007) have shown that the key issues for small-scale fish farmers are as follows:

- developing fish feeds and fertilisers which are both economic and appropriate for small-scale farmers
- providing training to farmers on pond-based fish husbandry
- providing training, particularly to women fish farmers on fingerling production and hatchery techniques
- improving infrastructure for aquaculture, particularly at HAQDEC.

There are clear opportunities for international aid donors to provide assistance. However, donors need to be confident that their assistance will have a high probability of providing lasting impacts and benefits to small-scale fish farmers and their communities. The past record in PNG shows that international projects with good intentions were either unsustainable or unsuccessful because of problems with processes of governance and bureaucracy (Smith and Mufuape, 2007; Smith 2009).

Hence programs in PNG by international donors need a climate and structure in which problems between departments and agencies are minimised. This is achievable because there are many well-motivated officers and farmers in PNG who want to collaborate and cooperate. Also, the PNG Government has recognised that fish farming is a priority for food security and poverty alleviation (NADP, 2007).

Any future international program needs to establish as a prerequisite, a Memorandum of Understanding (MOU) and a Memorandum of Agreement (MOA) between participants and agencies. This recommendation is in agreement with recent policies in PNG (NADP, 2007) which state that the main policy consideration is to:

> *"…clarify the roles of NFA and NDAL and respective Provinces through MOU/MOA.…Under the Food Security Program, NDAL links with Provincial DAL which in turn provides links to districts and LLGS to promote livestock production, processing and marketing.….Since 2004, the government has no policy on aquaculture. Though the Fisheries Management ACT (1994 and 1998) specifically identified NFA as the lead agency, no strategies were developed on aquaculture development. The 2004 Aquatic Development Policy specified commercial aquaculture but it has no definite policy on artisanal/subsistence aquaculture and the agency responsible for this, except for NDAL's implementation of programs/projects under its Food Security Programs.….The mandate to oversee fish production, processing and marketing is with NFA, but it is only concerned*

with commercial aquaculture. A MOA between NDAL and NFA should define the roles to implement inland fisheries and aquaculture programs."

Further, Aquaculture is listed as a Priority Program and the strategies for development are based on: "promoting aquaculture development for household food security and income" (item 7.3.4 NADP, 2007). Four clear and important strategies are listed which should be supported by International aid donors:

1) Develop aquaculture feed using locally available feed ingredients
2) Technical training for farmers
3) Set up hatchery to reproduce genetically improved species for distribution
4) Establish co-operative marketing arrangements.

These four issues are in general agreement with the key issues identified in surveys (Kolkolo *et al*., 2007).

In summary, NDAL has been identified as the leading organisation for promoting the Food Security Program with small-scale farmers in Provinces and Districts (NADP, 2007). Hence it is the logical institution to lead projects by international aid donors that target small-scale fish farmers. The use of a MOA and MOU to clearly define roles would minimise a repeat of the problems that have been encountered in other international projects in PNG.

With regards the key issue of fish nutrition, it is important that international aid donors base decisions on the fundamental fact that the survival of a small-scale fish farm depends on profitability. The R&D studies by JICA and ACIAR over the last 15 years have had good intention, but the fact is that fishmeal-based feeds have not been adopted by small-scale fish farmers in PNG. This is simply because those diets are not economical for the reasons given previously. International aid donors need to understand this finding so that they do not repeatedly waste their funds as well as the farmers' time and resources.

CONCLUSIONS AND RECOMMENDATIONS

Small-scale fish farming had increased from 5 400 farms with a value of production of K5 million in 2003, to 15 000 farms with a value of K20 million in 2008. This growth has occurred because of the release of GIFT fish in 2003 and R&D and farm-based training programs. The growth in small-scale fish farming is being driven by the grass roots because of the economic returns and improved nutrition for families. Women farmers report that fish farming is more profitable and less of a burden than other forms of agriculture and there are benefits in employment, especially for the youth. The increased income for families and communities is producing benefits which are spilling-over into areas of education, health and other social benefits.

Previous international programs by donors have illustrated that problems occur when projects do not have a MOU and a MOA in place before activities begin. The Government of PNG is requesting this approach and also it requires that the role of NFA for commercial farms and NDAL for small-scale fish farms be formalised by agreement (NADP, 2007). Without this process, good intentions have been spoiled because officers do not have clear agreement or understanding of their roles. This leads to a lack of cooperation and ultimately funds are not transferred to the district and provincial agencies that are implementing the project (Smith, 2009). Also, the R&D programs that encourage the use of fishmeal-based feeds have not been taken up because those feeds are not profitable for small-scale fish farming in PNG.

The Government in PNG (NADP, 2007) and surveys have identified the following four key entry points for policy-makers and international aid donors for enhancing the contribution of small-scale fish farming to food security, poverty reduction and socio-economic development:

1) Develop feeds for aquaculture and train farmers on using locally available feed ingredients which are both economical and appropriate for small-scale farmers.

2) Provide technical training for farmers on pond-based fish husbandry, as well as for women fish farmers on fingerling production and hatchery techniques.
3) Set up facilities to produce genetically improved species for distribution. This would include but not be limited to improving infrastructure at HAQDEC
4) Establish and train farmers on co-operative marketing arrangements.

International programs which address these key topics will strengthen the capacity of small-scale fish farmers to deal with threats, risks, shocks, crises and emergencies.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the generous cooperation and assistance of the fish farmers in PNG. Key people who assisted the author during his work in PNG were Mr Kine Mufuape and Mr Charlie Availe. Also, advice and help was generously provided by officers: Ms Hopa Simon, Ms Tensa Yasang, Mr Mawe Gonapa, Mr Masayan Moat, Mr Nefion Tarapi, Mr Awepster Seka, Mr Bubia Muhuju, Mr Augustine Mobiha, Mr Jacob Wani, Mr Johnney Soranzie, Mr Wally Solato, Mr Joe Alois, Mr Peter Minnimulu, Mr Billy Kerowa, Mr Douglas Kawa and staff at HAQDEC, EHPG, NFA and NDAL. Funding was provided by Australian Centre for International Agricultural Research (ACIAR) and the University of Western Sydney.

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Challenges and issues facing small-scale aquaculture producers: perspectives from Eastern Africa

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ABSTRACT

Eastern African countries have had repeated failed policies and programmes for aquaculture development since the early 1900s when the practice was first introduced by colonial governments. However, there seems to be light at the end of the tunnel as the region is witnessing growth in the aquaculture sector. For the last ten or so years, interest has been renewed in aquaculture in East Africa and further introductions of technology has increased but not of species. Aquaculture now occupies a place in the national development strategies. With the current prominence, it is important that respective plans, programmes, and legislation are developed for the sector. Aquaculture at small-scale level is starting to contribute significantly not only for animal protein dietary provisions but also as a marketable commodity for income generation. Apart from the usual global challenges of lack of quality fish seed, lack of fish feeds, poor extension or lack of appropriate information, and poverty, the Eastern Africa region has typical challenges including the lack of traditional experience for aquaculture in the region, inappropriate policies at the time of introduction of aquaculture in the region, inappropriate land tenure system and male-biased system of control of production resources, poor physical and technological infrastructure to support aquaculture development and lack of critical masses of commercial farming units to attract support related industries for aquaculture development. Over time, there have been change and several efforts were made to address specific challenges identified in a number of countries in the region. These efforts have only started to bear results for a number of countries, and we have had a revolution in the aquaculture sector with an average annual growth rate of more than 300 percent during the last 10 years. Fish seed and fish feed are now produced commercially in Kenya and Uganda, and technical information can be accessed more easily than before with increasing numbers of trained service providers or extension workers for aquaculture. Most of the countries have policies that provide for development of small-scale aquaculture producer, and have budgets with provisions for rural aquaculture development.

It has been reported by some that all "small-scale" producers in other regions are business-minded, the "small" referring most to the size of their enterprise, the enterprise nevertheless operated as a business. In the context of much of Africa, small-scale may be synonymous with "subsistence", where the activity is not operated as a business, albeit some products may be bought or sold. To address this possible confusion in terminology or classification, much of the region has adopted terminologies of systems as being "commercial" or "non-commercial", irrespective of size. In the present exercise, the older taxonomy has been used and, in the context of East Africa, the object is small-scale subsistence farmers, not to be confused with operators of micro-, small- or medium-scale aqua-businesses; the latter form the focus of much of current development efforts.

Keywords: Eastern African aquaculture, small-scale aquaculture, Kenya, Uganda, Tanzania.

INTRODUCTION

Aquaculture, in all its forms is essential to meet future demand for aquatic products in East Africa. While aquaculture is expanding to supply domestic and export markets, various issues concerning the potentially limited capacity of the East African region to promote and guide its sustainable development, in fresh, brackish, and marine environments need to be addressed. The domestic demand for fish has continued to rise with the rapid increase in population which is growing at an average of 2.47 percent per annum for Kenya, Uganda and Tanzania. More emphasis also needs to be placed on applying aquaculture for poverty reduction and economic growth.

The type of finfish aquaculture systems used in the region include ponds, tanks, raceways, recirculation units, pens and cages. Typically, the majority of freshwater fish farmers in East Africa can be characterised as smallholders who practice subsistence aquaculture using small ponds (e.g. average total water surface of less than 500 m^2), constructed and managed using unpaid family labour (Mwanja *et al*., 2005; Mushi *et al*., 2005). These management and production systems can be characterised as 'low input - low output' with little or no routine management. Stocking is usually unplanned or non-quantified, with seed sourced from neighbours, relatives, or farmer friends, at little or no cost and/or received from government agencies either for free or heavily subsidized (Mwanja *et al.*, 2005). Ponds are normally stocked once and depend on natural reproduction for replenishment. The two most common fresh warmwater species that are raised across the region are Nile tilapia (*Oreochromis niloticus*) and African catfish (*Clarias gariepinus*). Production at this level of management is usually in the range of 500 kg to 1000 kg/ha/annum (Mwanja *et al*., 2006). Also a common practice within this group, especially in ponds in wetlands, has been the sourcing of seed from the wild where they seine and stock fish of multi-species composition and age structure into their ponds.

The development of coastal aquaculture in the region dates back to the late 1970s with the establishment of a pilot farm to demonstrate the feasibility of intertidal aquaculture in Kenya.

Even though mariculture holds a great promise in East Africa as a means for further economic development, contributing to poverty alleviation and increasing food security, poor technical understanding, absence of supportive policy frameworks and weaknesses in inter-sectoral coordination continues to hinder its development. Indeed, several mariculture initiatives in Kenya and Tanzania during the last two decades have shown only limited success, in spite of promising mariculture research findings and the availability of sound models for mariculture development from other parts of the world. It should be noted, though, that Tanzania has made progress towards profitability in culturing seaweed, and is now a significant producer. Pearl farming is also developing and appears to hold some promise as are culture of mud crab and shrimp.

With growing market prices for fish, farmers' quest for profitable production, and the strong public intervention for promotion of aquaculture against a backdrop of stagnating supply from capture fisheries, has led to the entry of a new breed of farmers in some Eastern Africa countries choosing to adopt larger ponds of 1000 m^2 and more, using higher stocking densities especially for African catfish (Mwanja *et al.*, 2006). These farmers adopt a broad range of production systems including cage culture, tank-based culture, pen culture, and using improved stocking materials and diverse range of culture species. Farmers are moving away from sourcing seed from the wild and non-certified sources to established certified fish seed producers and suppliers (Mwanja, 2007). These farmers are medium- to large-scale producers comprised mainly of middle or working class farmers, whose production on a global scale would still fall in the small-scale category. They have improved their aquaculture holdings and management to levels that are now being referred to as the 'emerging commercial' aquaculture producers. At this level, we are witnessing more deliberate efforts in planning, closer working and cooperation with private technical experts for paid services, and growing fish for targeted and established markets such as export, regional and premium markets. Farmers at this level are using commercially available formulated feed and higher stocking rates as well as more pond area to meet production targets.

Emerging small-scale commercial aquaculture farms in Kenya

PHOTO BY C. NGUGI

PHOTO BY B. NYANDAT

TABLE 1
Recent aquaculture production trends

	2000	2001	2002	2003	2004	2005	20006	2007	2008
Burundi	100	100	150	200	200	200	200	200	200
Djibouti	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ethiopia	-	-	-	-	-	-	-	-	-
Kenya	512	1 009	798	1 012	1 035	1 047	1 012	4 240	4 452
Rwanda	270	435	612	1 027	386	386	400	4 038	
Somali	-	-	-	-	-	-	-	-	
Sudan	1 000	1 000	1 600	1 600	1 600	1 600	1 600	1 950	
Tanzania	7 210	7 300	7 630	7 002	6 011	6 010	330	410	
Uganda	820	2 360	4 915	5 500	5 539	10 817	32 392	51 110	72,300

Source: Country Fisheries Statistics Bulletins.

Challenges for small-scale aquaculture producers

Although the importance of aquaculture in the region is widely recognized, it is still a long way from meeting the present or future demands for fish and much remains to be addressed. The development of production systems that can meet these demands face a number of major challenges, some of which are discussed below.

Dadzie (1992) asserted that the main constraints to aquaculture in Eastern Africa are biological, infrastructural and economical. The inability of the region to tap its natural aquaculture potential is also affected by limitations on the quality of aquatic organisms farmed, the technologies employed to harness the potential of these farmed species and the inability of farmers to economically invest and operate aquaculture enterprises. These constraints loosely translate into inadequate supply of quality seed, lack of affordable quality feed, inadequate and inappropriate technical advice/information, and use of inappropriate production systems: in short, the "big five" omnipresent constraints – lack of access to quality and affordable feed, seed, information along with access to optimal markets (Mushi *et al*., 2005; Mwanja *et al.*, 2005). Clearly in Eastern Africa, as throughout the region, these traditional challenges remain. Most small-scale production remains unplanned, using inappropriate production systems and methodologies. To address this gap, government extension services are inadequate to provide the services required by farmers. The seed is of poor quality, the feed, if used, is based on home and farm by-products since most farmers cannot afford to buy milled feeds on regular basis. There is, therefore, a need for aquaculture research to tackle these concerns/constraints and generate solutions targeted specifically for smallholders.

Specific challenges that apply to East Africa include: the lack of fish culture tradition, land tenure issues, in some cases lack of successful stories/examples of aquaculture production and farming systems (Rutaisire *et al*., 2009) and lack of critical mass to meet the necessary threshold for aquaculture to blossom. As a result, most fish farming is in the form of subsistence small-scale production practiced together with a multitude of other equally small-scale farming activities including both crop and livestock husbandry. It is important to have aquaculture technologies that can be integrated into these mixed agriculture farming systems with little or no specialised management skills required.

As small-scale farmers produce largely for subsistence, classified as rural poor who own and manage low input–low output systems on a non-monetary basis (Rutaisire *et al*., 2009; Mwanja *et al.*, 2005), any aquaculture systems extended to this category of farmers must, at least in the initial phase, rely on non-monetary means to access the required inputs and technical advice. Critically tied to this challenge is the issue of land tenure. Small-scale farmers may not own land but may either rent, share crop, or farm on public or communally-owned land. Under these conditions, land security and ownership are weak and do not allow farmers to engage in expansive or long-term investments. With this high degree of uncertainty, these farmers generally only engage in annual food crops which allow for maximum mobility if needed. Therefore plans to develop and improve aquaculture production for these farmers, who tend to be scattered over great distances, need to take in consideration such challenges.

The lack of the necessary guidelines and management skills/technologies had been highlighted by several recent proposals for large-scale investment in mariculture. Without a planning framework (e.g. allocation of areas for various uses such as aquaculture, fisheries, tourism, transport, biodiversity conservation, industry, urban development and energy), coastal protection and conservation can be significantly challenged. In order to help resolve the most fundamental issues that now constrain sustainable mariculture development in East Africa, drawing up national mariculture development plans that integrate both poverty alleviation and natural resource management strategies are needed, and must be complemented by development of targeted mariculture guidelines that promote environmental sustainability as well as economic viability.

The increasingly erratic and unpredictable climate is also proving to be a major challenge for small-scale aquaculture (SSA) in East Africa. Climate change is expected to disrupt ecosystems and hence aquaculture productions on a devastating scale in the years ahead. Global warming and the consequent increase in water temperature are already impacting significantly and negatively on aquaculture in the region. Differential warming between land and oceans and between polar and tropical regions are already affecting the intensity, frequency and seasonality of climate patterns (e.g. El Niño) and extreme events (e.g. floods, droughts, storms) are affecting the stability of marine and fresh water resources adapted to or affected by these events (FAO, 2008). This has unpredictable consequences for aquatic production. The smallholder group of farmers normally does not have the safeguards to depend on, guard against or ameliorate such natural calamities (World Food Centre, 2009). In East Africa, floods and drought are now major concerns as they affect aquaculture in terms of destroying ponds, with fish escaping into the wild, or causing drying out of previously permanent water sources.

The growth of the SSA sector in the region is limited principally by an inadequate knowledge base on the use of farm-made feeds. In addition, small-scale farmers are constrained by the availability of animal manure because of the free range nature of animal husbandry and the cost of inorganic fertilizers, thus the need to focus on appropriate farm-made feeds (FAO, 2007). Several issues related to feed and fertilizer that the aquaculture industry will have to address in the near future include the following: the use of conventional protein sources; adherence to the tough national environmental protection measures as well as stringent food safety requirements; the quality standard imposed by the governments on raw materials, additives and feeds at national, regional and international levels; the safe and appropriate use of aqua-feeds produced by small-scale manufacturers as well as support to improve their production technology; development of on-farm feeding strategies and practices for improved utilization of agricultural and terrestrial by-products; and capacity building of small-scale farmers to make more effective farm-made feeds.

In Eastern Africa, we are only beginning to see the production at a commercial scale of complete formulated feed. Fish feed factories producing floating pellets have been established in Kenya and Uganda, and similar plans are underway in Rwanda. But the key challenge to fish feed manufacturers in the region will be finding an appropriate substitute to fish meal which is continually increasing in price due to the demand on the same source for several uses including human food. Most of the fish meal used in Eastern Africa comes from capture fisheries of small minnow-like pelagic

On-farm made feed (pellets)

Manufactured floating feed (pellets)

PHOTOS BY B. NYANDAT

Rastreneobola argentea found in Lake Victoria. This species locally known in Tanzania and Kenya as Dagaa and in Uganda as Mukene has growing regional market where it is increasingly being used as human food.

Most farmers make partial harvests of their ponds over a period of several months. While partial harvesting is good from the biological production point of view it can cause problems especially in mixed-sex tilapia ponds because of the prolific nature of these fish (Veverica *et al*., 2001). Large fish are removed first, thereby leaving the slowest growers as broodstock, and skewing the sex ratio towards female, leading to the accumulation of a large biomass of fingerlings whose growth virtually ceases as the pond has reached its carrying capacity. At this stage, farmers fail to distinguish between large fingerlings and stunted females. This has led to disappointment and discouragement from continuing with aquaculture as farmers have been unable to breakeven and have to abandon the ponds.

Another big challenge to SSA is the level, quality and cost of technical advice/ information. While there are many professors and researchers in the region in this field, there are very few extension agents accessible to small-scale fish farmers. Many agents who are working within the local government authorities are normally involved with planning and administration of the sector, and may not be necessarily be exposed to the field nor have the necessary competence required to guide such farmers. The few good agents are usually busy advising the emerging commercial fish farmers; such services are too costly for typical small-scale farmers.

As aquaculture continues to grow and mature as an industry where the place of the small-scale subsistence fish farmer is uncertain, the importance and need for reliable information and data to ensure a sustainable growth of the sector are also recognized. Currently, data collected from the farmers are not uniform mainly because data sheets or record sheets that farmers have are not the same. There is a need to have better species level reporting as well as an agreement on definitions and standards. A particular problem identified is the lack of reliable data on the contribution of small-scale producers.

A leading challenge to SSA, given its dependence on public support, concerns policy for aquaculture development in the region. There are no appropriate policies in place as compared to policies concerning capture fisheries. Some policies focus on regulation and control of aquaculture and none on support and promotion of the enterprise. The sector which is not there yet in most countries is simply over-regulated. Many policies in the past have also failed starting with rural livelihood approaches, the predominant public support systems for SSA, and the non-commercial focus of such policies have failed aquaculture take-off in the region. Like all other agricultural production enterprises, aquaculture has also suffered from the impact of the constantly shifting macroeconomic policies at local, region and global levels.

Solutions

Among the solutions being considered and at different levels of trial include linking of small-scale producers to market centres, establishment of nucleus farmers for support with aquaculture inputs, technical guidance on farm management and as means of marketing of their produce through buy-back mechanisms. The grow-out farmers are provided with inputs and supplies from the nucleus farmers in return for access and buying back of the farm produce. The cluster approach is also being implemented in Kenya, with the clusters eventually being registered as a group or Community-Based Organization (CBO), for benefits from economies of scale when dealing with inputs and markets.

In Uganda, efforts are underway to reorganize rural smallholder aquaculture into commercial assemblages through setting up aquaculture parks whereby smallholder farms are spatially amalgamated into well-planned production systems. They are

TABLE 2
2008 Population of 8 African countries

	2008 Population (millions)
World	6,705
East Africa	219
Ethiopia	79.1
Tanzania	40.2
Kenya	38.0
Uganda	29.2
Rwanda	9.6
Somalia	9.0
Burundi	8.9
Eritrea	5.0

Source: Carl Haub and Mary Mederios Kent, *2008 World Population Data Sheet.*

provided with the required infrastructure for commercial aquaculture production which can then attract the required services and inputs to support farmers address the common challenges of quality seed and feed, technical guidance and marketing. In addition, this approach eliminates the challenge of production system planning and construction as this shall be done at public cost on a scale large enough to lower the costs and that allows farmers to lease and own suitable commercial production units at nominal fees. This approach is also important as it creates the critical mass needed especially regarding to inputs and supplies and for marketing farm produce.

The challenge of land tenure and poorly constructed production systems can equally be addressed through this concept of aquaculture parks where small-scale farms would be set up and managed on sites with well-planned and engineered units, and leased to small-scale farmers at nominal fee.

One novel project generated with support from the FAO Technical Cooperation Programme (TCP) assistance in Uganda concerns small-scale privately-owned and operated rural hatcheries (Mwanja *et al*., 2005). This approach has changed the way quality fish seeds are produced, distributed and made available to rural smallholder fish farmers. Quality seed of Nile tilapia and African catfish can now be produced and made readily available through such set up, a departure from the usual system of ineffective public production and public distribution of seed. Among the features include private ownership and operation of the hatchery, technical training of hatchery operators that enable them to serve as primary service providers, hatchery operator as nucleus or centre to service a pre-determined minimum number of farmers. Where possible, a seed credit system with a built-in buy back system of market-size fish in exchange for for seeds is put in place including a monitor system for seed quality from the nucleus hatchery operator.

In Kenya, working with European partners, a project on using small cages that are easy to moor and move when needed was developed and piloted in Kenya, Uganda and Ethiopia. Known as the BOMOSA Cage Culture fish farming systems, the project was intended for small- scale fish production in ponds and temporary water bodies and also using a holistic approach to address the challenges facing SSA such as the lack of quality seed, feed, technical information, market, and for some areas, the lack of fish eating culture in a manner that is simple and cheap to apply at small-scale level (Waidabacher, 2006).

Opportunities

Despite the many challenges to SSA, there are also many opportunities in the region. One is the increased demand for fish against the backdrop to stagnated and/or collapsed fisheries from the wild. This means that farmers can make money producing and marketing their fish with reduced competition. The Eastern African region has a record of fast human population growth, with 8 countries with combined population at 219 million in 2008 (Haub and Kent, 2008; Table 2). With the increase in fish demand, there has been almost exponential growth in the value of the fish locally, regionally at premium markets giving commercial small-scale producers a second opportunity to maximize production based on scarcity of supply. A third and clear opportunity for small- scale aquaculture producers is the availability of serene or near serene systems hardly been tapped for aquaculture production such as coastal and marine environment, the many streams and minor lakes, the temporary water bodies including communal water reservoirs, ponds and others.

Recent Initiatives

Recently, Belgium through the Ghent University expressed interest in working with local communities and tertiary institutes in both Kenya and Uganda in exploring Artemia production in several salt pans across the two countries as possible alternative to fish meal as source of protein component for feeds, but especially as feed for fish larvae and fry, which is a very critical stage in ensuring the quality of the produced seed. Uganda has already initiated a proposal with Ghent University in this regard aiming to tap into Viet Nam experience through a tripartite collaboration. Also Uganda has seen its leading fish feed manufacture UGACHICK adopt soya as the protein base in the fish feeds with resounding success, and will soon partner with Ministry of Agriculture, Animal Industry and Fisheries in promoting growing of soya locally in Uganda.

Sampling of farmers pond in the FAO TCP project in Kenya

PHOTOS BY B. NYANDAT

In the recent past, FAO had assisted a number of East African countries in the development of their National Aquaculture Strategies and related plans. Assistance has also been given under the FAO TCP, with the current implementation being in Kenya dubbed as “Strengthening fish production through adoption of improved aquaculture technology”. The aim of the project was to improve households’ food security by making fish and fish products more easily accessible for sale and for domestic consumption through the promotion of fish farmer’s participation in cluster groups for enhanced fish production in ponds or cages. It is a vehicle to introduce and practically demonstrate new and sustainable approaches to farm-level aquaculture management using good business techniques that are economically, socially and environmentally sound that will serve as demonstration to other would be investors and a foundation for the expansion of the sub-sector countrywide.

The Government of Kenya in its efforts to revitalize the economy and to set it back on the path of medium- to long-term growth projections has recognized that aquaculture/ fish farming has substantial potential to significantly contribute to food security, poverty reduction, employment creation and reduction of pressure on capture fisheries. It has also recognized that it can be easily integrated into small-holder farming systems, therefore providing employment opportunities and diversifying income options for farmers through funding an aquaculture programme, the Fish Farming Enterprise Project running from July 2009 to June 2010. In this program, 200 fish ponds will be constructed in 140 constituencies totalling to 28 000 fish ponds with a minimum size of 300 m^2 each. This project is intended to improve nutrition and create over 120 000 employment and income opportunities. Currently, Phase I one of the project where 14 000 ponds were to be constructed is complete. This project has also triggered market for fingerlings and manufactured feeds.

The governments in the region are recognizing the constraints hindering aquaculture growth and development, realizing that the sub-sector could play an important role in poverty reduction and economic growth, especially in the rural population, through the provision of high-protein food, reduction of fishing pressure in natural, creating jobs and generating income.

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Governance institutions and the adaptive capacity of small-scale aquaculture to climate change in the Philippines

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Fernandez, P.R. 2013. Governance institutions and the adaptive capacity of small-scale aquaculture to climate change in the Philippines. *In* M.G. Bondad-Reantaso & R.P. Subasinghe, eds. *Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development,* pp. 153–164. FAO Fisheries and Aquaculture Proceedings No. 31. Rome, FAO. 255 pp.

ABSTRACT

This paper is a critical analysis of relevant social and environmental science literature on actors/actants, mechanisms and processes of governance, food security, and climate change adaptation in small scale aquaculture (SSA) in the Philippines. The country is the 12th largest exporter of fisheries products and at least 22 percent of the nation's protein diet comes from fisheries products. The fisheries sector by the turn of the 21st century has topped all agriculture sub-sectors in overall production. The aquaculture sector is rapidly expanding and the national government is expected to channel most of its resources to further such growth. Consequently, fish products and the protein needs of this nation state are increasingly coming from farmed fish. Aquaculture can also provide food with a low carbon footprint and fish food are highly efficient at converting grain to protein. Such benefits, however, are threatened by the ongoing ill effects of climate change.

The first part of the paper introduces key concepts and terms. In the process, it describes the threat posed by climate change and the related vulnerabilities and challenges faced by SSA and coastal systems in the Philippines. The second section explains and analyses the major policies, institutions and actor relationships that govern and manage SSA and food security systems in the Philippines. Highlighted are some of the main features, best practices and challenges of aquaculture governance and management systems in the context of enhancing climate change adaptation and achieving food security.

Keywords: governance, aquaculture, adaptive capacity, food security, poverty.

CONFRONTING NATURE'S CONSTRUCT

Climate change, food security and socio-ecological context

The Philippines is considered as one of the most disaster-prone countries in the world, subject to major natural or climate-induced hazards (Greenpeace, 2007). According to the Resources, Environment and Economics Center for Studies, Inc. (REECS, 2010), the coastal sector is one of the most vulnerable areas to climate change and the country is ranked as one of the ten countries most vulnerable to sea level rise in terms of population and natural resource exposure. In analysing case study researches and presentations on SSA, food security and climate change in the Philippines during the last 30 years, some important patterns emerge. It can be concluded that the country is highly vulnerable to climate change (i.e. sea level rise, as well as intense and prolonged weather patterns caused by emissions from fossil-fuel dependent and industrialized countries) due to its geo-physical characteristics. The country is also located in the typhoon belt with 60 percent of its 92 million population living in coastal areas. Weather disturbances and rise in sea levels negatively affect communities and infrastructures on a regular basis, leading to flooding, mudslides, saltwater inundation of coastal ponds and agricultural lands and pollution of other water sources.

At least 20 cyclones per year causes an annual average property damage of more than USD13.4 billion or 0.4 percent of gross national product (GNP). Uncommon dry spells also hit the country threatening agricultural and fisheries production, domestic water supplies and hydroelectricity. An estimated 50 million people are at risk from these types of climatic hazards, many of them marginal communities of fisherfolks and farmers because 70 percent of the country's human settlements are located in its 32 400 kilometer coastline. In terms of impact on food security, climate change can seriously affect coastal and aquaculture fisheries providing around 40-60 percent of total fish catch or 4 percent of the country's gross national product and 70 percent of the populace' total animal protein intake. Over-all, the Philippines' coastal and marine resources directly provide food and employment to around 1 million Filipinos. Current coping mechanisms are expected to be grossly inadequate in relation to the projected magnitude of climate change impacts.

Mangroves, coral reefs and seagrasses, on the other hand, are key ecosystems that are expected to be significantly impacted by climate change. Climate change-related destruction and degradation of mangroves and coral reefs, through ocean acidification and bleaching, will in turn exacerbate already fragile ecosystems and result in long-term socio-economic and food security problems. This is because these coastal ecosystems are central to the tourism, agriculture, fishing, and aquaculture industries. Impacts on coastal regions are interrelated with sea levels, river deltas, natural disasters, water resources, agriculture, forests, human livelihoods and infrastructure.

The physical and ecological threat of climate change therefore aggravates the high levels of poverty, inequality, and poor health of coastal residents. All these can lead to conflict and magnify existing environmental, politico-economic and socio-demographic concerns. Such complex problems entail innovative approaches to bring all concerned actors and policies together. But key national government agencies, local government authorities and the vulnerable communities are constrained by inadequate or non-existent systems and tools, and lack of awareness and competencies on climate change adaptation and sustainable development. More importantly, in framing policies and deploying resources to address the challenge, care should be made to ensure that key issues and concerns are not depolitisized. Complex problems require both technical fixes, as well as structural or political solutions. Addressing these deficiencies, and adjusting to the global economic and trading order are national priorities.

Governance thinking and actor cooperation

Interest in the theory and practice of "governance" in the Philippines emerged to balance top-down and heavy-handed governmental, technocratic, and market-driven approaches to environmental management with that of civil society support for environment-based social movements and community-based initiatives. In the context of increasing the productive and coping capacity of SSA amidst climate change, "governance" is a concept, process and goal. Conceptually, governance is a framework to understand changing processes of managing different socio-ecological systems (i.e. actors, their natural resource base and technology). Governance, at the same time, is a process of institutional cooperation and coordination for no single stakeholder or organization is capable of addressing complex challenges effectively. The process of governance is expressed and represented by the three interacting mechanisms of the state (public service and national interest), market (profit-oriented and system of allocation) and civil society (non-state and non-profit self-help groups). The concept of "governance" has gained acceptance as a possible bridge to connect the gap between the biophysical and social science appreciations of what needs to be done, and for whom, within the context of coastal area or resource management or CRM (Cicin-Sain, 1993; Chua, 1993; Clark, 1995; McFadden, 2007; Turner, 2000; Kooiman *et al.*, 2006).

The word 'governance' has grown in importance during the last few decades in part due to its flexibility. The term originates from the needs of economics (via corporate governance) and political science (via state governance) creating an all-embracing political economy concept capable of conveying the diverse meanings not covered by the traditional term "government". The most popular definition of the term is that given by the United Nations Development Programme (UNDP, 1997:2-3): *The exercise of political, economic and administrative authority in the management of a country's affairs at all levels. Governance comprises the complex mechanisms, processes and institutions through which citizens and groups articulate their interests, mediate their differences, and exercise their legal rights and obligations in specific places (e.g, politico- or bio-geographic) and spaces (from local to global).*

Issues on governance and management have gained importance in recent decades because of increased societal concern about growing unsustainability in coasts and other ecosystems. As a result, societal demands and the search for alternative futures have shaped the evolution of science and of systems of representations (Escobar, 2006). These are manifested in the adoption of the United Nations Convention of the Law of the Sea (UNCLOS) in 1982, the Brundtland Commission in 1987, the UN Conference on Environment and Development in 1992 (that created the Philippine Agenda 21 initiative), Millennium Development Goals in 2001, and the World Summit on Sustainable Development in 2002 (that created the Global Forum on Oceans, Coasts and Islands).

According to some analysts (Stoker, 1998) the concept of "governance" encompasses the following objects of study, namely: sets of institutions, rules, processes and standards in specific organizations from government and beyond; the blurring of boundaries and responsibilities for addressing social issues; the collaboration between different sectors; autonomous self-governing networks; and the capacity to get things done without relying primarily on state actors. It is argued that the use of governance analysis would produce more adequate understanding of how power and authority are currently exercised, as well as providing valuable inputs for the policy process.

Governance as a process assumes that no single institution alone is capable of addressing complex challenges effectively. The process of governance is manifested and represented by the three interacting mechanism of the state[1], market[2] and civil society[3] (Peet and Watts, 2004). These mechanisms or actors have complex interactions and can alter individual or organizational behavior, as well as social and ecological systems. In the context of CRM, "governance" refers to a complex system (whether legitimate or illegitimate) of institutions, actors, traditions, knowledge bases, and systems involving the state, market, and civil society on matters relating to public concerns over the management and development of coasts (Fernandez *et al*., 2000). Governance describes the structures and processes used by a variety of social actors to influence and make decisions on matters of public interest (Institute on Governance, 2002). Non-state actors popularized the use of site-specific, livelihood-based, and market approaches (e.g. ecolabeling, fair trade movement) towards an environment-friendly and health conscious economy (National Research Council [NRC], 2008; Brosius, 1999).

If "governance" is about actor-related mechanisms and processes, the term "management" refers to the achievement of objectives set by the governance system, and the upgrade of the capacities of actors or mechanisms to achieve them. The extent to which management objectives are achieved should be the principal measure used in measuring performance levels. Such assessment is in the form of judging achievement against some predetermined criteria and helps management systems to adapt and improve through a learning process (Hockings *et al*., 2000). To ensure success, theories and planning methods should evade compartmentalized thinking and sufficiently adhere to the social nature of governing development and management interventions. In implementing an aquaculture project, for example, staff or personnel improvisation amidst socio-politico-technical constraints is a better indicator of performance. Personnel are therefore assessed not only in the achievement of technical day-to-day project targets but primarily on how creative and adaptive they are in fulfilling their roles and overcoming constraints and problems (Mowles, Stacey & Griffin, 2008). Innovative thinking and acting is crucial amidst the challenges posed by climate change in SSA and food security.

EXPERIENCE OF THE PHILIPPINES IN AQUACULTURE GOVERNANCE AND FOOD SECURITY

The importance of political structures and technological inputs

Since the fall of the Ferdinand Marcos regime in 1987 local and foreign-based NGOs and non-profit groups (including the Church) have challenged dictatorial government, crony-capitalism and over reliance on technocratic thinking and practice. They help monitor and prevent "elite capture", monopoly and destruction of common pool

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1 A state is a basic unit where people are organized politically and is often called country or nation. The various branches of government, and the civil service (i.e., bureaucracy and military) are part of the state. The state is often seen as a mechanism: of rules, regulations and policies to promote public interest and to counteract failure in the market and civil society. States, however, may also be rigid and inflexible structures for allocating resources, may be poorly coordinated, may create rents for particular classes or groups, or may simply coopt and dictate upon civil society and market forces.

2 A market is an institutionalized connection between buyers and sellers. It is a real or virtual space in which buyers and sellers bid against one another. Market actors seek profit and includes: small, medium and large enterprises; multinational corporations; financial and lending institutions, etc. Traditionally, market forces have been viewed as the most efficient mechanisms for allocating or distributing scarce goods and resources that may or may not lead to better environmental stewardship and outcomes. Whatever purported virtues of the market, however, they may also be monopolistic, imperfect and inflexible.

3 Civil society refers to a non-state sphere of influence commonly called private, where exercise of power and consent is organized. It possesses the potential for rational self-regulation and freedom. Non-governmental organizations (NGOs), peoples' organizations (POs) and the Church fall under this category. Civil society is often seen as a critical intermediary space between state and market. It embodies a people's rights, advocacy, participation, and lobbying. Civil society, however, may also bring forth religious, ethnic, gender, or other identity-based fanaticism and strictures.

resources similar to the boom-bust cycle of the tiger prawn industry and mangrove conversion to fishponds from the 1960s to the 1990s (Fernandez, 2005; Primavera, 1997). Consequently, national and local leaders are often encouraged to endorse community-led and livelihood-based approaches to achieve socio-ecological objectives such as sustainable development and food security. Recently, mitigation and adaptive strategies have been developed (i.e. National Framework Strategy on Climate Change 2010-2022) to face the growing challenge of climate change (see www.neda.gov.ph/references/Guidelines/DRR/nfscc_sgd.pdf). The framework adopts the Philippines Agenda 21 (visit http://emb.gov.ph/eeid/philagenda.htm) for sustainable development.

Declining agricultural productivity and fishing yields due to climate change raise concerns about food insecurity for many Filipino families. The lack of a stable and reliable food supply contributes to poor nutritional status for many Filipinos, especially for children. According to the United Nations Children's Fund (UNICEF, 2004), approximately 28 percent of children under 5 years of age in the country are underweight. The figures are higher in coastal communities (Fernandez and Carnaje, 2002). Food insecurity also contributes to increase in environmentally destructive practices such as slash-and-burn agriculture or the use of banned technologies to increase short-term fish catches. Concerns about livelihoods and food security can prompt families to relocate to cities in search of income and social services, or to send a family member abroad to earn an income that can be sent back to the Philippines to support relatives.

Food security generally refers to a situation when people have physical, social and economic access at all times to sufficient, safe and nutritious food to meet culturally and nutritionally appropriate food for a healthy and active lifestyle (FAO, 1996). Sufficient production though is not a guarantee in meeting public expectations for food. This is due to the possibility of governance or political failure in pursuing policy goals in food security. It is therefore instructive to frame and analyse food security, in the context of climate change, as a function of interrelated concepts and processes relating to: availability, accessibility, appropriateness, acceptability, and institutionalization (see Rocha, 2007).

Academic literature puts a heavy emphasis on the technical issue of availability or sufficiency of food supply to meet people's needs (see Cunningham, 2005 for a focus on aquaculture). Some lip service though is given to accessibility (i.e. economic and physical ability to acquire food) as well as to appropriateness (i.e. ecological sustainability and the safety of food supply). But matters pertaining to acceptability (i.e. cultural and nutritional suitability of food) and institutionalization of social structures are not well tackled. The latter consideration is a political economy or political ecology perspective that refers to the structuring of actors and their institutions from international to local levels (Robbins, 2004). In this perspective, as applied to the Philippines, the actors interacting to frame and implement food security and climate change policies are properly contextualized as they consider the following needs: right to food, food sovereignty, affordable food policies, trade and alleviation of poverty.

Seafood from fisheries and aquaculture are important to food security and have a low carbon footprint. It is an important source of animal protein, especially for developing countries. It is also an important source of livelihood and employment. Seafood are also highly traded internationally and can boost export earnings. Global aquaculture production increased by almost 50 percent between 1997 and 2003, while capture fisheries decreased by nearly 5 percent (Brander, 2010). The sector is primarily driven by technical and market-based advances in hatchery systems, feeds and feed-delivery systems, disease management, better stock selection and the culture of a wider range of species. Such trend of increased role of aquaculture in food security is expected to continue. Aquaculture attempts to unhinge fish production from environmental fluctuations by controlling growing conditions, feed and chemical input, disease and genetic contamination for wild species. Sustainability certification and labeling programs have been encouraged by scientists and big business to reduce the negative effects of aquaculture operations (Charles *et al.*, 2010). The increased scope for technology and market-based interventions in aquaculture operations also means that it can be designed to better adapt to climate change, as compared to capture fisheries.

But developing countries such as the Philippines often lack the institutions necessary to prevent harmful ecosystem effects of aquaculture production. These are primarily in the form of organic and chemical effluents (as operators defy ordinances and environmental standards) and reduced biodiversity (when farmed fish escape to alter species composition and ecosystems) (Lasco and Espaldon, 2005; Halwart *et al.*, 2007; Smith *et al.*, 2010). Also, production from fisheries and aquaculture production may uniquely threaten food security because of its tight coupling to other ecosystems and dependence on common-pool resources. For example, fisheries and aquaculture are vulnerable to external shocks such as climate change and ocean acidification, as well as the destruction of key habitats such as coral reefs, mangroves and seagrass areas. But internal changes are also particularly important. Common pool fish stocks are often open-access, and unregulated and unsustainable fishing effort can push stock levels beyond its natural limits. Fisheries and aquaculture can also alter marine food webs and have cumulative impacts to marine ecosystems, undermining the productive capacity of target species (Halpern *et al.*, 2008).

More importantly, poorly defined property rights (i.e. bad governance and access rights to resources) and poor management systems by key actors and their institutions can lead to reduced production, increased emissions[4] and even increased inequality in communities where aquaculture farms operate. In estuarine and marine environments, nutrient pollution, farmed fish escapes, disease spread, and the use of captured fish in feed also threaten aquacultures sustainability (FAO, 2009). Large scale aquaculture or mariculture activities, on the other hand, is moving towards high-value fish production (with infrastructure and manpower support), fish processing, as well as export growth[5] (BFAR, 2010), rather than addressing structural or political problems concerning food security. Governmental and business institutions, it seems, continue to prioritize economic growth over social equity and environmental protection and conservation. The latter goals are essential to meet the food and basic needs of subsistence fishers and SSA operations.

Highlighting the role of key actors and their institutions as they forge a fisheries or aquaculture-based food security system that is adaptive to climate change necessitates a look at governance dynamics. There is evidence in the Philippines that action agenda of government can only serve as comprehensive "wish lists" that are not complemented with the capacity to implement. Competent personnel, finance and political support are often lacking to prevent open access fisheries and the promotion of ecosystem-based management. The result is the breakdown of law and order, and mismanagement in the use of coastal and aquatic resources. The perceived inadequacy of budgetary resources for research and development activities is seen as a manifestation of government's lack of political will to pursue key agenda and science-based policies. When development-oriented resources are available, however, there are documented cases of rent seeking

[4] Some studies argue that aside from production activities, other activities in the supply chain significantly contribute to increased greenhouse gas emissions. These include land use, transportation, packaging and processing of food products (Greenpeace, 2008).

[5] Small scale aquaculture farms in developing countries like the Philippines lack the financial resources, awareness, organization, marketing skills to participate in local and international trade that mandates food safety/quality certifications and labelling schemes. Prices of non-certified products may also go down, therefore favouring large-scale operations in local and international trading (see FAO, 2001 for the case of shrimp farming).

behavior and corrupt practices in the national and local levels (e.g., *Ginintuang Masaganang Ani* Program). Credit programs for small-scale farmers, on the other hand, may end up benefitting bigger borrowers (Hishamunda *et al.*, 2009). There is also a tendency for policymakers and managers to immediately buy in and invest in technical solutions, lacking the will to make hard political or structural solutions.

The Local Government Code of 1991 (devolving natural resources governance and management functions to local governments), the Fisheries Code of 1998 (consolidates fisheries laws to promote local livelihoods and protection of coastal and marine resources), the Agricultural and Fisheries Modernization Act of 1997 (aims to modernize fisheries to enhance competitiveness), Executive Order 533 of 2009 (i.e. policy for integrated coastal management), varied Fisheries Administrative Orders and "codes of conduct", as well as the Climate Change Act of 2010 (includes disaster risk reduction strategies), have all institutionalized a formal system to help meet sustainable development (i.e., environment-friendly growth, conservation, and equitable sharing of costs and benefits), ecosystem-based management (integrated and science-based approach to balance different societal objectives), and food security goals. The generic goals are embodied in the Philippines Agenda 21 and other international agreements such as the Millennium Development Goal. These enabling legislations, policies and guidelines encourage coordination by various sectors, decentralized policymaking and grassroots-led development. Specifically, they give preference to the resource, food security, and safety needs of subsistence and municipal fishers. It also encourages the active participation of women and the youth in decision-making processes. Also highlighted is the coordinative and capacity enhancing role of the national government. Specifically, the government is tasked to consolidate, coordinate and strengthen all climate-related national and local policies, programs and efforts.

Accounting for successes and failures in various scales

Successful cases of community-based (Herminio, 2007; Maliao *et al.*, 2009), municipal and provincial-level adaptation have been documented (David *et al.*, 2009; Lasco *et al.*, 2008a and 2008b) in the country. Stakeholder cooperation and engagements can enhance the capacity of coastal communities and their organizations to reduce vulnerability to natural hazards and adapt to climate change by: promoting a culture of prevention and proactive stance; creating stable and flexible institutions (e.g. policies, plans, legislation, multi-stakeholder mechanisms, etc.); identifying risks (e.g. risk mapping, risk, hazard and vulnerability assessments); promoting early warning systems; building hazard-resistant structures (e.g. critical infrastructures, schools and health centers); protecting and developing of hazard buffers (natural ecosystems such as forests, reefs and mangroves); improving preparedness, response and the development of pre-disaster recovery plans; and creating insurance schemes.

Successful adaptation to climate change in the Philippines is possible at different levels or scales. Understanding, maintaining and upscaling best practices are therefore important. Take the case of SSA. This kind of operation usually covers less than five hectares of brackish water ponds (Irz *et al.*, 2007). Recently, coastal zone aquaculture or marine ranching has become popular and can cover larger areas. Species cultured include milkfish, shrimps, tilapia, mudcrab, catfish, seabass, seaweeds, groupers, siganids and filter feeders (e.g. oysters and mussels). Ornamental fish breeding and urban aquaculture are also practiced as alternative livelihoods (Bureau of Fisheries and Aquatic Resources [BFAR], 2010).

At the household level, there is evidence that the adoption of polyculture practices, together with SSA and mangrove reforestation, has proven to be resilient to climate change and promote food security (Altieri and Koohafkan, 2008; Ellis, 2008; Hasan *et al.*, 2007). Support for indigenous knowledge and technology, as well as entrepreneurial skills training are important to sustain diverse strategies in family-based farms. In the process it can also promote food security and supplementary livelihood. At the scale of the local community high levels of social capital (e.g. leadership, trust and social network) and the creation of aquaculture cooperatives become an advantage when: constructing wave breaks, sea walls and beach reinforcements using local resources; strengthening fishponds and related infrastructures; dredging mouth of rivers; tapping into developmental and livelihood projects/programs from external partners/donors; and operating fishponds for profit and poverty alleviation. Studies show, however, that small-scale operations, cooperatives or clusters need lengthy external support to improve know-how, achieve efficient marketing, ensure timely purchase of supplies and secure credit insurance coverage (Stevenson and Irz, 2009; Cochrane *et al*., 2009)

Vital to all these sub-national efforts is strong collaboration with local government units, other relevant government agencies[6], NGOs, as well as financial and donor agencies. Through the enactment of the Fisheries Code of 1998 much emphasis on "empowering" the fisherfolk by creating a Fisheries and Aquatic Resources Management Council (FARMC) at local (village, municipalities, cities) and national levels. The council is involved in legislative support, planning and decision-making, and monitoring of fisheries and coastal related programs. This initiative aims to uphold the interests of fisherfolks (including women and the youth) and their organizations. But there are documented cases where local councils can also be dominated by groups that do not necessarily represent the interests of subsistence fishers (Eisma *et al*., 2005; Fernandez, 2006).

At higher politico-geographic levels, support of state, civil society and business groups are important in setting up a suite of technological and fair trade systems, as well as people-centered approaches that can: institutionalize early warning techniques, environmental education and awareness-raising systems; create hazard and vulnerability maps; improve communication and transport systems; conserve and enhance watersheds, coral reefs, mangroves, seagrasses and littoral vegetation; address vulnerabilities (e.g., public health, waste management and water resources); improve legal, judicial and police systems; implement ecosystem-based management systems; use high quality feeds and environment-friendly inputs; proper zoning and spacing of aquaculture farms and facilities; diversify local livelihoods and economic development (e.g., through mariculture parks using semi-intensive methods); and train and hire enough aquaculture technicians, extension experts and community workers. The proper monitoring of larger scale and intensive aquaculture and mariculture operations, however, is crucial to prevent pollution and disease outbreaks (Bondad-Reantaso *et al*., 2005), promote social equity, and develop a market for "sustainable seafood". At the national and international levels lobby groups and local partners are encouraged to push for the implementation of pro-poor aquaculture projects and programs to prevent the opposition or cooptation of vested or private interests.

Aquaculture development in the Philippines can improve adaptation to climate change and enhance food security. There is no literature that presents information and evidence that directly links current aquaculture practices with climate change adaptation, food security and reduction of poverty. But there are enough case examples showing that the development of aquaculture, given the right social and structural conditions, can have positive effects in the lives of small farmers (Stevenson and Irz, 2009; Irz *et al*., 2007; Sheriff *et al*., 2008). These can be met by encouraging the use of new technologies that are labour-intensive and attuned to the socio-ecological context of local communities. Further gain can be achieved by neutralizing the main barriers

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[6] The Bureau of Fisheries and Aquatic Resources (BFAR) is the national line agency responsible for overseeing the development, conservation, management, protection and use of fisheries resources under the Fisheries Code of 1998. But direct supervision and licensing of aquaculture operations, save for public lands, have been devolved to the local government.

to adoption of aquaculture by the poor and the vulnerable. Priority should therefore be given to local employment and the creation of site-specific aquaculture operations, rather than yield increasing goals.

In general, current institutional arrangements and strategies in the country can be enhanced by improving the level of trust and partnership between state and non-state actors as they jointly implement both centralized and decentralized projects/programs. A contentious issue between government and civil society groups is the fair and just validation, delineation (e.g. access rights for artisanal and seasonal fishers) and licensing system of "underutilized and idle" farmlands and offshore and inland bodies of water for aquaculture, related business enterprises, mangrove reforestation, coral reef protection and community-based stewardship (Primavera, 2005). Other common concerns include: building fish processing and post harvest facilities; investment in the generation and dissemination of appropriate technologies; funding research and development; providing access to credit and insurance; and enhancing access to social services. In all these engagements the national university (with campuses nationwide), research institutions and partners/donors can help increase the legitimacy, socio-ecological viability, and continuity of state and non-state partnerships in aquaculture-related projects/programs.

CONCLUSION: DIVERSE CONTEXTS NEED DIVERSE INSTITUTIONS

Complex and diverse socio-ecological contexts such as those prevailing in Philippine coasts and aquaculture systems entail site-specific and flexible governance systems, management and technical responses and livelihood strategies. No single group, strategy and scale has clear access to understanding and resolving the intertwined structural and technical issues concerning food security and climate change. Institutional cooperation, regular communication and new forms of learning and integration are crucial. Drawing from experiences and successes in hierarchical governance models and participatory governance encounters, coupled with technical or political solutions, can enable actors to: enhance food access and security; advance agendas to strengthen adaptive capacities to climate change; and pursue sustainable development of SSA through offices and institutions for integrated and ecosystem-based coastal management. But it is important to stress that the particular sets of political (or organizational) and technical challenges faced by vulnerable and marginalized coastal communities should be prioritized and addressed. At the same time, balance should also be struck in meeting the coupled goals of human well-being and/or environmental protection. That would initially entail the breaking down of barriers between the social and natural sciences to help create governance structures and technology for sustainability and food security.

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Social issues in small scale aquaculture (SSA): the social impacts and responsibilities of SSA

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Bueno, P.B. 2013. Social issues in small scale aquaculture (SSA): the social impacts and responsibilities of SSA. *In* M.G. Bondad-Reantaso & R.P. Subasinghe, eds. *Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development,* pp. 165–170. FAO Fisheries and Aquaculture Proceedings No. 31. Rome, FAO. 255 pp.

ABSTRACT

Social issues are complex because their causes cannot be easily identified. They are usually the expression of risks that are not social in nature and origin. They then exacerbate the impacts of all other risks. Understanding social issues is crucial to developing strategies to efficiently mitigate their impacts. The paper highlights the importance of distinguishing symptoms from causes of social problems that impact on small scale aquaculture (SSA). It gives examples of ways aquaculture can deal with and avoid causing or adding to social problems. It suggests that the question, "What is the contribution of aquaculture to society?" is subsumed under the larger question, "What is the social responsibility of aquaculture?" It argues that the social responsibilities of aquaculture include being viable because a failed farm contributes nothing positive to society, converting a problem into an opportunity so that the problem ceases to be one, and contributing to the mitigation of or at least not exacerbating social ills. Examples illustrate how SSA contributes to the mitigation of social problems, taken from the pilot studies in three Asian countries to test the indicators of SSAs' contribution to rural development and from some cases in the Pacific.

Keywords: social risk, poverty.

INTRODUCTION

The complex nature of social issues

It would be much less complicated world for farmers if social problems can be as easily diagnosed and cured as a disease caused by a pathogen. The complexity and thus importance of social issues in any context derives from three characteristics: (i) they tend to slowly build up, undetected, below the surface until they suddenly rear up on an unsuspecting population, (ii) they are often the final expression of impacts whose origins are natural, technological, economic, cultural, or political or any combination of these, and (iii) having thus arisen, they exacerbate all other issues.

The first characteristic is crucial because the resilience of social systems could have been already eroded by small and repeated impacts that were not felt, so that a shock or a slowly building trend suddenly overwhelms an unprepared population. The second makes it difficult to pinpoint the source or identify the cause making it

TABLE 1
Hazards other than natural, physical and biological

• Civil unrest, civil strife • Social tension • Political instability • Poor or weak governance • Rampant poverty - a proxy to weak government • High unemployment - an indicator of horizontal inequality • Social exclusion -- highly defined inequality in accessing services and resources • Tendency of government to solve social conflicts by military action	• Lack of independent judiciary • Insufficient regulatory system • Excessive regulation • Ill-defined property rights • Lack of protection of assets • Economic crisis • Seasonality, unreliability of labor • Changes in consumer preferences • Appearance of substitutes • Loss of comparative or competitive advantage • Market volatility

inefficient to set up mitigation strategies against the impact. The third can lead to addressing symptoms rather than causes. For instance, unemployment can be the result of a combination of factors that are social, political, economic, technological and natural in character. Widespread unemployment spawns or exacerbates existing social problems (like drug addiction and violent crime), exposes economic weaknesses heretofore masked by widespread prosperity, and probably intensifies political anomalies (such as inconsistent and arbitrary rules and decisions). Table 1 above is a rather lengthy but by no means complete list of social, political and economic hazards. One or any combination of these can result in a social impact that then exacerbates all other issues.

Distinguishing the symptoms and causes

The understanding of a social issue therefore depends on identifying and understanding its underlying cause(s), which may not be social in nature. Hunger for instance is a social issue, as it is an effect of poverty. And poverty is more a political than an economic issue (Sen, 1999). An economic measure of poverty is income below a threshold – USD1 or USD2 a day. But that does not explain why a household is earning less than either amount. "Capability deprivation" is the concept used by Sen (1999) to characterize the condition and cause of poverty; it is not low income, which Sen (1999) points out as only instrumentally rather than intrinsically significant.

The International Institute for Sustainable Development (ISSD) in 2003 articulated a functional definition of poverty, one that is based on the intrinsic factors of capability deprivation i.e. "*Poverty is the lack of basic capacities marked by the inability to satisfy basic needs, lack of control over resources, lack of education and skills, poor health and malnutrition, lack of access to water and sanitation, vulnerability to natural and economic shocks, and lack of political freedom and voice in policies.*" With this definition, poverty is seen as a symptom of social ills and a syndrome. It is one of many symptoms of social dysfunction but it is usually the ultimate manifestation. The list of social issues associated with aquaculture can be lengthy (Bondad-Reantaso, Arthur and Subasinghe, 2008). The important thing is to distinguish the issues that are the impact of aquaculture and the ones that are the problems of society itself. The former can turn into a social risk, broadly defined as the challenge of society to the perceived or real harm of a practice (Kelly, 2005 and Bekefi, *et al.*, 2006 as cited by Bueno, 2008). The latter are manifestations of dysfunctions in society which a farm has to deal or live with, and whose resolution is under the mandate of other institutions. This is not to say that a farm. a firm or an aquaculture community cannot contribute to their resolution; aquaculture can and there are examples revealed by recent studies cited in the next sections.

SOCIAL IMPACTS AND RESPONSIBILITIES OF SMALL SCALE AQUACULTURE (SSA)

Impacts

Any impact of aquaculture, whether directly on people or on the environment, is ultimately an impact on society. It becomes a social risk to the farm or firm if society feels it is harmed and mounts a challenge. The results of the pilot studies conducted by FAO in 2009 (Pongthanapanich, 2013), which tested the indicators of the contribution of SSA to rural development, show that Type 1 SSAs are less dependent on profit and market to be viable than Type 2s. Although they sell part of their produce, the immediate contribution of Type 1s is more to the household and the neighbourhood than to the broader market. By the same token, they have less impact on the environment and people or, if any, the impact is restricted to the immediate locality. Type 2 SSAs have more product output, use more inputs and produce more waste. They use more resources including labour, space, water, energy and money and therefore depend much on off-farm supply of these inputs. Such dependence makes them more vulnerable to problems of supply but also more prone to contribute to these problems. They market most of their products. Overall they have larger ecological and carbon footprints than Type 1s except seaweed farming (Bondad-Reantaso, Bueno and Ponthanapanich, in preparation).

Social responsibilities

The question, *What are the contributions of SSA*? is the first part of a more fundamental one: *What are SSA's responsibilities to society*? A farm has two basic social responsibilities. The first is to be viable; a failed farm contributes nothing positive to society (except perhaps as a case study in failure). The second is not to cause harm. One way to deal with a social impact of one's own making is not to do the activity that is causing the impact; for instance adopting good management practice or an alternative way of producing the same output without the impact. Another way is to turn the problem into an opportunity, in which case it ceases to be a problem (Drucker, 2001). For social problems that defy this approach, or which solutions lie with other social or political institutions, the least that aquaculture can do is not to exacerbate them.

Capacities and opportunities

Farms need the ability to perform three tasks: (i) prevent or lessen their impacts on society, (ii) mitigate the impacts of social problems on their viability, and (iii) convert either into an opportunity. These are not mutually exclusive so that the capacity to address each one need not be distinct. This capacity rests on firstly, their strength, which is innate to their being small and which their cultural context – a rural society that is invariably governed as much by social norms as legal sanctions – endows, and secondly, on the opportunities that their socio-economic circumstances and political context allow them. Table 2 outlines an indicative[1] set of SWOTs (Strengths, Weaknesses, Opportunities and Threats) associated with SSA.

CONCLUSIONS

SSA is not a panacea to poverty or social ills but some of its attributes can help alleviate rural poverty and mitigate social problems. From the SSA case studies, these include: being (i) an alternative employment opportunity for underemployed or otherwise idle rural labor (Dung, 2014), (ii) able to provide additional community livelihood (Espaldon *et al*., 2014), (iii) a fallback employment to displaced labour from the commercial and industrial sector (Pongthanapanich, Bueno and Sungkao, 2014), and (iv) able to attract investments from government and private sector into the rural community (Nguyen, Nguyen and Khanh, 2014; Espaldon *et al*., 2014).

In addition to the case studies and other studies cited above, a women-oriented aquaculture project in Nepal that was started in 2000 showed that SSA meets the fundamental objective of empowering rural women who are poor so that they can move

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[1] Apparent and indicative because a SWOT analysis of a firm, institution or industry must have the participation of representatives of all its major stakeholders for its results to be valid.

TABLE 2
Indicative SWOTs of small-scale aquaculture farms

Strengths	Type 1	Type 2
1. Low emission thus low environmental impact (Philippine seaweed; Thailand pond polyculture)	X	X
2. Less vulnerability to market fluctuations and economic crises (Thailand pond polyculture)	X	
3. Resource sharing strengthens community relations and goodwill (Thailand polyculture and small pond catfish culture); reciprocally, SSAs draw strength from traditional community values (Viet Nam shrimp; Philippine seaweed)	X	X
4. Reliable and significant volume of economic output attracts outside investments (Philippine tilapia and Vietnam shrimp) and investments in infrastructure (Vietnam shrimp, and catfish "tra and basa" industry)		X
5. Shared decision-making in farm household empowers women	X	
6. Fuller and more efficient utilization of family labour	X	
6. Nimble and flexible operation thus resilient to shocks	X	X
Weaknesses	**Type 1**	**Type 2**
1. Unmeasured economic output does not attract investments in infrastructure	X	
2. Organizing formal associations of farmers can be fraught with opportunism		X
3. Lack of assertiveness does not give them prominence in government polices and plans	X	
4. Lack of organization means lack of bargaining power and a higher transaction cost (as in the procurement of inputs and marketing of products)		X
5. Low profile causes them to be overlooked by providers of institutional services	X	X
6. Government tends to see servicing small farms as not cost effective and inefficient	X	X
Opportunities	**Type 1**	**Type 2**
1. Can position itself as an employer of underemployed and unemployed (Viet Nam)		X
2. Fallback employment for laid off family members in non-farm jobs (Thailand)	X	X
2. Alternative livelihood to displaced fishers; reduces pressure on fishery (Vietnam lobster)		X
3. Supplementary source of household income (Philippine seaweed; Thailand polyculture)	X	X
4. Major community income earner (Philippine seaweed, Vietnam shrimp and Philippine tilapia);		X
5. Spawns other income generating activities in community (supply of inputs, local transport, local convenience shops, on-farm processing, buying and selling of farm produce, and marketing (Philippine tilapia, Vietnam shrimp and basa catfish)		X
6. Buffer to failure of other farm enterprises (Thailand – polyculture)	X	
7. Urbanization and economic development provides opportunity to improve overall family income structure from non-farm jobs (Butso and Isvilanonda, 2010)	X	X
Threats	**Type 1**	**Type 2**
1. Consolidation – being consolidated into a large agribusiness	X	X
2. Urbanization – land prices go up and farms are sold to developers (Thailand)	X	X
3. Demographics – ageing of farmers and loss of family labor (Butso and Isvilanonda, 2010)	X	
4. Outmigration – younger members migrate to cities: (a) loss of household labour; (b) scarcer and higher cost of farm labor (Butso and Isvilanonda, 2010)	X	X
5. Susceptible to being co-opted by larger entities whose interests may not serve smaller members	X	X

out of poverty. The project enabled a mix of positive social impacts that ranged from enabling the women to earn more, to improving their and their family's health, enabling children to have a better opportunity to attend school longer, motivating the women farmers to take a more active part in community affairs, and building or strengthening community institutions. (In the words of the author, "*better and a more reliable stream of income to the family, extra income used for children's education, increased access to income and more active participation in community affairs, and improved health from better nutrition, and the creation or strengthening of a rural institution i.e. cooperatives that have promoted further social and economic activities*" (Panth, 2010), and, it is fair to expect, engendered community development and harmony.

In another context, in the Pacific region, some medium-scale enterprises have worked out a business model in the culture and trade of giant clams that relies on mutual trust between the hatchery operator-exporter and the grow-out farmers. In Kiribati for instance, a private farm (categorized as a medium-scale enterprise, with the owner-manager and a technician as the regular technical staff and hiring four to six workers depending on the season) produces and distributes giant clam to households in a nearby atoll community for them to grow into aquarium size clams. The farm provides the cages and dispenses technical advice as well. It then buys back the market size clams from the ongrowers. The farm collects the market size clams on two occasions during a year, when the farm households need money the most, before the independence day celebrations in mid-July and before Christmas. It pays cash on the spot. The small on-growers in turn, with the farm's technical advice, assure that the farm is buying back healthy clams of the desired size. The farm provides certified F2 seed and the farmer-ongrowers are under a strict obligation not to mix poached clams with the harvest because of the European Union (EU) as well as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) rules (although Kiribati is not a member of CITES or the World Animal Health Organisation). The clams are exported to Germany. The business relationship between the farm and the small farmer-ongrowers is thus proving to be a sustainable and economically viable arrangement[2]. Basically a similar model is being followed by a larger farm in the Republic of Marshall Islands with a parent company in Florida, U.S.A. There is however more active government involvement in the provision of technical advice to the farmers in the atoll community as well as some spats to supplement the ones from the private farm's hatchery.

IMPLICATION

Mitigating a risk costs money and probably the only way to bear the cost without becoming insolvent and provoking a challenge from society (which could very well lead to insolvency) is to be profitable without cutting corners. To reiterate, being viable is a social responsibility, which for any industry is not to cause harm to society with its products or practice. The application of risk analysis and risk management to aquaculture including SSAs and the adoption of better management practices would increase the prospect of long term economic viability of small farms (Umesh *et al*., 2010).

The growing body of documented cases of adoption of better management practices and codes of conduct by farmers of any scale has moved to the realm of received wisdom the heretofore statement of faith that being environmentally responsible makes good business sense. This raises the question as to whether the market can be relied on to instill social responsibility. The answer is it can, and the voluntary adoption of codes of conduct and better management practices and adherence to standards demonstrate the efficiency and effectiveness of the market. But it is only one of a mix of governance mechanisms, which includes laws and regulations, social norms of conduct, and self-management by organized farmers. Social responsibility increases the positive impacts of a farm on society. It mitigates the impacts of probably all types of risks that a farmer faces. Because farms have to be economically viable the mechanisms that facilitate social responsibility should not only be effective, they should also assure that farms can operate efficiently.

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Resiliency of small-holder fishfarmers to climate change and market prices in selected communities in the Philippines

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ABSTRACT

A rapid assessment of the resiliency of small-holder fishfarmers in selected communities in the Philippines was conducted to gather the fishfarmers' observations and insights about climate change and market prices, and the impacts of climate change on their environment, livelihood and life, in general, and to learn measures they have adopted to cope with adverse situations. The study sites were communities that were undertaking aquaculture livelihood, with technical support from the Aquaculture Department of the Southeast Asian Fisheries Development Centre or SEAFDEC/AQD and logistical assistance from their local governments and international and private donors. The climate change phenomena observed in the study sites were flash floods, sea level rises, increases in temperature, stronger waves, and longer dry season (drought). The major ecological impacts were mortality of marine flora and fauna, destruction of aquaculture facilities (cages and ponds), disruption of aquaculture protocol, and frequent occurrence of fish diseases. As a result, fishfarmers suffered substantial financial losses that forced them to either borrow more money (most are already heavily indebted), or stop operation until financial support is available. To help each other survive common hardships, the fishfarmers resorted to the Philippine traditional "*bayanihan*" system or collective action for their common good.

Rapid assessment studies can only provide initial insights on the situation in the community. A more comprehensive and integrated methodology to include various dimensions (human, ecological, economic, technological and institutional) is recommended in future studies on climate change.

Keywords: resiliency, small-holder fishfarmer, rapid assessment.

INTRODUCTION

Emerging issues related to climate change and market prices influenced by global trade adversely affected the fragile aquaculture livelihood of the small-holder fish farmers.

Climate change

Sea level rise is expected to reach 1 m or more by 2100 due to global warming, glacier melting, and accelerated decline in polar ice sheet mass (Nicholls and Cazenave, 2010). The resulting disastrous impacts on low elevation coastal zones are certain, but the ability of society to cope via adaptation remains uncertain. Moreover, observations on climate change in West Antarctic show that rapid environmental change has coincided with shifts in the food web from its base to the apex (Schofield *et al.*, 2010). This complicates the management and protection of marine resources that have direct negative impacts on coastal communities. The climate change phenomena observed in many countries - flash floods, increase in sea levels, increase in temperature, stronger waves, and longer dry season (drought) – have also been observed in coastal areas in the Philippines.

Market prices

The fluctuations of prices of fish in the domestic and global markets have also adversely affected fishfarmers. Fish trade globalization is perceived as having created opportunities for great profit for big investors but caused grave threat and insecurity to the food and livelihood of small-scale fishers, and abetted environmental degradation (Salayo and Agbayani, 2005).

Rapid assessment of small-holder fishfarmers' resiliency

A rapid assessment of the resiliency of small-holder fishfarmers in selected fishing communities was conducted by the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC/AQD) in order to:

1. learn about the perceptions of the small-scale fishfarmers about the impacts of climate change and market prices on their livelihood;
2. know their adaptive mechanisms for reducing negative impacts on their livelihood; and
3. draw conclusions and recommend research directions in support of sustainable aquaculture livelihood.

Gunderson (2000) defines resiliency as the amount of disturbance that a system can withstand without changing self-organized processes and structures. The resiliency approach focuses on the strengths and resources of the communities that are harnessed to lessen their losses from climate change and to help them to bounce back or thrive in spite of adverse circumstances. This study, with its inherent limitations as a rapid assessment, will provide researchers some insights about small-holder fishfarmers' way of coping with climate change and their attitude towards fish price fluctuations. These will serve as inputs to the development of a more comprehensive methodology for further studies on climate change and market studies.

ANALYTICAL FRAMEWORK AND METHODOLOGY

Analytical framework

An expanded framework on the ecosystem approach to aquaculture (EAA) by Bailey (2008) was adopted by the Study Team in order to expand the perspectives in doing interdisciplinary research on climate change. Bailey (2008) contends that biophysical (ecological) and human dimensions of ecosystems are inextricably related and mutually supportive and a change in one dimension is highly likely to generate change in the other. The main human considerations of the EAA are: 1) entrepreneurial opportunity and employment generation, 2) gender relations, 3) economic diversification, 4) infrastructure development, 5) food supply and value chain, 6) user conflicts, and 7) balances in wealth, income, and power. On the other hand, the main ecological considerations of EAA are: 1) organic and inorganic loading, 2) residual heavy metals, 3) residual therapeutants, physical interactions between marine life and gear and escapees, 4) wild juveniles for grow-out, and wild stocks for fish feed, 5) degradation or replacement of habitats (mangroves, seagrass beds, coral reefs, etc), and 6) climate change phenomena.

Marine aquaculture (mariculture) is forecasted to diversify, and production will continue to increase to supply both the human consumption and industrial use (as in seaweeds farming). The paradox, however, is that although mariculture will meet the increasing demand for aquatic food and will decrease fishing pressure, it may also cause the collapse of fisheries stocks because of the use of wild fish as feed of cultured fish (Burbridge *et al*., 2001). It is, therefore, important to include the technological and institutional dimensions in EAA so as to achieve a more holistic understanding of the fears and needs of the coastal communities. The technological dimensions are: 1) best aquaculture and management practices, 2) full-cycle aquaculture with focus on quality seeds and environment-friendly feeds, and 3) genetic integrity of natural fish populations. The institutional dimensions are: 1) rules and rights in the management of fishery resources and 2) enforcement of fisheries and environmental laws.

Methodology

The following methods were used:

1. Prepared and pre-tested a questionnaire based on a modified version of the EAA;
2. Conducted key informant interviews and focus group discussions in the four study sites;
3. Reviewed the literature.

Study sites

The study sites are shown in Figure 1.

The study sites were fishing communities undertaking various aquaculture livelihood with technical assistance from SEAFDEC/AQD under its Institutional Capacity Development for Sustainable Aquaculture (ICDSA) Project and funding support from local government units (LGUs) and donor agencies such as the Australian Centre for International Agricultural Research (ACIAR) and Petron Foundation. The goal of ICDSA was to empower the stakeholders of coastal resources – the poor fisherfolk and their organizations, their local government, on-the-ground non-government organizations (NGO), and concerned private companies – to become responsible stewards of their natural resources even as they harness these for their food and livelihood through sustainable aquaculture (Agbayani and Toledo, 2008).

The main problems that beset the target fisherfolk-beneficiaries and ICDSA interventions are shown in Table 1. The selection of aquaculture systems suited for the target fishing communities was based on their ecological resources, socioeconomic characteristics, market attributes, and present and potential support from the local government units.

FIGURE 1
Institutional Capacity Development for Sustainable Aquaculture (ICDSA) project sites

TABLE 1
Site description and ICDSA interventions

Site	Main problem	Aquaculture system	Training	Farm Demonstration	Remarks
Northern Samar (Municipalities of Laoang, Pambujan, Lavezares, and Rosario)	Smuggling of crablets outside of the province detrimental to the small-scale collectors and mudcrab growers	Mudcrab nursery, grow-out and fattening	Trained 60-80 fisherfolk, students, teachers, development workers	Demonstrated mudcrab nurseries in 3 sites (in mangrove areas and ponds: a) survival rates in Phase 1 – 50-70%; Phase 2 – 70-83%; b) ROI Phase 1 – 4-153%	Funding support from ACIAR
Misamis Occidental	Dislocation of small-scale fishers from their traditional fishing grounds that were declared as marine protected areas	Integrated grouper hatchery, cage nursery and grow-out	Trained more than 100 fishers, LGU staff, and Coop technicians	Demonstration runs registered 32-48% ROI; as of June 28, 2010 – trial delivery for export of 500 kg at P480/kg: Province operated hatchery now producing grouper fry	Funding support from ACIAR
Capiz (municipality of Dumarao)	Perennial flooding of rice farms caused by an unfinished construction of dam	Tilapia cage farming in a river	Trained 50 farmers, students, teachers, LGU staff, development workers	Demonstrated tilapia cage culture in Badbaran river; about 50% of trainees adopted the technology as an additional livelihood;	Funding support from the provincial government of Capiz
Guimaras (four barangays of Nueva Valencia)	Oil spill from oil carrier that sank south of the island province of Guimaras destroyed the marine resources that are sources of food and livelihood of the fisherfolk.	Milkfish cage culture	Trained 150 fishers from 4 barangays	In Phase 1, harvested 26.3 tons valued at P2.6 M; income to the Fisherfolk Associations (FAs) – P267 285; Turned over one fish cage each for the 4 barangays for Phase 2. First harvest in one cage produced 2.52 tons, valued at P230 000, income to the FA – P45 000; Value-adding (deboning, smoking) on-going.	Funding support from Petron Foundation and Citibank for the training and livelihood of the fisherfolk affected by the oil spill

The fishing communities in the four sites were victims of various natural and man-made disasters, trade practices, and even environmental policies that adversely affected their food source and livelihood.

In Northern Samar, the supply chain of crablets was controlled by stock buyers or traders who purchased "fly-size" crablets from small-scale collectors, mostly out-of-school youth who worked to help their parents earn a few pesos for their sustenance.

In the province of Misamis Occidental in Northeastern Mindanao, the beneficiaries were fishers who depended mainly on the fishery resources for their livelihood. They were banned to fish in their traditional fishing grounds after the LGUs declared the fishing grounds as marine protected areas (MPAs). Since they could not afford to own big motorized boats to fish farther offshore, away from the MPAs, they had to engage in land-based livelihood like driving "tricycles", carpentry and seasonal farming.

In Capiz province, the respondents were rice farmers who were victims of perennial flooding caused by the unfinished construction of a dam intended for irrigation. The rice farmers turned to tilapia farming as an alternative or supplemental livelihood and source of food.

In the fourth site, in Guimaras Province, the respondents were victims of the oil spill from an oil carrier that sank south of the island province in mid-2006. The marine resources –mangroves, coral reefs, and seagrass beds – were devastated and resulted to loss of livelihood and food for the coastal communities.

RESULTS AND DISCUSSION

Ecological and technological dimensions of climate change

The climate change phenomena that were observed by the respondents in their environment were: a) frequent flooding caused by frequent and strong typhoons, 2) sea level rises, 3) stronger waves and change of the onset of seasons or monsoon, 4) longer than usual dry season and extreme heat, and 5) sudden and extreme temperature changes. The major effects of these occurrences were destruction of marine resources (flora and fauna, mangroves), siltation and pollution, and proliferation of barnacles and hyacinth (Table 2). The damages on their livelihood were the destruction of the fish cage facilities, disruption of hatchery and grow-out protocols, and increasing occurrence of fish diseases. Although not all of the respondents were able to undertake adaptive measures, the suggested solutions were: (1) change in aquaculture protocols, (2) change in cage and pond designs, and (3) adapt disease prevention mechanisms. Most of the respondents, however, were unable to implement such solutions mainly because of lack of resources and know-how. Some decided to stop the aquaculture

TABLE 2
Ecological and technological dimensions of impacts of climate change

Identified climate change phenomena	Some major effects and impacts	Some adaptive measures
1. Frequent flooding 2. Sea-level rise 3. Stronger waves/change of season or monsoon 4. Longer dry season, drought, extreme heat 5. Sudden and extreme temperature change	1. Mortality of flora and fauna 2. Occurrence of mangrove associates 3. Proliferation of barnacles, water hyacinth 4. Siltation, pollution 5. Destruction of cages and other structures 6. Decrease in catch 7. Disruption of hatchery and grow-out protocols 8. Fish diseases	1. Change in hatchery and grow-out protocols 2. Change in cage and pond designs 3. Disease prevention mechanisms 4. Stop operation; look for alternative livelihood 5. Enforcement of conservation of flora and fauna 6. Cleaning of surroundings 7. Building of stilt houses/ structures, putting sand barriers 8. Re-enforcing dikes 9. Relocation 10. Land fill 11. Evasion/do nothing

operation and looked for alternative sources of income, such as carpentry and farming, which were scarce and seasonal. Others suggested the implementation of conservation measures to preserve the marine flora and fauna. Some chose to do nothing about their predicament and wait for better times.

In a case study in Cantho Province, Viet Nam, on the vulnerability and adaptation of catfish growers, the farmers who were affected by climate change suggested the development of new culture systems, building stronger pond dikes, producing good quality and healthy fry, holding workshops on climate change, and giving financial support to affected farmers (Nagothu *et al.*, 2009). Other case studies initiated by the Network of Aquaculture Centres in Asia-Pacific (NACA) in India, Thailand, Philippines, and Nepal strongly recommended the holding of workshops to establish guidelines, frameworks and tools for policy and action programs of government and development agencies that will increase the resilience and enhance the adaptive capacities of small-holder fishfarmers.

Human dimensions

Production disruption caused by climate change, e.g. damage to aquaculture farm set-up, occurrence of fish and human diseases, resulted to financial losses (Table 3). Material and physical damages forced many fishfarmers to borrow money from whoever was willing to lend them in order to cope with the financial losses. Others were forced to stop operation until financial help was available. Some could not pay their production loans. Campos (2009) reported that small fishers who were victims of frequent and more intense typhoons, floods, drought and pest and diseases were unable to pay their loans from the Quedan and Rural Credit Guarantee Corp (QUEDANCOR). QUEDANCOR provides bridge loans and extends grace periods in order to help the victims to cope with the disasters.

The *bayanihan* spirit (community collective action to help one another) has been a traditional practice that enabled Filipinos to survive countless disasters, man-made and natural. In some cases, the victims just accept natural disasters as fate and do nothing about the situation.

TABLE 3
Human dimensions on impacts of climate change

Identified climate change phenomena	Some major effects and impacts	Some adaptive measures
1. Frequent flooding 2. Sea-level rise 3. Stronger waves/ change of season or monsoon 4. Longer dry season, drought, extreme heat 5. Sudden and extreme temperature change	1. Less production 2. Damage to aquaculture set-up 3. Lack of fry supply 4. Additional labour and maintenance cost 5. Inceased occurrence of fish diseases 6. High incidence of illnesses in the communities	1. Culture of fast growing commodities 2. Livelihood diversification 3. Increase/negotiate prices 4. Price watch; sell products during full moon 5. Borrow money to cover loss and other expenses 6. Reinforcement of structures/ houses/high stilts; constant checking of nets 7. Stop operation 8. Collective action help each other in the community (bayanihan) 9. Change cage/pond engineering designs 10. Local/traditional knowledge in treating illness/diseases 11. Stay at home; do nothing

Institutional dimensions

Most of the respondents expressed frustration over the lack of effort or failure to enforce national environmental laws and LGU ordinances that could have eased up or lessened the damages caused by natural disasters. The laws on solid waste management, mangrove reforestation and fish sanctuary were perceived by the respondents to be effective in minimizing the damages caused by natural disasters (Table 4). They recommended that the national government improve the weather forecasting facilities and systems, and disseminate timely weather alerts through TV and radio. In the Philippines, the National Disaster Control Council (NDCC) is the coordinating body that is responsible for ensuring the protection and welfare of the people during disasters or emergencies. NDCC coordinates the disaster-relief activities of the different government agencies to ensure expeditious distribution of relief goods and services to affected communities. Private and non-government organizations that provide assistance to disaster victims coordinate their activities with the NDCC to avoid unnecessary duplications and to have more cost-effective and responsive rescue and relief operations.

TABLE 4
Institutional dimensions of climate change

Identified climate change phenomena	Institutional adaptive measures
1. Frequent flooding 2. Sea-level rise 3. Stronger waves/ change of season or monsoon 4. Longer dry season, drought, extreme heat 5. Sudden and extreme temperature change	1. Enforcement of laws and municipal ordinances on solid waste management 2. Implementation of mangrove reforestation program 3. Implementation of fish sanctuary protection 4. Improvement of weather forecasting equipment and capabilities and effective use of media (radio, TV, internet) in preparing for disasters and climate change

Market prices: aquaculture trends in the study sites

This study also looked into adaptive strategies of small-holder fishfarmers on market price fluctuations (Table 5) which were influenced by either trade globalization or the local economy. The small farmers were price-takers and were, most of the time, under the mercy of traders. They sold their products mostly in local and provincial markets. Seldom did their products reach the big urban markets (Manila and Cebu in the Philippines) because of the small volume of production from their farm. Harvests were timed with the full moon, when fish catch from the wild was low and fish prices were generally higher. Most times, however, they could not wait for full moon because of the

TABLE 5
Market prices and local trends

Market scenario	Local trends
Harvest indicators	• Marketable size (species-dependent); when price is high (full moon); when cash is needed
Increase in price of feeds	• Feeding protocol is modified:commercial feeds mixed with corn, kangkong and locally available feeds; loan from micro-finance; evasion/do nothing
Increase in prices of pond or cage materials	• Use local materials: loan from micro-finance • Evasion/do nothing
Perceived causes of market price fluctuations	• Increasing population • Shift in food preference • Natural disasters
If there are many fish cage competitors?	• No effect, supply of fish is insufficient to meet the demand • Harvest is by schedule: important role of info exchange • Suggestion: formal organization of fish cage farmers
When substitutes for cultured fish are cheap?	• No harvest • Virtue of waiting
Effects of price fluctuations	• When price of cultured fish drops: no direct effects to fish cage labourers but big loss to entrepreneurs • Buy when prices are low and limit consumption when prices are high; choose marginally nutritious alternatives rather than more expensive highly nutritious species

need for cash, and so they harvested even if the price was low. When prices of inputs, like feeds, increased, they modified their feeding protocol in order to decrease their cost of production. They mixed commercial feeds with locally available ingredients such as corn and *kangkong* (morning glory or water spinach).

Some fishfarmers did not feel threatened by competition from other growers; they believed that the supply of fish was insufficient to meet growing demand. There has been a global shift in food preference to fish because of health reasons and the animal diseases that are harmful to man (foot and mouth disease and mad cow disease) in Europe some years ago (Salayo and Agbayani, 2005). Noting the people's changing food preference, the growing consciousness about health food, and the hectic lifestyle of people, especially in the rich importing countries, fish processors developed new and value-added products such as "ready-to-eat" and "easy-to-cook" preparations.

On the farm level, when fish substitutes are cheap, harvest is postponed until prices get better.

CONCLUSIONS

The following conclusions were drawn from the study:

1. Respondent-fishfarmers, in general, did not have full comprehension about climate change and its impacts – either currently felt or potential – on the environment and their livelihood.
2. Rapid assessment as a research methodology can only determine the respondent's perceptions and insights on climate change. It does not measure the quantitative impacts of climate change on respondents' families or households.
3. Government support is erratic and inadequate because its agencies do not have the facilities and capabilities to forecast extreme weather changes.
4. Small-holder fishfarmers are price-takers; they need support in obtaining information about the local economy and global market that enable them to compete.

RECOMMENDATIONS

In the light of the research findings and conclusions, the following actions are recommended:

1. Risk analysis in aquaculture should be incorporated in resiliency studies in order to evaluate both the dangers and weaknesses of the aquaculture system *vis-a-vis* strengths or resiliency of the affected farmers in adapting to climate change. Depending on the scope of the research, the general categories of risk analysis as recommend by the Food and Agriculture Organization of the United Nations (Arthur *et al*., FAO, 2009) include pathogen, food safety, ecological, genetic, financial and social. Risk analysis will provide researchers, development workers and policy makers better understanding on how to deal with climate change and in turn formulate better policies and strategies in engaging the affected communities to cope with these disasters.
2. In social research, the process documentation approach will be useful in documenting the climate change events in a fishing community and the coping mechanisms that they adopt as the events happen (Korsten, 1988).
3. Community-based adaptation strategies can make use of the Philippine traditional "bayanihan" spirit or collective action for mutual help during emergencies and disasters.
4. Community protocol for assessing the impacts of aquaculture in their surrounding waters can also be used – certainly with modifications – to monitor changes brought about by climate change to enable the fishfarmers to respond to the situation (Santander, 2008).
5. A gender perspective, particularly concerning health, should be included in resiliency studies.

6. The national and local governments should devise strategies and put in place mechanisms and facilities for the timely dissemination of relevant information to the fishfarmers. The government should purchase up-to-date and adequate weather forecasting equipment and systems and should hire good scientists to operate these equipment, as well as conduct studies pertaining to climate change.
7. Fishing communities should be provided with timely market information (prices, consumer preferences distribution network) through cell phone text messages, radio and television, community bulletin and LGU internet to enable them to compete.

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Poverty alleviation and women's empowerment through aquaculture: an experience from Nepal

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Pant, M., Shrestha, K. & Phillips, M.J. 2013*. Poverty alleviation and women's empowerment through aquaculture: an experience from Nepal. *In* M.G. Bondad-Reantaso & R.P. Subasinghe, eds. *Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development,* pp. 181–187. FAO Fisheries and Aquaculture Proceedings No. 31. Rome, FAO. 255 pp.

ABSTRACT

An adaptive research project carried out involving women members of ethnic *Tharu, Darai, Bote* and *Gurung* communities in Chitwan and Nawalparasi districts in Nepal between 2000 and 2007 evaluated the role of a farm pond in diversification of livelihoods and reducing vulnerability. A newly introduced aquaculture sub-system complemented well with the existing farming systems by virtue of increased synergistic relationships among the three sub-systems transforming traditional mixed crop-livestock farming systems to more diversified Integrated Agriculture Aquaculture (IAA) Systems. Food and nutrition security of the participating households increased as a result of a notable rise in quantity and frequency of fish consumption. In addition, household incomes were augmented through the sale of surplus fish. Development of Community Fish Production and Marketing Cooperatives, exclusively owned and managed by the women themselves, helped in women's empowerment through their increased access to and control over resources and increased roles in decision making at both household and community levels. The study strongly suggests that IAA farming households are likely to be more resilient in coping with ecological, social and economic perturbations than their counterparts practicing traditional mixed crop-livestock farming.

Keywords: fish; Integrated agriculture-aquaculture (IAA); Livelihoods; Resilience; Nepal.

BACKGROUND

Rural livelihoods that are dependent on small-scale farming system in Asia and elsewhere are becoming increasingly vulnerable to the effects of global climate change and changes in social and economic systems. Increasing vulnerability of livelihoods is attributed to increasing incidences of one or more types of "shocks", namely physical, biological, economic, and social and policy (Resilience Alliance, 2007, 2010). In Nepal, melting of

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* Parts of this paper were also published earlier: **Pant, J., Shrestha, M.K. & Bhujel, R.C.** 2012. Aquaculture and resilience: Women in aquaculture in Nepal. p. 19-24. *In* M.K. Shrestha & J. Pant, eds. Small-scale aquaculture for rural livelihoods: Proceedings of the National Symposium on Small-scale Aquaculture for Increasing Resilience of Rural Livelihoods in Nepal. Institute of Agriculture and Animal Science, Tribhuvan University. Rampur, Chitwan, Nepal, and WorldFish, Penang, Malaysia.

glaciers at a rapid rate, uneven distribution of monsoonal rainfall, and increasing incidences of floods and droughts – common effects of global climate change – have become phenomenal in recent decades. Consequently, adaptive capacity of semi-subsistence crop-livestock-based rural livelihoods in the country is believed to be declining.

Diversification of livelihood options is vital to maintaining ecosystem resilience and building social systems resilience. Integrated agriculture-aquaculture (IAA) farming systems – considered among the promising options for small-scale farming households in China and Viet Nam for ages – is likely to be relevant in the context of mixed crop-livestock farming systems elsewhere as well (Pant *et al*., 2005). The role of IAA systems in household food and nutrition security, income generation and empowerment of women and marginalized communities has been increasingly appreciated in recent decades in a number of countries of Asia and Africa. As elsewhere, livelihoods of traditional small-scale mixed crop-livestock farming communities in a relatively poor resource-base context in Nepal can also be improved through the introduction of an aquaculture sub-system. It is believed to be effective in increasing local fish supply and diversifying livelihood options of small-holder farmers in *terai* (southern plains) and mid-hill valleys, thereby also increasing resilience of rural livelihoods in these areas.

An adaptive research project, namely "Women in Aquaculture in Nepal" involving women members of *Tharu, Darai* and *Bote* – traditional fishing communities – was carried out in Chitwan and Nawalparasi districts in Nepal between 2000 and 2007, with the objective of diversifying livelihood options of the ethnic minorities. The project was jointly implemented by the Institute of Agriculture and Animal Science (IAAS), Nepal, Asian Institute of Technology (AIT), Thailand, and Rural Integrated Development Society – Nepal (RIDS - Nepal), a local NGO. The project, considering social, economic, ecological and institutional aspects, has successfully developed a model for small-scale aquaculture (SSA) development in Nepal (Shrestha *et al*., 2009). In this paper, we outline the key processes of aquaculture development and women's empowerment simultaneously, and discuss how aquaculture sub-system complemented with existing rural livelihoods and contributed towards building resilient livelihoods of ethnic minority communities. The results presented are based specifically on a survey of the project households in Chitwan in 2009 where the project was implemented right from the year of its inception in 2000.

AQUACULTURE FOR FOOD AND NUTRITION SECURITY AND BEYOND

Semi-subsistence farming was essentially the only source of livelihoods for the majority of the project households. The farming systems were characterized by cultivation of crops (particularly, paddy, wheat and maize) in multiple cropping systems, and raising of a few heads of livestock, namely cattle, buffaloes and goats. Most of the households also raised a few scavenging chickens/ducks.

Whilst most of the project households belonged to traditional fishing communities, fish captured from local water bodies had contributed significantly to their food and nutrition security in the past. Besides, some of the households had also augmented their incomes through selling their catches that were surplus over household consumption. Most of the households used to go for fishing when the farming activities were slack. Drying and storing of surplus fish over fresh consumption was common. Treating guests with a meal without fish or meat is rather uncommon in these communities. Family deities are also offered with the preparations made from fresh or preserved fish on special occasions.

However, there has been a sharp decline in natural fish stock over time due essentially to increased fishing pressure. Declining availability of natural fish among the traditional fishing communities has negative implication not only for food and nutrition security but also for their cultural and social values. Whilst reducing exposure and sensitivity, and increasing adaptive capacity (Beveridge, 2009) to cope with socio-economic and environmental perturbations are key to increasing resilience, rationale for the introduction of aquaculture was to reduce the dependence of these communities on ever-declining capture fisheries and at the same time ensuring sustainable supply of fish for family consumption as well as augmenting household income from the sale of surplus. Besides, aquaculture development in the area was also believed to have positive impact on local aquatic resources by reducing fishing pressure.

AQUACULTURE INTERVENTION IN SMALLHOLDERS FARMING SYSTEMS: KEY PROCESSES

The project followed a systematic process. The interventions were centered around diversification of livelihood options through development of sustainable aquaculture, as well as empowerment of women members of the community through organizing them in cooperative owned and managed by themselves which we summarize in this section of the paper.

Sustainable aquaculture development

Whilst aquaculture is a relatively new farming activity, its integration, particularly in small-scale farming systems, requires a systematic process (Pant *et al.*, 2004, 2005) as any perturbation in the initial years may even lead to the abandonment of aquaculture practice. Considering this, the project judiciously planned its activities emphasizing introduction of backyard pond aquaculture during the first phase (2000–2002); its integration with livestock and horticultural enterprises in the second phase (2003–2005); and intensification of fish production system through development of freshwater prawn–fish integrated systems in the third phase (2005–2007).

Although most of the project households were traditionally making their living partially from capture fisheries, none of them had experience in culturing fish. Converting a paddy plot into a fish pond was a crucial turning point for them to transform their livelihoods from crop-livestock-based to IAA-based during the first phase. Excavation of ponds was carried out by using family labour but a partial subsidy covering 50 percent of labour costs was also provided to ease the transition. Size of pond, which ranged between 59 and 300 m^2, with an average of 234 m^2 in the initial years, was largely dependent on land availability, size of family labour force, and willingness of the households to convert their lands into ponds (Bhujel *et al.*, 2008). However, farmers continued expanding their ponds, resulting in an average pond size of 314 m^2 (Range: 33 to 3019 m^2) by the end of the third phase (2005–2007). Besides, spillover effects of the project have been quite impressive as over a dozen of relatively better off farmers in the area have also started fish culture at Small and Medium Enterprise (SME) level in recent years, which would inevitably contribute towards meeting an ever-growing fish demand in the area. The project households were provided with a series of practical training on pond construction, stocking, feeding and management, harvesting and post-harvest handling, maintaining farm records, and estimating costs and benefits of fish production system during the project period.

Integration of aquaculture with crop and livestock enterprises was the focus of the second phase (2003–2005). In smallholders farming systems, a farm pond is not only meant for fish culture, but it also serves as a reservoir for irrigation to the crops in pond dikes and adjacent farm plots. Benefits of aquaculture in the area were adequately realized through increased fish consumption and supplemental income from the sale of surplus. Besides, development of vegetable gardening in the dike and adjacent plots notably increased the vegetables consumption as well. In the third phase (2005–2007), integration of freshwater prawn with fish resulted in further increased efficiency of aquaculture as the farmers realized additional returns from prawn without having to compromise fish yields. Hence, aquaculture sub-system complemented well with existing household farming systems.

Women's empowerment through organizing them in cooperative

Empowerment of women through developing and strengthening their own organization was a key focus of the entire project. Therefore, concurrent to aquaculture intervention, savings groups involving women members of the households were formed in the initial years. During the first phase, all the members organized themselves in savings groups in which each of them saved a small amount on a monthly basis. They were registered as aquaculture farmers' groups with the Agriculture and Cooperative Office at district level during the second phase. They continued increasing their monthly savings, corresponding to increase in returns from aquaculture. By the sixth year in 2006, these women's groups were developed into a full-fledged cooperative "Rural Women Aquaculture Cooperative Ltd", exclusively owned and operated by the women themselves.

Initially, a total of 63 women farmers were embraced by the cooperative and the number is steadily increasing over the last few years. The project provided a sum of NRs 200 000 (USD 1 = NRs 72) as seed money while the members deposited their savings as share. The cooperative has been providing loan to its members at 12 percent interest rate for a maximum of six months per loan cycle. Members can apply for loan equivalent to a maximum of 20 times of their share in the cooperative. As of May 2010, over NRs 400 000 was disbursed – mostly for aquaculture and no defaulters have been reported so far.

DIVERSIFICATION OF LIVELIHOODS: CAN AQUACULTURE MAKE THE DIFFERENCE?

The project households reported on a range of benefits related to livelihoods improvement that they realized from fish farming (Table 1). The major one was improved household food and nutrition security by virtue of fish being readily available on-farm like rice, vegetables and herbs, without requiring direct expenditure in cash. In the past, cash expenses on meat or fish items used to be high as the households had to buy these from the market. However, expenditure on these items has reduced substantially in recent years. In addition, fish culture has been a good source of household income. Returns from fish were reported higher compared with those from other enterprises. Yet, labour requirement was substantially lower and the practice was considered rather easy. Institutional development and women's empowerment were indirect benefits realized from fish culture (Figure 1). The role of aquaculture in improving household food and nutrition security and augmenting income, as well as in women's empowerment is described below, along with its contribution towards increasing resilience of rural livelihoods.

TABLE 1
Fish production, consumption and sale by households in Kathar, Chitwan (n = 98)

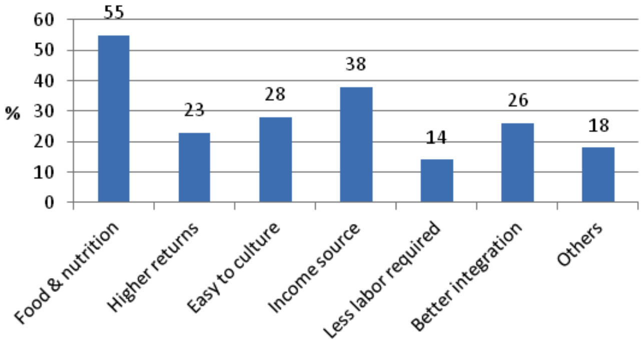
	Mean	StDev	Median	Min	Max
Pond area (m^2)	314.0	395.0	198.0	33.0	3019.0
Fish production(kg/year)	114.0	105.0	80.0	10.0	550.0
Fish Consumption:					
Household (kg)	58.0	49.0	50.0	7.0	200.0
Per caput (kg)	11.0	9.7	6.8	0.5	42.5
Consumption frequency (times/month)	6.5	5.4	4.0	2.0	16.0
Income (USD)	103.0	185.0	51.0	7.0	1430.0

Source: Household survey, 2009.

INCREASED FOOD AND NUTRIENT SECURITY

A notable improvement in food and nutrition security was evident among the fish farming households. According to the Food and Agriculture Organization of the United Nations (FAO, 2010), per caput fish consumption was estimated at 11.0 kg (range: 0.5 to 42.5 kg) which was over 7 times the national average of 1.50 kg. Per

FIGURE 1
Households' responses on benefits of fish culture in Kathar, Chitwan (n=98). (Rounding number exceeds 98 due to multiple responses)



Source: Household survey, 2009.

capita fish consumption among the same communities was estimated at 3.0 kg in the initial years (2001-2002) of fish culture (Bhujel *et al*., 2008) which increased steadily, reaching 11.0 kg in 2009 (Table 1). Such an increase in fish consumption was associated with the corresponding increase in fish production over time because of the increase in productivity as well as expansion of pond areas by the majority of the households.

Clearly, as opposed to very low national average in Nepal, per capita fish consumption among the project households was estimated to be close to the same in Bangladesh – one of the top 10 food fish producing countries. Frequency of fish consumption by the project households was estimated at over 6 times per month. In a situation where a majority of the project households were practicing semi-subsistence farming, their frequent consumption of fish – an expensive food item – has been possible only due to its on-farm production, which confirms the pivotal role of aquaculture in improving household food and nutrition security.

Increased income

Aquaculture played a vital role in augmenting household income right from the first year of project intervention. In the initial years, the project households used around 40.0 percent of the fish produced for household consumption and sold the remaining 60.0 percent (Bhujel *et al*., 2008). In recent years, however, they were using around 50 percent of the total production for household consumption. An average income from selling surplus over household consumption in the initial years was estimated at USD47, which increased steadily over the years, reaching USD103 in 2008. In addition to its significant contribution to household food and nutrition security, aquaculture has become a viable option to augment household income (Table 1).

Income from fish sales was used for a wide range of purposes. Purchasing foods and household merchandises and re-investing on aquaculture (pond expansion, seed and feed) were the major ones. Children's education (including school fees, books, stationeries and school uniforms) was another important area where income from fish was being used. Besides, paying for health care expenses and repaying family loan were also reported by a number of households.

Essentially, all the project households were planning to continue fish farming. Whilst most of them had already expanded their pond area once, nearly a quarter of them were considering expanding it again in the years to come.

Women's empowerment

Women fish farmers' improved access to resources and their increased role in household decision-making were noted as important outcomes of the project. Besides, organizing them through their own cooperative also contributed significantly to their empowerment. In over 40 percent of the households, decision-making pertaining to farming was carried out jointly by men and women, while it was done exclusively by male members in another 40 percent. Female members were the primary decision-makers in nearly one-fifth of the households. These findings reflect that women were directly or indirectly involved in household decision-making in over 60.0 percent of the project households.

Spillover effects of the project have also been impressive as over a dozen of relatively better off households have voluntarily started SME-level fish farming in recent years, corroborating a catalytic role of "Rural Women Aquaculture Cooperative" in developing aquaculture enterprises in the area.

The cooperative has been providing not only loans but also technical support to its members. It has been coordinating input purchase (including seed) and facilitates scheduling, harvesting and marketing. Moreover, increased participation of the cooperative members in a wide range of social activities has been observed, reflecting the enormous success of the endeavor – "empowering through organization". The role of the cooperative in addressing the problem of food security has been exemplary and secured a substantial media coverage at local and national levels. The success of "Women in Aquaculture in Nepal" project in diversifying rural livelihoods and empowering women has widely been commended at both national and international levels.

CONCLUSIONS

Our work with the ethnic fishing communities in Nepal for over a period of a decade visibly demonstrated that IAA farming households are likely to be more resilient to cope with ecological, social and economic perturbations than their counterparts practicing traditional mixed crop-livestock farming. Increased capacity of these households to cope with social and economic stresses is attributed to such factors as improved food and nutrition security, increased household income and empowerment of women members who – after getting organized in a cooperative owned and managed by themselves – could enjoy increased access to and control over resources and increased decision-making role in the households and the community. Future research should emphasize on assessing the role of aquaculture in increasing resilience of agro-ecosystems in these areas.

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Good governance, policies, and other frameworks that work in favour of small-scale aquaculture producers

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ABSTRACT

Aquaculture, as the fastest growing food production sector, provides tangible opportunity to generate sustainable rural livelihoods, further reduce poverty, ensure nutritional security and earn valuable foreign exchange. In India and elsewhere, the bulk of fish is produced by small-scale aquaculture (SSA), whose products are locally consumed and the sector contributes significantly to household income. Several gaps and inadequacies in the present policy, governance and institutional framework limit further development of SSA producers and overall rural development. Experience from implementation of field projects of the Food and Agriculture Organization of the United Nations in Bangladesh and action research programmes by Central institute of Fisheries Education, Mumbai in several states of India have demonstrated immense possibilities in significantly improving the livelihoods of small-scale farmers through good governance practices, appropriate technologies, innovative extension and market support services. This paper discusses these cases in some detail and the key principle learnings for good governance, policies, core values of service provider organizations and other frameworks that work in favour of SSA producers.

Keywords: small-scale aquaculture; aquaculture extension; institutional arrangements; participatory extension; policy and governance.

INTRODUCTION

The fisheries and aquaculture sector has been growing at a faster rate (compounded annual growth rate of 6.8 percent) than crop and livestock sectors during the last three decades. This sunrise sector provides tangible opportunity to generate sustainable rural livelihoods, further reduce poverty, ensure nutritional security and earn valuable foreign exchange. As in most of the developing world of Asia and elsewhere, aquaculture is becoming a major source of fish in India as well. Except for shrimp aquaculture and few patches of freshwater aquaculture in Andhra Pradesh, where aquaculture is practiced on commercial-scale using high input-based semi-intensive aquaculture in relatively large drainable ponds, elsewhere in India, it is a small-scale household-based food farming activity for family consumption and supplementing cash income for family through sale of surplus fish. Out of a total production of about 3.84 million tonnes, hardly ten percent, especially those coming from commercial-scale aquaculture, are exported. The bulk of fish produced by small-scale aquaculture (SSA) are locally consumed thus contributing significantly to the national, local and family level food and nutritional security. In the context of India, where more than one third of children and mothers do suffer from serious malnutrition, promotion of SSA deserves highest priority. But the lack of and inadequacies in the present policy and regulatory framework on one hand and appropriate governance and institutional framework on the other has limited its impact on SSA producers and overall rural development. It is also interesting to note that a large part of the commercial-scale aquaculture activities are based on technologies accessed by entrepreneurs themselves from elsewhere.

Experience from implementation of field projects of the Food and Agriculture Organization of the United Nations (FAO) in Bangladesh and action research programmes by Central institute of Fisheries Education (fisheries university of ICAR) in several States of India (Manipur, Tripura, Mizoram, Assam, Bihar, Jharkhand and Maharashtra) have demonstrated immense possibilities in significantly improving the livelihoods of small-scale farmers through good governance practices, appropriate technologies, innovative extension and market support services (Reddy *et al.,* 2010; Dube *et al.*, 2011). This paper discusses these cases and the key principle learnings for good governance, policies, core values of service provider organizations and other frameworks that work in favour of SSA producers.

GOOD GOVERNANCE – PERCEIVED ISSUES

In the case of fisheries and aquaculture, good governance means developing a responsible and well-regulated policy and institutional environments at national and local levels that involves communities (both men and women) and that recognizes the importance of local level needs and expertise in research, education, development planning, implementation, monitoring, evaluation and regulation. In the SSA sub-sector, peoples' livelihood strategies are influenced not only by available natural endowments but also by national institutions and local power structures and most importantly governance that regulates access to the natural resources like water, land and support services by the community. The other challenges include availability and access to appropriate technology, institutional finance including microfinance, subsidies and incentives including tax structure for water, energy and income. Capacity building and pro-poor orientation of development staff, community organisation including self-help groups (SHGs), marketing network creation and support services for both inputs and outputs do influence and play great roles in redefining the governance and institutional environment. It is equally important that the research and development (R&D) organizations realize the present contribution and untapped potential of SSA and give priority focus that this sub-sector rightly deserves.

More specifically, governance is perceived by SSA farmers as adequate access to appropriate technology and services, access to incentives, hand holding by the development agencies, awareness about programmes and schemes, transparency in the implementation of schemes and process, their participation in planning, implementation, monitoring and evaluation (M & E) and decision making, and that they be considered as development partners rather than as passive receivers of doles.

From SSA farmers' perspective, enabling policies would mean reorienting the role and functions of various State Departments of Fisheries (DOFs) that are presently focused on revenue generation, regulation and distribution of subsidies. There has to be a paradigm shift from DOF as the predominant legal/regulatory authority to an agency for promoting aquaculture for development. More importantly, the larger goal of economic development shall not prioritise commercialization, export earning, and enhancing production, but rather poverty reduction, rural livelihood development, food and nutritional security following an inclusive growth strategy that reduces gap between rural and urban, and the resource poor and well-off sections of society. Public-funded research institutions have also to redefine their goals and objectives and prioritise their research agenda to suit to the needs of SSA producers. Commercial farmers have the means and capacity to access and use technologies developed elsewhere and pay for technical services rendered by private experts.

One of the essential ingredients in addressing the concerns of SSA farmers is developing and making available appropriate technologies that are low cost, required inputs are locally available and makes use of household/farm outputs to greater extent, are simple to comprehend and apply. It shall have short gestation period so that it produces outputs to meet times of family needs and emergencies while at the same time meets the local demand and catches good price. These technologies should have low level of perceived risks in order to be easily adopted by SSA farmers.

However, this cannot happen in the context of present R&D environment that is focused on enhancing production through intensification and high technology, high value commercial aquaculture. Developing biotechnological means is rather short-sighted with its heavy accent on creating expensive infrastructure and laboratory equipment oriented research programmes. Lack of mainstreaming of social sciences, emphasis on publications, inadequate field trials are some of the shortfalls of the present R&D environment which have to be reformed if we need to seriously address the concerns of SSA farmers. Currently, R&D institutions are suffering from "performance race" syndrome where performance is evaluated largely on publications and number of technologies developed. As a result, scientists look for pasture land which may allow them to crop good number of publications in the shortest possible time frame. Often technologies are released half-baked and techniques are claimed as technologies. All these have resulted in drastic reduction in technology flow from R&D institutions to the SSA sub-sector. At this point we quote few lines from the address of the Prime Minister of India indicating these concerns.

> *"...Unfortunately there is an impression among many that the National Agricultural Research System has become somewhat insular over time and responds less well to specific demands from those in the field. You must never lose sight of the fact that your main client is the Indian farmer. Unless you engage with farmers and their problems, you will not succeed in transforming new knowledge into higher productivity and better incomes for our farmers. You must get your research questions primarily from the farmers. This is perhaps the most difficult of the challenges that you must overcome in the years ahead and which can test your commitment and ability".*
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> *Indian PM's Address at 83rd Foundation Day of ICAR, New Delhi, 16 July, 2011.*

With respect to farm inputs, their access, cost, quality, timely and year-round availability in the vicinity, the lack of bargaining power due to small quantity continue to be the major concern of SSA farmers. Moreover inputs are often 'pushed' rather than 'pulled' by SSA farmers raising questions of their appropriateness and cost. Extension support services are rather inadequate due to top-down approach with focus mainly on transfer of technology. Often the target is the master of the house and not the family/women members though women play a crucial role in SSA. The lack or absence of appreciation of social mobilisation skills by the extension system and staff means that the empowerment, organization of small-scale farmers and their organizational development, are not on the agenda of development agencies, thus incentives/subsidies outweigh services. In pragmatic terms, there are very little efforts to tap the potential of farmers to participate in extension services with formal cooperatives becoming non-functional and pocket organizations with few empowered office bearers. Extension system also suffers from a lack of incentives, inadequate resources, and logistics support.

For the SSA farmers, access to institutional finance is rather restricted as it is led by governmental and non-governmental organizations with unfavourable terms and many traps. Sometimes, it is encouraged even though not critically needed. The SSA farmers' predicament in marketing their small quantity of surplus produce is very typical, with higher harvesting and transportation cost and increasing role of middlemen. Hence, organizing SSA producers for inputs mobilization, as well as harvesting and marketing, is of paramount importance and calls for priority focus of extension.

Small-scale producers are invariably treated as passive recipients of subsidies while many of the deserving beneficiary households are usually left out even to receive these incentives from development agencies. As activities are often designed to get incentives, this in the long-term fundamentally distorts services and governance leading to aid addiction and subsidy syndrome. Moreover, there is a lack of synergy between development programmes at the grassroots level which are sometimes found to be ccompeting, not complementing. Hence, there is a need to have convergence at the top, middle and local levels. In India, the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), besides generating rural employment, has also been able to create community and individual physical assets including ponds and dams in rural areas, which only recently are being thought of as potential resources for aquaculture. Earlier consultation and planning would have made these resources more suitable in the first place, for aquaculture.

One of the distinguishing characteristics of SSA producers is their high degree of vulnerability to disasters like flood, drought, pollution, climate change, poaching, poisoning, etc., due to their lower resource endowments and subsistence level livelihood activities.

It is in this context that there is a strong argument to make the SSA farmers as active partners in development through an all-round empowerment, i.e., economic, social, and political; empowerment in these domains will be effective and sustainable only if they are encouraged to get organized and the empowerment process is mediated through their organization. It is important that their capabilities are built through skills development programmes and they are systematically involved in extension, planning, implementation, M&E of development programmes.

Appropriate aquaculture technologies, namely manure-based low-cost carp polyculture, manure- and feed-based carp polyculture, polyculture of carps and freshwater prawn, monoculture of freshwater prawn, and household-based fish-cum-pig integrated farming, were further refined and adapted through action research and demonstration following a Trickle-Down System (TDS) of Aquaculture Extension implemented by the Central Institute of Fisheries Education (CIFE), Mumbai during the period 2003-2004 to 2007-08 in Manipur, Tripura, Mizoram and Assam (Reddy *et al*., 2010). Results indicated that average fish production after demonstration of manure-based low-cost carp polyculture increased to 2503 kg/ha, from the baseline production was 1273 kg of fish/ha within 8 months. This translated into a net profit of Indian Rupees (Rs.) 31 879/ha or Rs. 16 513/farmer against the baseline scenario of Rs. 15,931/ha or Rs. 8252/farmer having an average area of 0.5 ha of simple dug-out, rainfed and undrainable pond, representing a 200 percent increase in net profit. Here, it shall be noted that the average cost of production is significantly low, using the cheapest technology, where every additional rupee spent earned Rs. 2.80 profit. This technology is most appropriate for small-scale farmers with less surplus and limited cash income. It offered less risk, was simple to use and relied principally on local resources except for the purchase of fingerlings.

One of the challenges was availability of required quantity of fingerlings (or yearlings) in nearby vicinity as the success of technology depended on it. Additionally, it could be converted into an opportunity with collective effort and cooperation on the part of farmers, CIFE and state fisheries departments. Farmers with perennial ponds became seed growers and supplied fingerlings mutually benefitting all and adding more value. Another important lesson was that technologies are neither scale-neutral nor space- and time-neutral and hence they need to be adapted to suit various location specific aqua-climatic as well as socio-economic characteristics. Thus standard technological prescriptions, be it composite fish culture or carp-prawn polyculture or integrated farming systems, had to be converted into appropriate farm and farmer specific technologies in order to make them relevant and work in the long term. As this process was mediated with active participation of farmers, the outcome was not only enriching but also became sustainable and popular.

The 700-plus farmer-led demonstrations in a span of one year in Bangladesh under the FAO project TCP/BGD/4451 "Strengthening Rural Pond Fish culture Extension Services" led to nearly three-fold increase in production from 1 461 kg/ha to 4 105 kg/ha with a benefit cost ratio of 3:1 as against 2.1:1 earlier production ratio. The success of such a large country-wide demonstration was mainly due to the active participation of farmers in the demonstration including mobilizing of required inputs exclusively from their own resources; simple, low cost and locally-available inputs-based technology; and effective extension approach (FAO, 1996).

Although aquaculture technologies were available for many years, its adoption and potential to promote rural livelihoods was low as reflected in the poor average yield from aquaculture. One obvious reason was that the existing conventional top-down extension system was not able to drive large-scale adoption of technologies by small-scale producers who were often dispersed across far and remote areas. This flawed extension system worked, to some extent, only in resource-rich regions, and among progressive farmers who 'pulled' the available technologies from private as well as public R&D agencies. Until recently, there was hardly any impact in regions dominated by resource poor farmers as in Manipur and Tripura. This illustrates another fundamental principle that it matters greatly not just *what is delivered* (particular technology), but also *how it is delivered* (extension approach followed) if we want to ensure large-scale diffusion of technology across different segments of farmers and improve livelihoods. The participatory TDS of Aquaculture Extension method not only made large-scale adoption possible, but farmers gained moral ownership of technology and its diffusion process as well as regained their self confidence (Kumar, 1999).

The participatory and collective extension approaches cannot blossom within an institutional environment designed predominantly to cater to the regulatory- and revenue- oriented objectives. In order to reorient the extension machinery of fisheries departments and make it as a professional service delivery agency, the DOF staffs were made integral part of both TDS and other co-management approaches. Besides, several separate training/human resources development (HRD) programmes were conducted during the same period for DOF staff on subject areas such as extension approaches as well as participatory technology refinement and demonstration processes. These efforts have created certain positive changes in the institutional environment as well as the governance of these programmes, including: (i) changed attitude and approaches among DOF staff towards field-oriented developmental work; (ii) increased transparency and accountability of DOF among farmers and fishers; (iii) participatory farmer-led extension system for small-scale producers; (iv) changed attitude of banks towards funding aquaculture activities; and (v) changed attitude of community organizations towards developmental programmes.

Marketing has been one of the weakest link in increasing the share of small-scale producers in consumers' price. Small-scale fish farmers in Tripura formed 600-plus fisheries-based SHGs and cooperated as a collective unit for joint advance planning of culture activities in order to regulate supply, collective purchase of seed and other inputs at reduced rates, and regulated multiple harvest to control supply in local markets for better price. As a result, Tripura witnessed an average annual growth rate of 20 percent during the period 2004-2008 and higher *per capita* annual consumption of fish. Good governance and all other supportive frameworks outlined above were in full practice in a collaborative mode among all state fisheries departments, CIFE, farmer SHGs and village-level panchayati raj institutions.

In SSA, especially homestead/backyard aquaculture, women play relatively more productive and effective roles in aquaculture activities such as periodic application of manure, feed, regular monitoring and management. Not only are these in alignment with women's household activities, women are more receptive to extension advice, they manage financial resources judiciously, and ensure sustainability of aquaculture practices. Participation of women in SSA is beneficial for aquaculture as well as for their family. In addition, only pond preparation/renovation and harvesting require 'hard' physical labour while others are not strenuous and time consuming jobs but require constant and periodic attention (manuring, feeding, monitoring) where women are more effective in performing. It was observed that women's participation ensured more equitable resource sharing within the family while improving their position in society.

LESSONS LEARNED

The MGNREGA was aimed at creating community/common property assets like water harvesting structures providing a minimum of 100 work days of rural employment. But this resource has been tapped to develop fisheries-based livelihood for small-scale fish farmers. Interventions have been taken up by CIFE in the states of Jharkhand and Maharashtra, India to integrate aquaculture with the ponds developed under MGNREGA so that there are multiple users of this resource. This integration has brought policy changes in the way MGNREGA is being implemented.

An action research on community-based enhanced-fisheries management in Dimbhe reservoir (1278 ha), Pune, Maharashtra has been undertaken by CIFE during 2006–2010. The reservoir has very low primary productivity and is very remotely located with 200 displaced and highly disadvantaged families of the primitive tribe, *Katkaris*, inhabiting the peripheral villages. Various technical, social, managerial and marketing interventions along with community mobilization, organization and subsequent empowerment with the active support of a grassroots NGO has led to significant increase in fish production and income and at the same time, ensuring both income and gender equity. Soil organic carbon increased from 0.45 percent to 0.70 percent, and net primary productivity increased from 225 mg C/m^3/day to 265 mg C/m^3/day. Catch composition has changed from dominant but low value *Chela* sp. to relatively more profitable catla and rohu whose yields increased by more than 200 percent. The gross sales of the fish increased from 5.10 lakh Rs to 7.03 lakh Rs in the year 2009 as compared to years 2006-2007 (Dube *et al.*, 2010).

It is incumbent upon policy makers and planners to clearly recognize and prioritize policy objectives. Experiences from within India with varied objectives, often implicit in programmes and strategies adopted, have produced interesting insights in terms of implications for small-scale fish farmers. The Tripura model of attaining self-sufficiency in fish production through generating SSA-based livelihoods since 2003–2004 has led to economic and social empowerment of large number of small producers. The Andhra Pradesh model has adopted a development-oriented policy which led to impressive fisheries development with resultant socio-economic upliftment of farmers during the 1980s and early 1990s. However, the rather 'unregulated' and market-based approach since mid 1990s resulted in negative ecological impacts including potential biodiversity loss and inequitable benefits among small-scale and large-scale farmers/fishers. This has raised questions on sustainability of fisheries development at present and underscored the need for balancing development objectives with long-term conservation, sustainability and equity objectives. The 'revenue-based model' of reservoir/tank leasing policy in Rajasthan led to high lease revenue from reservoir fishing while the productivity also increased significantly, among the highest in India. But this open auction model has systematically failed to generate rural fisheries-based livelihoods as it favoured few large contractors who exploited wage labourers. It underscored the need to balance and prioritize livelihood generation vs. revenue generation while making policies.

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Improving access to financial services by small-scale aquaculture producers: challenges and opportunities

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Ahmad, I.U. 2013. Improving access to financial services by small-scale aquaculture producers: challenges and opportunities. *In* M.G. Bondad-Reantaso & R.P. Subasinghe, eds. *Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development,* pp. 197–206. FAO Fisheries and Aquaculture Proceedings No. 31. Rome, FAO. 255 pp.

ABSTRACT

Developing countries produce the bulk of aquaculture production, with significant contributions from small-scale aquaculture (SSA). Small-scale producers are facing new opportunities to improve their incomes and livelihoods as the market for aquaculture products continues to expand globally. However, small-scale producers need to overcome a number of challenges such as getting access to financial resources, integrating into modern supply chains and complying with increasingly stringent food quality and safety requirements demanded by national and international markets. Credit, a major component of financial services, is a critical input for establishing and operating financially viable small-scale aquaculture businesses. Semi-formal and informal sources are major suppliers of credit, while access to credit from formal sources is limited due to high transaction costs, lack of staff capacity and other banking-related factors. While there are multiple pathways to achieving business success for small-scale producers, experiences have shown that, in addition to ensuring access to financial services, a set of complementary investments by the public and private sectors, such as improving farm productivity and promoting producers' organizations, is usually needed to achieve business goals. It is also important that government policies and legal and regulatory framework are supportive of sustainable development of SSA.

Keywords: small-scale aquaculture, access to financial services, credit, rural finance.

INTRODUCTION

Aquaculture continues to be the world's fastest-growing animal food production sector and currently accounts for nearly half (45.6 percent) of the world's food fish production for human consumption (FAO, 2011). It is estimated that by 2012 more than 50 percent of global food fish consumption will originate from aquaculture. The Asia-Pacific region continues to dominate the aquaculture sector, accounting for

89.1 percent of global production. Although precise data is lacking, it is recognized that small-scale producers are important players in developing countries across Asia-Pacific, Africa and Latin America, making substantial contributions to economic growth, poverty reduction and food security. According to recent analyses, more than 16 million small farms are currently involved in aquaculture in Asia (RLF/WorldFish Center, 2010), with perhaps as many as 20 million globally[1]. Aquaculture in the Asia-Pacific region is dominated by small-scale aquaculture (SSA). Around 80 percent of aquaculture production in many countries in Asia comes from small-scale, family-owned operations (Phillips *et al.,* 2007).

Small-scale aquaculture involves a range of activities, from subsistence fish farming, practiced by farmers as part of a diverse livelihood strategy, to commercial operations, requiring more substantial labour and capital inputs, to micro- and small- enterprises (MSE) across value chains. However, while SSA is socially and economically important and continues to remain innovative, it faces many constraints and challenges such as getting access to financial and technical services, integrating into modern supply chains and complying with increasingly stringent food quality and safety requirements demanded by national and international markets. On financial services, due to the absence of systematic recording and collating of data by funding sources at the regional and country levels, it is difficult to quantify the total amount of such funds channeled to the SSA sector and hence the proportion of lending by each source.

SCOPE

Financial services broadly include: loans, savings, payment services, money transfers and insurance (ADB, 2010; and Tietze and Villareal, 2003). It is widely acknowledged that financial services can contribute significantly to sustainable development of SSA. However, due to the lack of global level systematic and comprehensive studies on the impact of financial services on SSA, this paper draws on limited data and information available from some case studies and development projects. It needs to be pointed out that there is no such hard data at the global level even in the case of large-scale aquaculture. However, some country case studies on financial services for small and marginal enterprise (SME) aquaculture producers and a global review of aquaculture insurance had been recently carried out (Kleih and Con Ich, 2010; Orchard and Abban, 2011; and Van Anrooy *et al.,* 2006). This paper makes references to the country studies and global review where appropriate. The paper primarily examines different pathways for improving access to loan or credit and insurance facilities by small-scale producers.

STRUCTURE OF PAPER

The paper first presents an overview of the characteristics of the different sources of financial services in a typical rural financial market (RFM), of which SSA is an important segment, then highlights some challenges and opportunities faced by small-scale producers in accessing financial services, and finally concludes by providing some suggestions for consideration by policy makers.

Rural financial market

As an integral part of the rural sector, SSA is an important livelihood activity which demands specialized financial products for achieving sustainability. Supply of adequate, timely, affordable and easily accessible financial services is important to support different elements of small-scale producers' livelihood strategies. The elements could be grouped into three broad areas: (a) smoothing small-scale producers' household

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[1] About 87 percent of the world's 500 million small farms (less than 2 ha) are located in Asia (The WorldFish Center, 2011).

income cycle (e.g. consumption loans to mitigate cash flow problems); (b) meeting unforeseen costs (e.g. in the absence of insurance mechanisms, small-scale producers require loans to meet the costs of unforeseen events, such as ill-health, accidents or adverse weather); and (c) supporting new businesses or scaling-up existing businesses (e.g. need for loans to operate micro- and SSA enterprises, or when graduating from subsistence farming to commercial farming).

In presenting an overview of the characteristics of the different sources of financial services in a typical rural financial market (RFM), this section: (a) describes the three broad sources of financial services; (b) explains the integrated approach model, which includes provision of both financial and non-financial services; and (c) summarizes the status of the aquaculture insurance market.

Sources of financial services

In the context of a typical rural financial market, financial services, notably credit, could be availed from three broad sources (Tietze and Villareal, 2003): (a) formal financial institutions (e.g. public and private development banks and commercial banks) that are subject to banking regulation and supervision); (b) semi-formal financial institutions, notably Microfinance Institutions (MFIs)/NGOs, credit unions and cooperatives and some Self-Help Groups (SHGs) that are usually not regulated by banking authorities, but are licensed and registered and supervised by other government agencies[2]; and (c) informal sources or entities (e.g. money lenders, shopkeepers, friends and relatives, and input suppliers and processors) that operate outside the structure of government regulation and supervision. The three sources are further analyzed in the context of SSA.

Formal financial institutions: While in principle small-scale producers in developing countries can have direct access to financial services from formal financial institutions, in practice they have limited access. A case in point is Ghana, where only 12 percent of aquaculture producers are able to obtain loans from either agricultural or commercial banks (Abban *et al.*, 2009). Formal financial institutions are generally cautious in extending loan facilities to SSA producers because of the inherent risks involved, such as the outbreaks of fish disease that could totally eliminate stocks, the long production cycle needed for repayment, the lack of farmers' capacity to prepare viable and bankable projects, the lack of staff capacity to appraise financial services needs of small-scale producers, the high costs involved in small transactions, and the lack of adequate collateral to cover risks.

Nonetheless, there are few cases of disbursement of formal credit to small-scale producers in some countries in sub-Saharan Africa and Asia. For example, in Kenya, Malawi and Nigeria, soft credit lines for aquaculture projects are provided by agricultural banks and commercial banks (Satia, 2011). With regards to credit in Asia, an important development is the Government of Vietnam's direct support to realize the potential of stripped catfish within the context of the country's aquaculture development. In addition to research and trade promotion support, the Government has arranged support for bank loans to both producers and processors (Thanh Phuong and Oanh, 2010). In the case of shrimp, which is mainly produced by small-scale producers, almost all farmers were able to obtain credit a few years ago when the market was booming. However, due to the recent global financial crisis and its repercussions, only about 60 percent of producers have credit – i.e. about 20 percent have debt from previous years, and 40 percent have new debt. It is expected that access

[2] There are exceptions as well. For example, in the case of Bangladesh, Non-government Microfinance Institutions (NGO-MFIs) have been brought under a regulatory framework (Microcredit Regulatory Authority Act, 2006). There are also cases of groups in many countries that are initially not registered.

to credit will improve in the near future given that the market is improving again and interest rates have been going up as well ((Kleih and Con Ich, 2010).

Semi-formal institutions and informal sources: Owing to the difficulties of obtaining loans from formal sources, small-scale producers' credit needs are largely met from semi-formal institutions and informal sources. Semi-formal institutions, mainly NGOs and Self-help Groups, have emerged as key players based on a variety of linkage programmes with formal institutions. For example, bank finance could be extended directly to a group or to NGOs for onlending to groups. In the latter case groups are promoted, nurtured and trained by NGOs. However, as most of the NGOs are dependent on grants and subsidies provided by donors, sustainability of NGO programmes often remain an issue after withdrawal of donor support or completion of projects.

Commercial aquaculture producers often have access to loans from their producers' associations and input suppliers and traders. The latter usually require producers to sell their harvest to them, often on unfavourable terms of trade. On the other hand, subsistence producers generally finance their activities with funds provided by friends and relatives. In a developing country context, as an example, small-scale shrimp producers in Viet Nam can obtain credit from a number of informal sources under varying terms and conditions, some of which are not in favour of the producers (Kleih and Con Ich, 2010; Box 1, Table 1).

Integrated approach

Research and project implementation experiences have shown that small-scale producers usually require more than financial services to face market challenges and ensure successful operation of their businesses (Kassam, Subasinghe and Phillips, 2011). The range of services can be broadly categorized into four groups (Tietze and Villareal, 2003)[3]:

- financial intermediation: the provision of financial products and services, notably credit and savings;
- social intermediation: the process of creating and building human and social capital required for sustainable financial intermediation;
- business and enterprise development services: a wide range of non-financial services and interventions that assist borrowers in running their micro businesses; and
- social services: non-financial services such as health, nutrition, education and literacy training.

BOX 1

Viet Nam small-scale shrimp producers: informal credit sources

Supply of inputs on credit (e.g. feed, in particular once the first 80 days of production have passed; cash price for shrimp feed is VND 27 000/kg and VND 28 500 if it is on credit); Credit provided by processing company (e.g. provide loan for 50 percent or 100 percent of working capital, provided the same proportion of the harvest is sold to the company); and Traders, other farmers, or money-lenders (usually charge high interest rate; e.g. 3 – 5 percent per month).

Note: Exchange rate (November 2010): 1 USD = 19 500 VND (*Vietnamese Dong*).

[3] Further discussed in the section on "Challenges and opportunities".

TABLE 1
Overview of Financial Services in the Aquaculture Value Chain of Vietnam

Stages in the export value chain	Financial services used and provided	Issues and challenges
Input Suppliers (e.g. feed, veterinary drugs, extension)	Input suppliers (e.g. feed companies) provide producers with inputs on credit. They carefully assess production and once they have ascertained that production is going according to plan then they provide inputs on credit during the last few months of production.	Inputs provided on credit are more expensive than inputs provided on cash. For example, cash price for shrimp feed is VND 27 000/kg compared to VND 28 500/kg if feed is on credit. Credit is short-term and only available for part of the production.
SME Aquaculture Producers (shrimp, Pangasius)	SME aquaculture producers obtain credit from a range of sources, including banks, input suppliers, processing factories, and informal sources, such as traders, friends or relatives. At present, producers appear to fund most of the capital costs through equity (own money or from friends or relatives), whilst part of working capital tends to be funded by the formal sources.	Although the feasibility of a potential project is being assessed which would include a credit element, at present little credit seems to be available for capital costs (i.e. "there are already enough ponds"). Credit access for working capital is easier. Credit from informal sources such as traders often comes with unfavourable conditions attached.
Intermediary traders/agents	Intermediary traders have access to bank loans, in particular if they can provide collateral. Some have large turn-over (e.g. USD 300 000/month). They provide loans to aquaculture producers (e.g. for fingerlings or post larvae), usually on the condition that the harvest will be sold to them.	The role of intermediary traders is diminishing in the Pangasius production system which is becoming more integrated. They are more prominent in areas where small-scale shrimp production dominates. They have a reputation for unfavourable loan conditions (e.g. high interest rates, 3 to 5 percent per month) or low purchasing prices.
Processing Factories Exporters	Processing factories tend to be large enterprises, in particular if they produce for overseas export. As a result, they tend to have relatively easy access to bank credit. They provide aquaculture producers with credit, in particular for working capital (e.g. fingerlings or feed).	Some banks appear to give credit to processing companies in order to avoid dealing with large numbers of SME producers. The processing companies then use the funds for on-lending to producers. The latter are usually expected to sell to the factory in return; sometimes reflecting the proportion of loan they have received for working capital (e.g. 50 percent).

Source: Kleih and Con Ich, 2010.

Globally, MFIs take on either one of two approaches in providing any of these services. The first is the minimalist or "credit first" approach that considers credit as the central piece in the business development programmes. In some cases, there are limited social intermediation inputs in group formation. The second approach, called the integrated approach or "credit plus" approach, recognizes the importance of providing both financial and non-financial services in supporting their clients. However, an MFI's decision to adopt a specific approach is guided by a number of factors: the objectives of the MFI, the demand and supply situation, in which it is operating, and the additional costs and feasibility of delivering such services.

Aquaculture insurance market

The worldwide aquaculture insurance market is at a preliminary stage, despite the increase in demand for insurance to share the risks associated with the rapidly changing production processes. A global review of the aquaculture insurance market by FAO (Van Anrooy *et al.*, 2006) reported that a conservative estimate of the total number of aquaculture policies in force would be between 7 500 and 8 000, with some 5 000 policies in the Asia region alone, indicating that less than one percent of the estimated 11 million farmers are insured. The aquaculture insurance market structure is dominated by a small number of international and national underwriters and reinsurance companies. Small-scale producers in Asia, Africa and Latin America and the Caribbean have little or no access to insurance, while the export oriented, more industrialized sector (e.g. salmon and shrimp) is somewhat better covered.

As a follow-up to the FAO global review of aquaculture insurance, a regional workshop held in Bali on the promotion of aquaculture insurance for small-scale farmers in the Asian region suggested the development of a layered risk management system, called the "hybrid approach" (Bueno and Van Anrooy, 2007; Secretan *et al.*, 2007). Broadly explained, at the bottom of the layered system is improved on-farm management based on adoption of better management practices (BMPs) by groups or clusters of farmers. Next is the development of mutual insurance schemes among groups of farmers and their associations, which constitutes the first level of insurable risks. The next level includes participation of national and international insurance and reinsurance companies. Finally, the top level consists of well-managed government emergency disaster relief systems and improved extension services.

At a subsequent workshop, which was conducted jointly by the Thai Department of Fisheries and FAO in September 2009 in Bangkok, it was agreed that the shrimp farming sector of Thailand, which includes around 13 000 farms (of which 85 percent are small-scale operations), would constitute an ideal group for the application of the "hybrid approach" and that formation of a mutual insurance company to be owned and operated by shrimp farmers themselves would be the best way forward. It was also recognized that Government would be required to provide an enabling environment through a policy and legal framework that would allow the establishment of a mutual insurance scheme. The workshop further recommended that a committee be formed to report on the social, legal and financial feasibility of establishing a mutual insurance company for the Thai shrimp farmers (FAO, 2010).

CHALLENGES AND OPPORTUNITIES

Small-scale aquaculture producers in developing countries are facing new sector challenges and opportunities for raising incomes and livelihoods as the demand for aquaculture products continues to grow in both domestic and international markets. However, most small-scale producers have had to market their products without access to reliable, affordable and adequate inputs and knowledge, financial, technical or transport services. Moreover, those small-scale producers who are able to access markets often find themselves disadvantaged owing to their weak bargaining position (Kassam, Subasinghe and Phillips, 2011).

Liberalization of markets and globalization of aquaculture trade have exacerbated the position of small-scale producers, as they have to deal with increased risks related to thin and volatile markets, compete with large commercial producers from all around the world and meet increasingly stringent quality and safety requirements demanded by buyers and consumers. Meeting the food safety standards, traceability, certification and other non-tariff conditions demanded by buyers and consumers require considerable investments. However, with limited resources and capacity, small-scale producers find it difficult to comply with these requirements and hence effectively integrate into modern supply chains.

Despite these challenges, there are many opportunities to bring social and economic benefits to small-scale producers. To establish themselves as a valuable supplier of aquaculture products in the global aquaculture market, small-scale producers should be supported to develop commercially viable businesses that would have scope to increase in value over time. While there may be multiple pathways to achieving business success for small-scale producers, experience has shown that, in addition to ensuring access to financial services, a set of complementary investments is usually needed to achieve business goals (The WordFish Center, 2011). Public and private sector investments in commercially oriented SSA have usually focused on development of individual investment components. Consequently, investment returns have been reduced and undervalued.

The following types of investments, which would also improve the overall financial viability, governance and management of the aquaculture sector, need to be considered in totality by policy makers and private sector, including small-scale producers:

Improving farm productivity. The focus is on investments, such as facilitating adoption of environmental standards, that support improvements and efficiencies in farm productivity and hence profitability. Investments in R&D such as development of better feeds or higher yielding fish strains could also be considered in this group.

Promoting farmers' organizations. Promoting and developing collective action among small-scale producers in the form of farmers' organizations could allow them to take advantage of economies of scale for access to goods and services, improve bargaining power, improve management systems, build social capital and create more equitable relations with input and output markets and comply with trade requirements in a cost-effective and responsible manner. Governments need to facilitate the development of small-scale farmers into farmers' organizations or producers' associations, or "cluster groups", or SHGs through capacity building on better management and marketing practices and other technical measures. India offers a good model, which is being replicated in some countries in the region, for effectively providing financial and other aquaculture support services to small-scale producers through adoption of better management practices (BMPs) and formation of "aquaclubs/societies" and clusters (Box 2).

BOX 2

Successful adoption of better management practices (BMPs) by small-scale shrimp farmers in India (2002-2009)

In the area of aquaculture support services, a major success story in Asia is the adoption of better management practices (BMPs) in India by small-scale shrimp farmers, who are organized into "aquaclubs/societies" and clusters. The BMP model is a good example to the rest of the world for supporting sustainable SSA development and management. Under a collaborative project between Marine Development Authority (MDA), India, and Network of Aquaculture Centres in Asia-Pacific (NACA), supported by FAO, shrimp farmers collectively implemented BMPs to reduce disease-related losses, improve yields and produce safe and quality shrimp.

In 2006, the project was implemented in five coastal states. BMPs were promoted in 28 clusters (aqua clubs) comprising 730 farmers (five in 2002) with 1,370 ponds. The production of BMP shrimp increased from 4 tonnes in 2002 to 870 tonnes in 2006. The prevalence of shrimp disease was reduced from 82 percent in 2003 to 17 percent in 2006. Farmers also had higher profitability and lower cost of production. In the demonstration ponds, for every USD 25 invested by a farmer, around USD 13 was earned as profit in 2006, compared with USD 6 by non-demonstration farmers. The project also improved the farmers ability: to articulate demands and to interact with markets and market forces; to access financial services; and to improve their farming skills and technical knowledge and awareness on pollution.

The government has been a driving force behind the success of the BMP model. To consolidate and expand the BMP activities after project closure, in 2007 the government established the National Centre for Sustainable Aquaculture (NaCSA) under the administrative control of the Marine Products Export Development Authority (MPEDA). In 2008-09, this centre extended support to 251 societies covering 6,486 farmers in five coastal states. Ongoing activities include: continued use of hatchery-supplied seed and pilot testing of specific pathogen free *P.monodon* seed in society farms; discouraging use of unnecessary chemicals and encouraging no use of antibiotics; use of a digitalized data base supported by geographic information systems (GIS), as part of the traceability programme; pilot testing of World Wide Fund for Nature (WWF) shrimp dialogue

BOX 2 (Cont.)

standards by societies; and working with banks and insurance companies to obtain credit and premium insurance coverage. Outside India, the BMP approach has been adopted by several countries in the Asia region (e.g. Viet Nam, Thailand and Indonesia), and is expected to spread to countries in other regions.

Note: The concept of BMPs is based on International Principles for Responsible Shrimp Farming, which was developed by FAO, NACA, the United Nations Environment Programme Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, the World Bank and the WWF Consortium on Shrimp Farming and the Environment. On November 8, 2006, the Consortium programme received a World Bank Green Award for its efforts towards responsible shrimp farming.

Source: Umesh, *et al.,* 2010; FAO, 2011.

Ensuring access to capital. Small-scale producers require access to working capital to finance operating costs for feed, seed and water management. Many small-scale producers, including those who are members of organizations or groups, arrange inputs from fish traders or processors. However, for farm improvements or expansion programmes that would generate higher incomes, they need to have access to larger amounts of capital. While demand for such capital could be met from semi-formal and informal sources, formal financial institutions could also fill in the gap. However, it would be essential to establish a policy environment that favours such lending operations based on the banking principles of viability and profitability of the chosen economic activities, but tailored to accommodate small-scale producers' credit needs.

Improving market access. Investments to improve access to output markets can create value for products both domestically and internationally. Such investments may also open opportunities for cooperation with larger customers and new markets, thereby creating incentives for adopting better management practices, such as meeting certification standards and environmental guidelines.

Improving infrastructure. This group of investments includes improvements in production facilities (e.g. ponds and cages), input supplies (e.g. hatcheries) and post-harvest facilities (processing). Such improvements add value to products and will often require access to loans with longer pay back periods.

CONCLUSIONS

As SSA involves a range of activities from subsistence fish farming to commercial operations to micro- and small- enterprises across value chains, the demand for financial services is equally diverse and requires differential financial products and services. Overall, the lack of access to affordable, adequate and timely financial services, notably credit and insurance, by small-scale producers has been a major constraint to scaling up existing business operations and attaining higher incomes and profits in response to the growing demand for aquaculture products at the domestic and international levels. While semi-formal and informal sources are major suppliers of credit to small-scale producers, there are some inherent limitations. For example, in the case of informal sources, the type of credit supplied generally meets short-term credit needs rather than medium-and long-term financial requirements. Further, their terms of finance are often disadvantageous to small-scale producers since they charge high rates of interest and credit is frequently linked to unfavourable terms of trade. Access to credit from formal sources is also limited due to high transaction costs, lack of staff capacity and other banking-related factors.

However, despite the shortcomings regarding access to financial services by small-scale producers, there are some best practice cases (e.g. adoption of BMPs by small-scale shrimp farmers groups in India that has generated considerable interest in the banking and insurance community), which the SSA sector policy makers should consider to develop more supportive policies and to design better financial products and services. Governments, in particular, have an important role to play by creating an enabling environment through policies and legal and regulatory frameworks that encourage private investment in SSA production and services. In view of the absence of comprehensive information on the impact of financial services on small-scale aquaculture development, governments, along with the private sector and donors, should also arrange carrying out an in-depth study at the global level.

Experiences have shown that, in addition to access to financial services, small-scale farmers usually need other support services, such as business and enterprise development, market information and social intermediation, to ensure successful operation of their businesses. In addition to governments, the services could be provided by the private sector and NGOs. As part of their advocacy programme, NGOs, can also play a crucial role in effectively influencing governments to develop policies and institutional environment that are focused towards support of the small-scale aquaculture sector.

While the private sector plays an important role in SSA development , the larger businesses should be encouraged to adopt more "Corporate social responsibility" (CSR) initiatives in the aquaculture sector, such as facilitating market access for small-scale aquaculture producers, providing technical and financial assistance to small-scale producers to comply with market requirements, and developing brands and marketing methods favourable to aquaculture products from smaller producers.

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Mainstreaming aquaculture into country poverty reduction strategies and plans: an overview

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ABSTRACT

While the contribution of the aquaculture sector to poverty alleviation and food security has long been recognized, an issue that has received recent attention of researchers is the extent to which the sector is mainstreamed into national Poverty Reduction Strategy Papers, other National Development Plans, World Bank's, Country Assistance Strategies, European Union's, Country Strategy Papers and other donor support programmes. This paper concludes that, based on recent studies by the Food and Agriculture Organization of the United Nations and others, there has been an improving trend towards mainstreaming. The paper adds that further efforts need to be made, such as building capacity of fisheries and aquaculture personnel and conducting systematic and rigorous impact evaluations, to more effectively address the challenges facing the sector, particularly addressing the needs of small-scale aquaculture, which constitutes the backbone of the sector.

Keywords: small-scale aquaculture, mainstreaming, poverty reduction strategies, national development plans.

INTRODUCTION

Global production of fish from aquaculture has grown substantially in the past decade, reaching 52.5 million tonnes in 2008, compared with 32.4 million tonnes in 2000. Aquaculture continues to be the fastest-growing animal food producing sector and currently accounts for nearly half (45.6 percent) of the world's food fish consumption, compared with 33.8 percent in 2000. With stagnating global capture fishery production, and an increasing population, aquaculture is perceived as having the greatest potential to produce more fish in the future to meet the growing demand for safe and quality aquatic food. According to FAO (2011), it is estimated that by 2012 more than 50 percent of global food fish consumption will originate from aquaculture.

Global aquaculture, however, has not grown evenly around the world. The Asia-Pacific region continues to dominate the aquaculture sector, accounting for 89.1 percent of global production, with China alone contributing 62.3 percent of global production.

Moreover, of the 15 leading aquaculture producing countries, 11 are in the Asia-Pacific region. Small-scale commercial producers continue to remain the backbone of the sector in the Asia-Pacific region, contributing the bulk of aquaculture production. In many countries in Asia, a large proportion (up to 80 percent) of aquaculture production comes from small-scale, family-owned operations (Phillips *et al.*, 2007). Small-scale producers and small and medium entrepreneurs are also important players in Africa. Commercial and industrial-scale producers dominate in Latin America, but there is strong potential for the development of small-scale production.

Although precise data are lacking, it is widely acknowledged that, with growth in volume and value of aquaculture production in the past decade, aquaculture, including small-scale aquaculture (SSA), provides important contributions to poverty reduction and food security. The contributions are made through three main interlinked pathways: (i) nutritional benefits from the consumption of fish; (ii) income to those employed in the sector and multiplier and spillover effects in fishery-dependent regions; and (iii) generation of revenues from exports, taxation, license fees and from payment for access to resources for foreign investment in aquaculture (WorldFish Center, 2011).

Nonetheless, it is also recognized that proper positioning of the aquaculture sector's contributions, based on a more systematic assessment and quantitative evaluation, is important to formulate well-informed policies, strategies and plans that governments and development partners will consider favourably for increased support and funding. To address such shortcomings in impact evaluation, a number of initiatives have been undertaken or are underway, such as FAO's recently completed work on development of systematic, conceptual and operational empirical frameworks for the assessment of commercial aquaculture's direct and indirect impacts on economic growth, poverty alleviation and food security, and ongoing work on the preparation of technical guidelines on enhancing the contribution of SSA (Cai, Leung and Hishamunda, 2009; Bondad-Reantaso and Prein, 2009; and FAO, 2011).

SCOPE

Acknowledging aquaculture's contributions to economic growth, poverty alleviation and food security, this paper provides an overview of the extent to which the fisheries and aquaculture sector is mainstreamed into national Poverty Reduction Strategy Papers (PRSPs), other National Development Plans (NDPs), World Bank's (WB) Country Assistance Strategies (CAS), European Union's (EU) Country Strategy Papers (CSPs) and other donor support programmes. This paper draws on the findings of an FAO desk study on mainstreaming the fisheries (including aquaculture) sector in the above national and donor country development strategies and plans, the first of its kind that was carried out between June 2003 and February 2004 (Thorpe, 2004). Although there has been no comprehensive global follow-up study since then, this paper also highlights the findings of various recent reviews, including six regional reviews and a global synthesis on aquaculture development status and trends by FAO in 2010 (Reid, Thorpe and Funge-Smith, 2008; and FAO, 2011) Further, the focus of this paper is on the status of mainstreaming the fisheries (including aquaculture) sector into PRSPs, since most national and development partners' strategies and plans are aligned to it. Furthermore, at this stage, as the overall fisheries sector's, including aquaculture sector's, contribution to GDP is relatively marginal compared to other sectors in most developing countries, this paper does not make a case for separate mainstreaming of aquaculture in national poverty reduction strategies and plans.

STRUCTURE OF PAPER

The paper first explains the concept of PRSP, then provides a brief assessment of mainstreaming fisheries, including aquaculture, in country PRSPs and other national and donor strategies and plans, based on various studies by FAO and other agencies, and finally concludes by offering some suggestions for consideration by aquaculture sector national policy makers and development partners.

Concept of PRSP

A PRSP describes a country's macroeconomic, structural, and social policies and programmes to promote growth and reduce poverty (Box 1).

BOX 1
PRSP

Successful plans to fight poverty require country ownership and broad based support from the public in order to succeed. A PRSP contains an assessment of poverty and describes the macroeconomic, structural, and social policies and programs that a country will pursue over several years to promote growth and reduce poverty, as well as external financing needs and the associated sources of financing. They are prepared by governments in low-income countries through a participatory process involving domestic stakeholders and external development partners, including the IMF and the World Bank.

Source: IMF, 2011. Factsheets. Poverty Reduction Strategy Papers. September 14, 2011.

The formulation of PRSPs is one of the main conditions for concessional lending by the International Monetary Fund (IMF) and the World Bank (WB) to low-income countries. In addition to IMF and WB, other donor partners explicitly align their lending operations to country-owned strategies and priorities for reducing poverty. PRSPs provide the link between national public actions, donor support, and the development outcomes needed to achieve the United Nation's Millennium Development Goals (MDGs), which aim to half poverty between 1990 and 2015. As of end-June 2009, over 90 full PRSPs have been prepared, as well as more than 50 preliminary, or "interim", PRSPs.

According to IMF (2010), five core principles underlie the PRSP approach. PRSP should be:

- **country-driven**, promoting national ownership of strategies through broad-based participation of civil society;
- **result-oriented** and focused on outcomes that will benefit the poor;
- **comprehensive** in recognizing the multidimensional nature of poverty;
- **partnership-oriented**, involving coordinated participation of development partners (government, domestic stakeholders, and external donors); and
- **long-term based** to achieve poverty reduction.

Mainstreaming fisheries and aquaculture

The overall findings and conclusions of the FAO study (Thorpe, 2004) are:

- the fisheries sector (including aquaculture) was most effectively mainstreamed in Asia (case of PRSPs, NDPs and WB CAS), closely followed by the African economies and the Small Island Developing States (SIDS);
- in contrast, Latin America, home to two of the top fishing nations (Chile and Peru) scored poorly as far as mainstreaming the fisheries sector in PRSPs and NDPs;
- seventeen countries provided examples of best practice in their PRSPs or NDPs (out of 85 PRSPs or NDPs), primarily in identifying fisheries-related issues and responses;
- nine EU CSPs (from a sample of 116) and two WB CAS (from a sample of 80) provided examples of best practice with regards to issues and responses;

- just one (plan) made explicit reference to FAO's Code of Conduct for Responsible Fisheries (CCRF), highlighting the importance of a more concerted effort by all stakeholders; and
- future research be carried out covering three areas: detailed analysis of best practice cases so as to produce a synthesis of "best" best practice; a study examining why certain countries with significant fisheries were not effectively mainstreamed; and a study identifying the local institutions and policy-making process which had allowed countries where the sector is relatively unimportant in terms of trade/ consumption and/or poverty/employment to create opportunities for greater inclusion in national agendas.

Another study (Reid, Thorpe and Funge-Smith, 2008) examined the significance of fisheries and aquaculture to developing Asia-Pacific economies, and evaluated the extent to which the sector had been mainstreamed in national development and poverty reduction strategies. The study concluded that the representation of fisheries-related issues, the recognition of sectoral poverty, policy responses, and stakeholder representation, was greater than in other fish producing regions, and there were many examples of best practice. The findings of this study reinforce the conclusions of the earlier FAO (Thorpe, 2004) study.

The six regional aquaculture development reviews and the resultant global synthesis reported that an increasing number of countries had formulated or were in the process of formulating fisheries policies, strategies, plans and legislation that would facilitate the growth and efficient management of the aquaculture sector (FAO, 2011). For example, in the context of Africa it was highlighted that the spectacular development of aquaculture in countries such as Egypt, Mozambique, Nigeria and Uganda had been due to government policies in favour of the private sector. It was also stressed that even the least aquaculturally developed regions, such as the Pacific Island countries were giving high priority to mainstreaming aquaculture in their development plans.

CONCLUSIONS

In general, the findings of recent reviews on mainstreaming of aquaculture into national development plans and poverty reduction strategies indicate an improving trend. In addition to the suggestions made by the FAO study (Thorpe, 2004) to carry out research covering three areas, including producing a synthesis of "best" best practice, the aquaculture sector needs to pro-actively make a strong case for more effectively mainstreaming the sector into national and development partners' strategies and plans. In essence, mainstreaming should address the challenges facing the aquaculture sector, such as dealing with climate change impacts and strengthening capacity of small-scale producers to meet increasingly stringent quality and safety requirements demanded by national and international buyers. To this end, a number of measures are suggested to achieve sustainable results on the ground.

First, the aquaculture sector could benefit by having national and global "champions" (e.g. select members of parliament, civil society, media and other non-governmental organizations) to promote its cause. A case in point is the current President of Sri Lanka, whose level of enthusiasm and dedication to develop the sector, as demonstrated by his contributions to various international meetings and workshops, is widely acknowledged. Second, the sector needs to strengthen the capacity of fisheries departments and ministries in understanding the linkages between sector policy, strategy and plans and national PRSPs and medium-term budget framework. Finally, the sector also needs to educate and convince policy-makers, planners and finance ministries on the benefits of aquaculture, including SSA, based on systematic and rigorous impact evaluation studies.

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Challenges for small-scale aquaculture: sustainable use and management of aquatic resources for small-scale aquaculture producers

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ABSTRACT

Some of the key challenges facing the small-scale aquaculture (SSA) sub-sector if it is to realise its potential in contributing to poverty reduction, food security, rural livelihoods and wider development are presented. Issues relating to the measurement and documentation of the contributions of SSA in these areas are discussed, along with the importance of better understanding the broader context within which SSA develops, particularly the characteristics and dynamics of rural poverty and the relationships between people involved in SSA and the institutions, policies and processes that support them.

Keywords: small-scale aquaculture, poverty, food security, livelihoods, rural development.

INTRODUCTION

Based on papers prepared for the Food and Agriculture Organization of the United Nations (FAO) Expert Consultation on Small-Scale Aquaculture (SSA) held in Hanoi, Vietnam in April 2010 and the subsequent discussions during the course of that workshop, it is possible to identify a set of key challenges facing SSA as a sub-sector. These challenges are outlined below along with recommendations for possible future action plans to address these challenges.

The focus in preparing this document has been on identifying challenges at a relatively high level which are broadly applicable across the sub-sector globally. Clearly there are dangers involved in this. Small-Scale Aquaculture is, by its very nature, an activity that is often extremely location specific and, as a result, broad generalisations will always be in danger of obscuring the particular issues and challenges facing aquaculture activities in specific areas and involving specific groups of stakeholders. Indeed, the fragmented and localised nature of SSA is one of the key challenges that faces the sub-sector as it tends to defy easy definition, detailed data collection and aggregation. This, in turn, contributes to the relative "invisibility" of much small-scale activity.

However, SSA is by no means the only sector of rural production that suffers from these characteristics and it should, nevertheless, be possible to identify generic challenges that reflect issues that are broadly encountered world-wide. A special note, however, is required with regard to SSA in Africa and South America. Simply through weight of numbers and available information, discussions about SSA tend to overwhelmingly draw on experience from Asia. The development of rural aquaculture has been much less extensive in other areas of the world and, where literature does exist, it tends to, above all, focus on the reasons for this more limited development there. Clearly, if SSAs were to "take-off" in these areas, it is likely that at least some "new" issues that specifically reflect the conditions of Africa and South America will probably arise in the future.

However, in the discussions of the challenges identified below, an attempt has been made to focus on more generic issues that are likely to be relevant for the development of the sub-sector in almost any context. Thus, for example, limited attention is paid to specific technical issues (which are almost inevitably issues that have been identified in the course of aquaculture interventions and research in Asia) and more to the **ways** in which technical issues are addressed and communicated, which is likely to have more general relevance.

KEY CHALLENGES – SMALL-SCALE AQUACULTURE AND POVERTY REDUCTION

Developing means of measuring and demonstrating the contribution of SSA to poverty reduction

In the short-term at least, a key challenge facing SSA development is the need to demonstrate far more clearly and precisely than at present the nature of their contribution to poverty reduction. This requires action on two key areas.

First of all, much more attention needs to be paid to the identification and characterisation of the people who are involved in, and benefit from, SSA interventions. This needs to go beyond the generic characterisations of "poor" rural communities often seen in the context of many aquaculture projects and requires a more detailed analysis of the different people within those communities in terms of:

- their access to assets and opportunities;
- their inclusion in decision-making and resource allocation processes;
- their representation in institutions and agencies that affect their livelihoods;
- the relative stability and vulnerability of their livelihood strategies and their capacity to adapt to change;
- their access to safety nets and support.

Importantly, undertaking such detailed analysis should not necessarily be done with a view to identifying appropriately "poor" target groups for aquaculture activities but to identify the appropriateness of aquaculture for different groups of people (including the "poor") and the ways in which the changes brought about by aquaculture development might affect different groups within a community or area. From a pragmatic point of view, an important output of this type of analysis will be to identify those people for whom engagement in SSA is **not** appropriate, either because they lack the capacity or access to key assets, or because they are not in a position to take on the risks involved.

The second key aspect that needs to be addressed is the development of effective and practical mechanisms for measuring and documenting the impacts of interventions on these different groups. Monitoring and evaluation of SSA interventions has too often tended to focus largely on production and income. While these are essential factors that need to be measured, in the context of poverty reduction they only tell a very limited part of the story. Measurement of overall impacts on livelihoods (including other activities undertaken by households or individuals), food security, health and expenditure are all critical if the real contribution of an activity to changes in poverty is to be understood. In particular, understanding how these impacts are **distributed** across different groups is vital.

Achieving a better understanding of the dynamics and nature of poverty among practitioners in SSA development

The paper on *Small-Scale Aquaculture in Context: Small-scale aquaculture and concepts of poverty, food security, rural livelihoods and development* prepared for the workshop discusses at some length new developments in the understanding of poverty, its characteristics and its dynamics, and how these need to be more fully incorporated into the thinking surrounding SSA and its contribution to poverty reduction.

The challenges involved in achieving this integration should not be underestimated. The prevailing discourse around poverty is often framed in terms which may be unfamiliar to people of a technical background and may often seem "impenetrable" to them. There is, therefore, a need to develop appropriate literature, supported by practical tools and approaches that can help those involved in the more technical aspects of SSA development to acquire a better understanding of poverty. Perhaps more importantly, they also need to be provided with the means to incorporate this understanding into their research, development and extension activities.

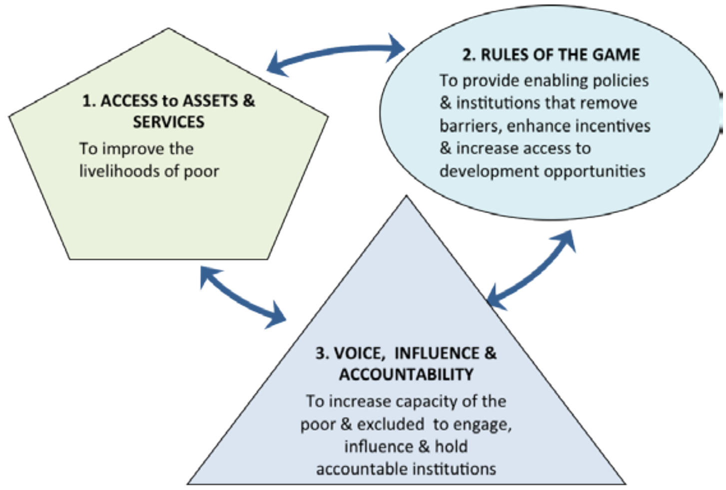
Numerous sets of tools and approaches exist to help development practitioners analyse and understand poverty at different levels, from the field right up to the policy levels. However, these are not always easily accessible, or easy to apply, in the context of the working environments of those involved at the "cutting edge" of SSA development – local aquaculture extension officers or project staff working in the field.

In addition, the focus of many of these tools tends to be the conduct of a "diagnosis" of poverty. However, while use of these tools can lead to a much better appreciation of the nature of poverty, turning that appreciation into practical action to address the complexities of poverty and its multiple dimensions is far more challenging and is rarely incorporated in such approaches in any detail. As a result, the application of "tools" to understand poverty can often be interpreted as a measure to address poverty. Unfortunately, as the persistence of poverty, particularly in rural areas, amply illustrates, effectively addressing poverty is a complex and difficult process which tends to resist simple solutions and almost invariably requires long-term engagement at multiple levels.

As an example, the diagram in Figure 1 shows one visualisation of some of the key elements that have been identified as playing a key role in defining poverty (in this case drawn from World Bank/DFID, 2005). While this illustrates effectively a set of key issues that generally are of great importance in determining poverty, and highlights the need to address poverty at multiple levels, the challenges for people working within a specific technical sector such as SSA to actually accommodate this understanding in their professional activities are considerable.

Aquaculture specialists may be equipped, both technically and institutionally, to provide **one** element that can contribute to addressing the **first** of these components (access to assets and services) in the form of appropriate technology for developing SSA. Appropriate forms of analysis can help them to understand how the other two elements shown will influence how effective their technical intervention is likely to be in contributing to sustainable and effective poverty alleviation. However, actually addressing the second and third elements of poverty reduction identified here is likely to be far beyond their capacities, both as professionals and bearing in mind the mandate of the institutions of which they are part.

FIGURE 1
Dimensions of change in addressing poverty



Source: Adapted from World Bank/DfID, 2005.

While providing aquaculture professionals with the appropriate tools and approaches to better understand poverty, equipping them to more effectively contribute to poverty reduction constitutes a wider challenge which is addressed below.

Ensuring that SSA is "mainstreamed" into broader rural development processes

Ensuring that the potential contribution of SSA to broader rural development processes requires that the agencies and institutions concerned with aquaculture, whether they be fisheries departments, extension agencies, research institutions or non-government actors, need to step outside of the disciplinary and institutional boundaries within which they commonly operate and integrate their efforts with wider development processes.

Better integration of different technical disciplines has long been on the agenda in rural development and significant progress has been made in ensuring that better coordination takes places between agencies with different mandates and areas of specialisation. Particularly in the context of efforts to decentralise government agencies, the work of different disciplines in development is now far better integrated, at least at the local level, than it used to be. However, this integration is often confined to the local level and does not always extend to higher levels of decision-making where the agenda for SSA development is often set and policy and strategy options for the sub-sector determined.

Partly this is due to the tendency of fisheries departments, where aquaculture generally resides, to be the "poor relative" within the agriculture sector. Given the priority generally accorded to agriculture development, the potential for aquaculture as an integrated part of broader rural development is often overlooked or regarded as of minor importance. However, this is also often the result of an excessively technical focus in the agencies and institutions concerned with aquaculture and a failure to effectively communicate with planners and policy-makers. As a result, where, for example, Poverty Reduction Strategies have been mainstreamed into the national policy and planning process, it is relatively rare for the potential role of aquaculture to be taken into account or even mentioned.

The challenge facing those working in the sub-sector is not simply one of promotion of the value of their sector, but more generally a capacity to clearly articulate evidence of that value and the way in which it can contribute to wider strategies for rural development. The sub-sector therefore needs to enhance its skills and capacity to present itself in terms that encourage its incorporation into wider planning processes. This will involve, first of all, generating clear evidence of impact and, secondly, being able to present that evidence in such a way that its contribution to national development goals and poverty reduction strategies is clearly articulated.

Achieving this is likely to require a combination of processes. *Curricula* in institutions that prepare staff for working in aquaculture agencies need to pay more attention to policy and planning and wider development issues as well as technical preparation. Within aquaculture agencies, greater openness to collaboration with other sectors and institutions needs to be promoted and the "silos" in which technical disciplines often tend to operate need to be broken down. Skills and capacities in communicating to non-technical audiences, such as policy-makers and economic planners need to be developed.

While it is probably difficult to develop "toolkits" that can help aquaculture agencies to develop these capacities, examples of best practice and encouragement to widen their skill base in communications and policy analysis and development could contribute significantly.

Recognising that poverty reduction is a long-term process and incorporating this into the planning and implementation of SSA projects and programmes

The time frames involved in undertaking effective poverty reduction interventions represent a challenge not just for SSA development, but for development interventions in general. In spite of a growing awareness of the complexities of poverty and the special requirements of interventions to address it, donor and implementing agencies are often reluctant to commit to the long-term, multi-sectoral and multi-level strategies that are often required to address poverty effectively and sustainably.

This reluctance is often a reflection of the structure of the agencies involved, where planning horizons are often relatively short and need to be responsive to changing political priorities, shifting trends in development thinking and career structures, and incentives that often militate against long-term thinking.

However, enabling SSA to properly contribute to poverty reduction, and have lasting impacts on the poor, will often mean incorporating this long-term perspective into planning for the sub-sector. This is particularly important, given that direct involvement in aquaculture production of any sort often requires secure access to assets (land and water), which the poorest members of rural society lack. The opportunities generated by SSA for poorer sections of society will often be "niche" opportunities and transient in nature. Without addressing the structural nature of poverty, any opportunity that generates value for the poor will often tend to end up being taken over or monopolised by the less poor. Maximising those opportunities that do exist for poorer target groups will require a strategic understanding of how those opportunities are liable to change over time, and who is likely to be able to take them up at different stages. Often, a focus on ensuring access of the poor to the provision of ancillary services required by SSA (such as pond preparation and harvesting, fingerling production, sales and transport, feeding, etc.) will be more appropriate. However, strategies for enabling poor people to engage in these successfully will often need to be long-term.

KEY CHALLENGES - SMALL-SCALE AQUACULTURE AND FOOD SECURITY

Developing means of measuring and demonstrating the contribution of SSA to food security

While, intuitively, there is little doubt that SSA does contribute to food security, and there is significant anecdotal evidence to support this, measuring and demonstrating the extent of this contribution remains an important challenge for the sub-sector.

The difficulties involved are, in part, inherent in the nature of the sub-sector – it is small scale and involves large numbers of small, dispersed and often seasonal activities which defy easy enumeration and monitoring; the sub-sector is usually relatively un-organised with little in the way of representative organisations that might have an incentive for collecting usable data; unlike in the commercial sector, harvesting and subsequent consumption often tends to be spread out over a considerable period and is therefore even more difficult to monitor.

However, developing appropriate means of doing this will be an important contribution to ensuring a continued flow of resources for research and extension for the sub-sector.

A key part of the challenge is ensuring that information goes beyond the consideration of **food availability** (based on production from the sector) to look at **food access**, **utilization** and **stability**, in order to cover all the key aspects of food security.

It is likely that this will require innovative approaches that combine statistical methods with data collected directly from producers, service providers and markets where aquaculture products are sold. While time and resource intensive, nutrition surveys that assess the contribution of aquaculture products to household consumption may be particularly important in demonstrating the role played by fish from local aquaculture in the diet of different groups of consumers, including the poor. As coverage of such surveys is bound to be limited by the resource requirements, appropriate approaches to using limited data sets to generate meaningful estimations of consumption across wider populations need to be developed, tested and adopted more widely as a basic element of SSA development programmes.

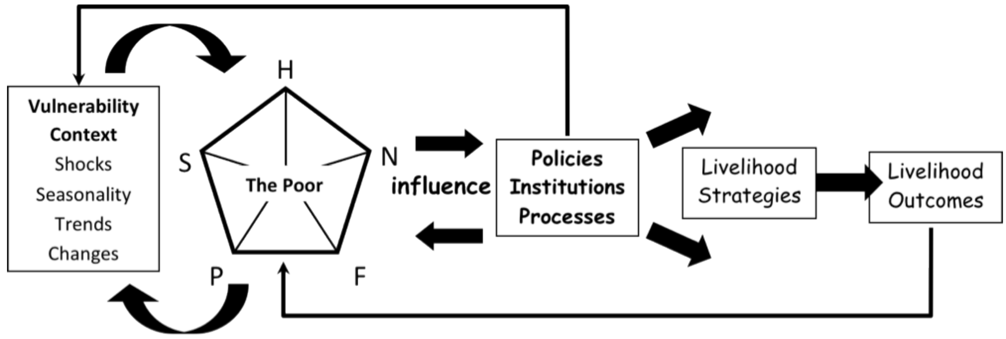
KEY CHALLENGES – SMALL-SCALE AQUACULTURE AND RURAL LIVELIHOODS

Promoting better understanding of SSA using the Sustainable Livelihoods Approach (SLA)

Approaches to small-scale aquaculture development have always been firmly rooted in the analysis of rural livelihoods systems. However, the analysis of these systems often tends to be limited to the on-farm or community scenario, concentrating on the ways in which different resources and assets can be mobilized to generate a more sustainable and robust farming system. However, many of the key features of sustainable livelihoods involve an understanding of the linkages between these localised systems with wider policies, institutions and processes. The SLA provides a framework (see Figure 2) for analysing some of these linkages, although it provides relatively limited assistance in "unpacking" them in any detail.

An important challenge for the sub-sector is to analyse and understand in more detail the exact nature of the "influences" that link the "policies, institutions and

FIGURE 2
The Sustainable Livelihoods Framework



Source: After DFID.

processes" indicated in the framework above with people's access to the assets they require to generate benefits from SSA. This is important whether the people at the centre of the framework are specifically the rural poor or whether they are other groups, including the non-poor, that are involved in the sub-sector or seeking to benefit from it in different ways.

This emphasis on analysing these relationships is important. Often, discussion of sustainable livelihoods, especially in the context of programmes for rural development, tends to focus on the "asset pentagon" element of this framework. However, it needs to be appreciated that much of the added value from the SLA lies less in the analysis of this pentagon (the ways in which people are able to access, make use of and exchange sets of human, social, natural, physical and financial assets) and more in the way in which that access is affected by the prevailing policy and institutional environment. This means extending the interpretation of rural livelihoods to include, as an integral part of those livelihoods, that policy and institutional environment, and the forms of governance that determine how it functions.

Providing tools and skills for the SSA sector for the analysis and engagement with policies, institutions and processes.

The predominantly technical, production-oriented focus of SSA development in the past has tended to encourage those involved in aquaculture initiatives to regard the policies, institutions and processes surrounding these initiatives as a "given" – an aspect of the environment over which they have limited control. An important challenge for the sub-sector is to encourage greater analysis of this "environment" and more active engagement with it in order to make it more supportive to SSA.

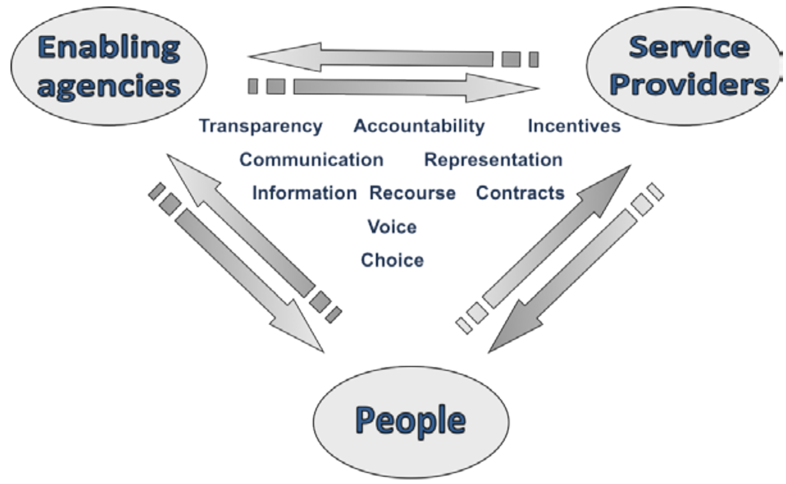
This is important because, all too often, it is this policy, institutional and process setting within which aquaculture initiatives take place that have a central role in determining longer term sustainability of initiatives once targeted support in the form of donor funds and specific projects are withdrawn.

While the SLA mentioned above highlights the importance of the linkages between people's livelihoods and the policies and institutions that affect their access to different assets, it provides relatively little indication on how to go about understanding and addressing these linkages. Tools and approaches for understanding this aspect of the livelihoods framework are generally not nearly as well developed as those that are available for looking at other aspects of livelihoods such as people's assets and the way they are used. However, failure to understand this area is critical, and people involved in the sub-sector need to have the appropriate tools at their disposal to do this.

Clearly, many of these tools and approaches are likely to be drawn from areas with which technical specialists from the aquaculture field may not be widely familiar. Those involved in aquaculture development in the past have tended to concentrate their attention on developing the technologies concerned, communicating them effectively to potential users and ensuring that there are appropriately trained technical support services in place. Where policies and institutions are already supportive, this relatively limited level of engagement with them can prove effective and lead to sustainable support to the sub-sector. However, where they are weak or poorly developed, or the institutions involved are less committed to supporting the small-scale sub-sector, failure to address these weaknesses can undermine even the best efforts in the field.

Critically, approaches to help practitioners understand and engage with these areas need to go beyond more traditional approaches to policy and institutional analysis that tend to be limited to the identification of "appropriate" policy elements and understanding the material and technical capacities of the institutions concerned with implementing policy. The focus should be extended to understanding the nature of the relationships that link the different "actors" involved – policy makers, legislators and those who generally set the "rules of the game" that affect the SSA sub-sector; the

FIGURE 3
Policies, institutions and processes – focussing on establishing supportive relationships



agencies (and individuals) that put those policies and regulations into effect and provide services to the sub-sector; and the actual and potential users of those services - people engaged in SSA as producers, consumers or service providers. While the capacity and skills of the institutions involved is also important, it is the **quality** of these relationships that often are more important in terms of how policies and institutional arrangements actually play out on the ground and influence people's livelihood choices. The "quality" of these relationships can be thought of as the "governance" arrangements within which SSA is developed.

Figure 3 provides an illustrative framework which highlights these relationships and suggests some of the key qualities that people involved in the SSA sub-sector need to be able to analyse and identify if they are to be able to encourage a more "enabling" environment for their activities.

Assisting practitioners involved in SSA promotion to better understand and analyse these relationships is an important challenge as it addresses areas that technical specialists often regard as areas that are "beyond their control" but which are fundamental in determining the outcomes that SSA is likely to provide for people "on the ground".

KEY CHALLENGES - SMALL-SCALE AQUACULTURE AND WIDER DEVELOPMENT

Continuing the development of appropriate technology for SSA in the faces of global changes in agriculture and development priorities

The past decades have seen the development of a range of effective and appropriate generic technologies for SSA that have become increasingly accepted and have been widely adopted, at least in some areas. Generally, the process of developing these technologies has focussed on achieving appropriate levels of production while limiting the degree of inputs required and the levels of care and maintenance in order to ensure that these technologies are broadly adaptable to the different needs and contexts within which small-scale producers operate.

Changes in the environment, as well as changes in the demands being made on the agricultural sector as a whole, are likely to bring about changes in the demands being made on SSA in the future. Competition for resources, particularly water and land, and volatility in the markets for food products will mean that the new questions will be constantly emerging regarding how resources can best be applied to different food production systems. These questions will come from producers themselves – given current conditions, what is the best use I can make of my available resources? – and of planners and policy makers in rural development in general – what priorities should we pursue to ensure the best balance of sustainable food supplies and wider economic growth?

The changing nature of these demands is likely to generate a continued need for new technological advances that respond to these changes. A particular concern is likely to be the development of technologies that are resilient in the face of climate change and increase the adaptive capacity of small-scale producers.

Maximising synergies between SSA and large-scale commercial aquaculture

In a period where food and food prices have become an increasingly dominant issue, aquaculture represents the fastest growing food production sector globally. Given the current crisis in capture fisheries and prospect of declining wild fish stocks in the foreseeable future, there is likely to be a growing emphasis on large-scale commercial production of fish from aquaculture to meet the growing demand for fish and fish products.

This presents both challenges and opportunities for the small-scale sector. Looking at the situation from the perspective of planners and policy-makers, there will inevitably be questions asked regarding the relevance of support to the small-scale sector when their concerns are likely to be increasingly focussed on providing reasonably priced food to growing urban populations. This is likely to encourage a growing emphasis on large-scale modes of production.

At the same time, there should be considerable opportunities to make use of an expanding large-scale sector to develop synergies with small-scale production. It will be an important challenge for the small-scale sub-sector to identify and develop these synergies. Engagement with the private sector involved in larger scale commercial operations may open up channels of support and funding that are likely to be increasingly difficult to identify from governmental sources. Research into more intensive forms of aquaculture may generate useful findings for smaller scale producers.

Understanding where these synergies lie is an important element for SSA in preparing for a future where attention is likely to be increasingly focussed on the demands of urban markets and larger scale food distribution.

Providing the sector with the means to clearly articulate its contribution to wider development

With renewed concern over the capacity of agriculture and fisheries to feed the world's projected population of 9 billion people in the year 2050, it is critical for any sub sector to be able to effectively articulate on how to contribute to this goal. This is particularly challenging for those sub-sectors, like SSA, that focus on small-scale modes of production. By their very nature, these tend to defy easy quantification and measurement as they deal with diverse, dispersed and un-organised forms of production, but finding ways of measuring these contributions and explaining them in ways meaningful for higher level policy makers and planners is of key importance.

If resources are to be allocated to the support and development of SSA in the future, it is particularly important that the economists who tend to play the key role in strategic planning at the national level, can be convinced of the importance of the sub-sector's contributions and can clearly identify the avenues through which the sub-sector will help in the achievement of national development goals (of which ensuring food security for the nation is likely to be an increasingly dominant element in the immediate future).

The challenges involved in this are complex. On one hand, there are issues involved in developing practical means of measuring the contributions of the sub-sector. On the other hand, the priorities regarding what contributions need to be measured are themselves constantly shifting in response to new concerns and new perceptions of what is important in development processes.

By way of illustration, under current conditions, greater efforts within the SSA development community are needed to identify ways of measuring and describing the sub-sector's contributions to:

- Gross Domestic Product (GDP)
- Export growth
- Wealth creation
- Inclusiveness
- Employment
- Safety nets
- Environmental services
- Health and nutrition

While these represent some of the current key measures of economic development that have been widely adopted to date, those involved in the sub-sector also need to have the capacity to constantly update their understanding of evolving development priorities. For example, current trends towards the development of "well-being" indexes as a supplement to GDP measurement means that sectors need to also consider how they contribute to other non-economic forms of development. Global concerns over climate change are likely to increasingly require development sectors to be able to demonstrate how they contribute to, or mitigate against, carbon emissions and how they contribute to strengthening adaptive capacity in the face of changes linked to global warming.

Actors in SSA need to be able to keep abreast of these changing priorities and rapidly incorporate them into their presentation of the contributions of the sub-sector. Failure to do so runs the risk of being perceived, within the context of wider development processes, as marginal or irrelevant.

Facing this challenge is likely to mean changes in research agendas, currently dominated by technical aspects of aquaculture, to incorporate more understanding of the economic context, the role of SSA in that context and the development of appropriate means of measurement.

Successful small-scale aquaculture (SSAs) and their contribution to economic growth at the national level, and poverty alleviation and rural development at the local level

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Edwards, P. 2013. Successful SSAs and their contribution to economic growth at the national level and poverty alleviation and rural development at the local level. *In* M.G. Bondad-Reantaso & R.P. Subasinghe, eds. *Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development,* pp. 223–255. FAO Fisheries and Aquaculture Proceedings No. 31. Rome, FAO. 255 pp.

ABSTRACT

Thirty three successful case studies of small-scale aquaculture (SSA), including both grow-out and seed production are presented to illustrate their contributions to poverty alleviation, economic growth and rural development, as well as to highlight issues regarding their definition, contributions, sustainability and potential for further development. The case studies indicate major social benefits from SSA in many countries in Asia although much fewer and to a less degree in Africa, and Latin America and the

Caribbean. However, it is clear that SSA continues to play a major role for relatively poor households in many countries in the three regions and has potential to continue to do so and expand in both inland and coastal areas. The contribution of SSA to rural development in these regions has been relatively minor compared to Asia. Nevertheless, it has its potential if it becomes more of a business-orientated, small- and medium-scale enterprise activity rather than being promoted for subsistence as in the past. This is increasingly the case in Asia and is starting to happen in some countries in Africa, and Latin America and the Caribbean.

Key words: Small-scale aquaculture, poverty alleviation, rural development.

INTRODUCTION

Thirty three successful case studies of small-scale aquaculture (SSA), including both grow-out and seed production are presented to illustrate their contributions to poverty alleviation, economic growth and rural development, as well as to highlight issues regarding their definition, contributions, sustainability and potential for further development (Table 1). Twenty seven are from Asia (19 inland and seven coastal), three from Africa (two inland and one coastal) and three from Latin America (all inland).

The case studies include a range of different production systems, both grow-out and seed, from inland and coastal areas, from diverse agro- and natural ecological, social and economic contexts The selection is biased heavily in favour of Asia as this region dominates global aquaculture and has the widest diversity of aquaculture systems.

The case studies indicate major social benefits from SSA in many countries in Asia although much fewer and to a less degree in Africa, and Latin America and the Caribbean. However, it is clear that SSA continues to play a major role for relatively poor households in many countries in the three regions and has potential to continue to do so and expand in both inland and coastal areas. The contribution of SSA to rural development in these regions has been relatively minor compared to Asia. Nevertheless, it has its potential if it becomes more of a business-orientated, small- and medium-scale enterprise (SME) activity rather than being promoted for subsistence as in the past. This is increasingly the case in Asia and is starting to happen in some countries in Africa, and Latin America and the Caribbean.

There is a voluminous literature dealing with SSA in journals, reports and magazines but much of the information is somewhat anecdotal. Official statistics do not differentiate production of SSA from that of aquaculture nor is there general agreement on a definition of SSA as discussed by Edwards (2010a).

An overview of the case studies is presented – their benefits, the definition of SSA, traditional versus modern aquaculture, seed production, access to resources and the changing balance of aquaculture scales of operation, followed by the 33 case studies of successful SSA.

OVERVIEW

The case studies

Asia, inland aquaculture

There are three case studies on rice/fish grow-out culture including both traditional and modern aquaculture:

- Case study 1, Traditional rice/fish culture in mountainous China;
- Case study 2, Rice/fish culture in lowland China;
- Case study 3, Rice/giant prawn integration in the Mekong Delta, Viet Nam.

Seven cases cover SSA with inland ponds ranging from traditional on-farm integration in Viet Nam to pellet-fed monoculture of catfish and tilapia in several countries:

- Case study 4, Traditional integrated aquaculture agriculture system (IAAS), Red River Delta (RRD), Viet Nam;
- Case study 5, Traditional IAAS, India;
- Case study 6, IAAS, Bangladesh;
- Case study 7, Intensive striped catfish culture, Bangladesh;
- Case study 8, Intensive tilapia pond culture, Philippines;
- Case study 9, Intensive striped catfish culture, Vietnam; and
- Case study 10, Intensive African catfish culture, Indonesia.

There are four case studies on SSA in cages from different countries:

- Case study 11, Extensive cage culture, Nepal;
- Case study 12, Intensive tilapia cage culture, Philippines;
- Case study 13, Intensive tilapia cage culture, Thailand; and
- Case study 14, Intensive tilapia cage culture, Bangladesh.

Three relatively minor systems are aquatic plants; the last two studies were both community-based aquaculture.

- Case study 15, Water spinach, Cambodia;
- Case study 16, Culture-based fisheries in reservoirs, Viet Nam; and
- Case study 17, Floodplain aquaculture, Bangladesh.

TABLE 1
Thirty-three case studies of successful Small-scale aquaculture systems from Asia, Africa, and Latin America and the Caribbean

Case study	Region	Area	Type	Country	System
1	Asia	Inland	Grow-out	China	Mountain rice/fish
2	"	"	"	China	Lowland rice/fish
3	"	"	"	Vietnam	Rice/giant prawn
4	"	"	"	Vietnam	Pond IAAS
5	"	"	"	India	Pond IAAS
6	"	"	"	Bangladesh	Pond IAAS
7	"	"	"	Bangladesh	Intensive pond striped catfish
8	"	"	"	Philippines	Intensive pond tilapia
9	"	"	"	Vietnam	Intensive pond striped catfish
10	"	"	"	Indonesia	Intensive pond African catfish
11	"	"	"	Nepal	Extensive cage carp
12	"	"	"	Philippines	Intensive cage tilapia
13	"	"	"	Thailand	Intensive cage tilapia
14	"	"	"	Bangladesh	Intensive cage tilapia
15	"	"	"	Cambodia	Water spinach
16	"	"	"	Vietnam	Culture-based fisheries reservoir
17	"	"	"	Bangladesh	Floodplain aquaculture
18	"	"	Seed production	Indonesia	Seed production networks
19	"	"	"	Bangladesh	Decentralized seed production
20	"	Coastal	Grow-out	Thailand	Shrimp
21	"	"	"	India	Shrimp
22	"	"	"	Thailand	Intensive finfish cage
23	"	"	"	Philippines	Mariculture park
24	"	"	"	Philippines	Seaweeds
25	"	"	"	Thailand	Mollusks
26	"	"	Seed production	Thailand	Backyard shrimp hatcheries
27	"	"	"	Indonesia	Backyard finfish hatcheries
28	Africa	Inland	Grow-out	Cameroon	Peri-urban pond
29	"	"	"	Nigeria	African catfish tank
30	"	Coastal	Grow-out	Tanzania	Seaweeds
31	Latin America	Inland	Grow-out	Honduras	Pond
32	"	"	"	Guatemala	Pond
33	"	"	"	Brazil	Pond

Two case studies are given on inland seed production:
- Case study 18, Seed production networks, Indonesia; and
- Case study 19, Decentralized seed production, Bangladesh.

Asia, coastal aquaculture

There are eight case studies on coastal SSA, six on various grow-out systems and two on seed production.

The grow-out case studies are:
- Case study 20, Shrimp, Thailand;
- Case study 21, Shrimp, India;
- Case study 22, Marine finfish cage culture, Thailand;
- Case study 23, Mariculture parks, Philippines;
- Case study 24, Seaweed farming, Philippines; and
- Case study 25, Mollusks, Thailand.

The two case studies on seed production are:
- Case study 26, Backyard shrimp hatcheries, Thailand; and
- Case study 27, Backyard finfish hatcheries, Indonesia.

Aquaculture in Africa

Three case studies are presented for Africa, the first two are inland and last one is coastal.

- Case study 28, Peri-urban pond culture, Cameroon;
- Case study 29, African catfish tank culture, Nigeria; and
- Case study 30, Seaweeds, Tanzania.

Aquaculture in Latin America and the Caribbean

Three case studies are presented for Latin America and the Caribbean, all pond-based inland grow-out:

- Case study 31, Pond culture, Honduras;
- Case study 32, Pond culture, Guatemala; and
- Case study 33, Pond culture, Brazil.

Benefits

Some of the better defined contributions of the case studies of SSA to food security, poverty alleviation and socio-economic development are outlined below:

- The income of some two to three million rural households has been significantly progressed through improved rice/fish culture as the Government has promoted the culture of high-value finfish and crustaceans in rice fields in an incentive to reduce migration to urban areas (Case Study 2, Rice/fish culture in lowland China).
- Provision of food and some income for generations as most farming households have small ponds located near the house dug for soil for use as filling material to raise the level of the land for the homestead and surrounding garden (Case Study 4, Traditional IAAS, Red River Delta, Viet Nam).
- In West Bengal, the number one state for aquaculture in India, majority are small farmers with less than 0.8 ha of land; and almost one third of the farmers in the "fish bowl" of India in the Kolleru Lake region of Andhra Pradesh are marginal or small-scale farmers with fish farms less than 2 ha although they are better considered SMEs rather than SSA (Case Study 5, Traditional IAAS, India).
- Small-scale farming households benefited from both sales and consumption of fish, all respondents selling an average of 244 kg of fish and 99 percent consuming an average of 56 kg of fish. Pond owners may be generally categorized as relatively better-off among rural households in the context of rural Bangladesh where about one third lived below the poverty line (Case Study 6, IAAS, Bangladesh).
- Almost all the rice fields in a village near Yogyakarta in Central Java have been converted into small ponds with about 100 families raising pellet-fed African catfish at high density for sale (Case Study 10, Intensive African catfish culture, Indonesia).
- Cage fish culture provides livelihood to about 300 families of a landless and deprived fishers community displaced by the construction of a dam in Kulekhani Reservoir; fish production has resulted in significant improvements to their livelihoods, that includes providing education for their children from primary to university levels (Case Study 11, Extensive cage culture, Nepal).
- Water spinach raised in untreated city wastewater by poor communities accounts for nearly half of the total sales of fresh vegetables in Phnom Penh (Case Study 15, Water spinach Cambodia).
- Grouper cage culture in Southern Thailand makes a substantial contribution to household incomes although in all except one of the surveyed villages where there was a Department of Fisheries program, cage aquaculture was practiced by only a few percent of the households as it was constrained above all by lack of financial resources for investment (Case Study 22, Marine finfish cage culture).
- Seaweed culture is an important and major livelihood in several coastal areas of the Philippines, with 90 000–110 000 farmers cultivating red algae for processing into carrageenan (Case study 24, Seaweed farming, Philippines).

- Cost-benefit analysis of mollusk farming by small-scale farmers in Bandon Bay, Surat Thani Province, who mostly managed without hiring additional labourers showed net returns for oyster and cockle of USD4 905 and USD1 257/ha/year, respectively (Case study 25, Mollusks, Thailand).
- Up to 75 percent of the 140 000 tonnes of African catfish production in Nigeria reported is from pellet-fed tank-based SSA. The total value of the industry is USD800 million from the value of fingerlings, feed and farmed catfish (Case Study 29, Intensive culture of African catfish in tanks, Nigeria)
- Production of about 7 000 tonnes of red seaweeds has been steady for a decade in Tanzania with the key producers being women from poor coastal communities who generally do not swim; in a few villages seaweed farming is becoming a family business with men adept at working in deeper waters or men who have boats assisting in seaweed farming in deeper waters where seaweed grows better (Case study 30, Seaweeds, Tanzania).
- Tilapia is now being farmed as a secondary livelihood, mostly by crop farmers, and can now be sold locally at a price that offers an attractive profit margin for small and medium-scale fish farmers since the image of tilapia as a "poor man's fish" has been changed following the export of the species by large-scale commercial farms to the United States of America (Case study 31, Pond culture, Honduras).
- Freshwater fish culture is practiced in every state in Brazil with 100 000 freshwater fish farmers producing about 179 000 tonnes/year primarily in small-scale earthen ponds with most production for local consumption (Case study 33, Pond culture in Brazil).

Definition of SSA

The lack of general agreement on the definition of SSA mainly concerns the upper limit of a small-scale farm. Common elements characterizing SSA are ownership of, or access to an aquatic resource, ownership by family or community, and relatively small size of landholding. However, if aquaculture becomes the primary livelihood activity rather than only one of several on-farm and off-farm livelihoods, there is likely to be greater investment and hire of labour with an indistinguishable overlap between small and medium or even large scale-aquaculture.

This issue of defining the upper limit of SSA is highlighted by Case Study 9 (Intensive striped catfish culture, Viet Nam) and Case Study 20 (Shrimp, Thailand) both of which are considered by some to be dominated by SSA. Although catfish culture in Vietnam is considered to be primarily SSA, the total costs were reported to be USD230 188/ha; an average rice farming household in the Mekong Delta with a farm of 1.2 ha obtains a yield of 6.1 tonnes/ha from which it could expect to earn USD470, a sum insufficient to provide enough feed to maintain 1 ha of striped catfish for a single day. The cost of production for a crop of the shrimp for an upper limit small-scale farm of 1.6 ha in 2009 ranged between USD47 000 to 56 000. The costs of both productions are rather high to qualify for 'small-scale'. Thus, perhaps a better term for these highly productive systems would be small and medium enterprise (SME) which could bridge the conceptual gap between the larger and more commercialized small-scale farmers and medium and large-scale aquaculture.

Case Study 28 (Peri-urban pond culture, Cameroon) indicates that the immediate future of SSA in Africa might be with SMEs with considerably increased production only possible in areas with good infrastructure and markets rather than from very small farms in remote rural areas. Only well-connected peri-urban farms in Cameroon are developing into SMEs. At least USD20 000 and an annual production of about 5 tonnes of fish from a total pond surface area of 1 ha is required to provide a necessary return on investment of about 30 percent for improved technology to be adopted as SME. However, the possible contribution that SSA might make to food security in remote rural areas remains a major issue. Up to 80 percent of the population in much of Africa comprises low-income, small-scale farmers who must somehow be targeted for assistance to provide rural food security, probably by subsidizing extension, especially marketing support.

Traditional versus modern aquaculture

Traditional aquaculture is mainly SSA and integrated with other human activity systems as these provided the only sources of nutritional inputs for farmed aquatic organisms in the past. Exceptions are coastal mollusks and seaweeds which depend on suspended particles and dissolved nutrients in the water column, respectively, and are mainly farmed in traditional systems. In contrast, the rapid increase in aquaculture production in the last few decades has been due in large part to the relatively recent introduction of agro-industrially manufactured pelleted feed. It may be termed as "modern" aquaculture but it requires considerably more investment that may constrain small-scale farmers with limited resources. Intensification through the increasing use of agro-industrial pelleted feed rather than traditional integrated aquaculture technology is a major feature of the "Blue Revolution" although this system has social and environmental issues.

Case Study 1 (Traditional rice/fish culture in mountainous China) and Case Study 4 (Traditional IAAS, RRD, Viet Nam) illustrate the contribution of SSA, especially in the past. However, small-scale farms in most developing countries usually have such a low resource base that in many cases, SSA provides mainly household subsistence with limited sale of fish, if any. While most of the rice fields in Qintgtian County, Zhejiang Province are stocked with common carp, fish production is low and there is significant out migration from the area. Traditional integrated SSA in the RRD, Viet Nam has provided food and some income for generations as most farming households have small ponds located near the house. These ponds were formed out of the diggings made by the people to get soil that was used as filling material to raise the level of the land for the homestead and surrounding garden. However, SSA in the RRD is changing rapidly through introduction of new or improved higher value species and increasing integration with feedlot livestock or use of pelleted feed with some SSA developing into SMEs.

Two case studies, Case Study 2 (Rice/fish culture in lowland China) and Case Study 3 (Rice/giant prawn integration in the Mekong Delta, Viet Nam) showed benefits of SSA through rice/fish integration of high-value species and increasingly with use of pelleted feed. However, rice/fish has never been as widespread as commonly believed. A more significant development is the conversion of rice fields to fish ponds. Rice fields used to be a major source of fingerlings in Indonesia but the practice of rice field nursing has almost disappeared (Case Study 18, Seed production networks, Indonesia).

Case study 5 (Traditional IAAS, India) indicates that significant fish production can be achieved in SSA through the use of indirect IAAS without the need for expensive pelleted feed. An important distinction in IAAS is between sole reliance on the usually limited on-farm nutrient base to feed the fish (direct IAA), and increasing use of fertilizers and/or supplementary feeds from off-farm but from the local agricultural resource base (indirect IAAS).

Nevertheless, as the case studies show, SSA has also benefited from the increasing use of pelleted feed. As outlined in Case Study 7 (Striped catfish culture, Bangladesh), there is a recent development in the country of intensive pond culture of striped catfish in monoculture with pelleted feed. Case Study 8 (Intensive tilapia pond culture of tilapia, Philippines) and Case Study 10 (Intensive African catfish culture, Indonesia) are further examples of SSA producing low-value fish with pelleted feed. Almost half of the tilapia farmers in the Philippine case study using ponds of a maximum of 1 ha total were below the official national poverty line. Tilapia farming was found to be five to six times more profitable/ha than rice farming. Pellet-fed small-scale production of African catfish has expanded rapidly in Indonesia as high-density small-scale pond production is attractive to small-scale farmers.

Most of the case studies with cages in inland and coastal areas are intensive and pellet-fed although in Case Study 11 (Extensive cage culture, Nepal), small-scale farmers raise filter-feeding Chinese carps extensively on plankton in reservoirs.

Seed production

Most of the case studies cover grow-out but small-scale farmers may be involved in nursery operations to produce fingerlings or post-larvae seed in inland and coastal waters. Nursing may be more appropriate than grow-out for small-scale farmers because of the short production cycle, less feed and capital, better cash flow and lower risk. Common carp and tilapia may be bred by small-scale farmers but fry and larvae of high-value species are usually produced by large-scale hatcheries as considerable resources and skills are required.

Case study 18 (Seed production networks, Indonesia) reports that freshwater fish seed production is dominated by small-scale farmer-operated hatcheries which supply about 80 percent of the national seed demand. There are over 26 000 small-scale hatcheries owned by individual small-scale farmers or farmer groups. Common carp and tilapia are traditionally bred and nursed in wastewater, or are otherwise pellet-fed. Small-scale farmers are organized into privately managed networks to nurse eggs or fry of high-value species such as giant gourami, pacu and striped catfish which are provided by large-scale hatcheries to the small-scale farmers who subsequently buy back the fingerlings then resell to buyers.

In Case study 19 (Decentralized seed production, Bangladesh), poor farming households have been taught how to breed and produce large fingerlings of common carp and tilapia in irrigated rice fields in north west Bangladesh. There was rapid adoption through farmer-to-farmer spread in surrounding communities and the approach has since been incorporated into the aquaculture development programs of the non-governmental organization (NGO) CARE across the country.

In Case study 26 (Backyard shrimp hatcheries, Thailand), backyard hatcheries refer to small-scale, usually family-owned and operated, seed production operations that are most often located in the backyard of the owners. As backyard hatcheries purchase shrimp nauplii from usually larger-scale hatcheries, they should be referred to as nurseries rather than hatcheries. Backyard hatcheries played a major role in the development of giant freshwater prawn project and penaeid shrimp culture in Thailand because they were small and flexible and able to adapt technology to changing circumstances although today they are being overshadowed by large-scale hatcheries.

In Case study 27 (Backyard finfish hatcheries, Indonesia), techniques developed by the Gondol Research Institute for Mariculture (GRIM) in Bali, Indonesia have been widely adopted by small-scale farmers in the northern part of Bali. The technology is reportedly contributing to farmers' incomes, job opportunities and export earnings, although little is known about the social and economic aspects of these small-scale hatcheries. The popularity of small-scale marine finfish hatcheries can be ascribed to their flexibility as they can be used for a range of species such as milkfish and grouper. Moreover, the capital and operating costs are low with a rapid return on investment.

Access to resources

Small-scale farmers, especially the poor, have limited access to the resources required for aquaculture. The case studies indicate various mechanisms through which SSA has been able to develop:

- The farmers (local people) are caretakers rather than owner-operators in tilapia cage culture in Lake Taal in the Philippines. They enter into a profit-sharing agreement with an external financier because they cannot afford the high feed cost. Most of the fish farmers who do not have financial capital requirements to carry out aquaculture are comfortable working as caretakers. They have multiple employment to reduce risks and provide additional financial security (Case Study 12, Intensive tilapia cage culture, Philippines).

- Charoen Pokphand Company (CP) initiated contract farming of red tilapia in cages, followed by several other feed companies. Contract farming is usually convenient for SSA as it arranges harvest and marketing of fish. However, contracted farmers have reported problems with inconsistent availability of fingerlings and delayed harvesting at times of oversupply, which disrupt production cycles (Case study 13, Intensive tilapia cage culture, Thailand).
- Cage culture has recently been successfully introduced in Bangladesh by a DoF officer after observing commercial tilapia cage culture in Thailand. Most cages are operated by better-off farmers and a few by small-scale farmers. Some cages are operated by women, organized into groups, some of whom belong to landless families along the riverside (Case study 14, intensive tilapia cage culture, Bangladesh).
- Small reservoirs in north Viet Nam are leased to farmers or farmer groups for aquaculture. Fish yields are low but income from sale of fish is significant in mountainous north Viet Nam, one of poorest regions of the country (Case study 16, culture-based fisheries in reservoirs, Viet Nam).
- Groups of 20 comprising landowners, fishers and landless labourers were organized to stock fish fingerlings of Chinese and Indian major carps in fenced areas during the flood season in Bangladesh. Returns from the sale of fish is shared among group members. However, the floodplain aquaculture system requires considerable investment and generates benefit for only certain sectors of the community, especially landowners. A large number of poor households do not benefit from the system, especially fishers from the floodplains because they are denied of common property rights (Case study 17, Floodplain aquaculture, Bangladesh).
- Shrimp culture in India is mainly carried out by small-scale farmers on holdings of less than 2 ha which account for 90 percent of the total area utilized for shrimp culture. Organization of farmers into groups, clusters and aquaclubs facilitated the adoption and implementation of Better Management Practices (BMPs) to provide benefits to the farmers, the environment and society (Case study 21, Shrimp, India).
- Mariculture parks in well-defined sites with supporting infrastructure are being developed for investment by small and medium as well as large-scale investors in the Philippines to generate employment and reduce poverty through marine fish cage culture as an alternative source of livelihood for marginalized and sustenance fishers (Case Study 23, Mariculture parks, Philippines).
- A "Fish Farming Village" with 175 cooperative fish farmers has been established in Nigeria to raise pellet-fed African catfish in concrete block tanks. Farmers joining the cooperative received credit for capital and operating costs for one crop (Case study 29, Intensive African catfish culture, Nigeria).

Changing balance of aquaculture scale

There appears to be a sizeable consolidation of aquaculture production underway with increased production on larger scale farms at the expense of SSA, the number of which has been reduced considerably. Good examples are the Thai shrimp industry, both grow-out and seed production.

According to Case Study 20 (Shrimp, Thailand), about 30 000 shrimp farms are registered in 2010 but only about 8 000 are currently operating. Most small-scale farms have ceased operation. Thai shrimp culture is possibly still dominated in number of farms by SSA, probably better called SMEs, although production is likely dominated by large farms.

According to Case Study 26 (Backyard shrimp hatcheries, Thailand), more than 2 000 small-scale hatcheries produce some 80 billion post-larvae/year or 90 percent of the total marine shrimp larvae for the country. However, it is likely that the contribution of backyard hatcheries has declined recently with the development of several corporate mega-hatcheries. Small-scale hatcheries have suffered from disease-related competition as large scale hatcheries are able to provide specific pathogen free (SPF) post-larvae (PL).

CASE STUDIES

Asia, inland aquaculture, rice/fish grow-out

Case study 1 – Traditional rice/fish culture in mountainous China

The culture of a red coloured variety of common carp (*Cyprinus carpio*) in stream-fed terraced rice fields in mountainous Qingtian County, Zhejiang Province, China, is a traditional rice/fish system with a documented history of 1 200 years (Edwards, 2006; Lu and Li, 2006). About 80 percent of the rice fields in the County (almost 7 000 ha) are stocked with carp. Rice is cultivated for household consumption but fish are more likely being sold today. Some are even exported abroad, as the red carp is considered a delicacy because of its special taste. Farm gate price of red carp USD 4–5 /kg.

Fish are bred in trenches and fry are directly released into the rice fields of small farms averaging 1 300–1 700 m^2. Livestock manure is provided as a basal fertilizer for the rice but the fry are otherwise raised extensively without further addition of fertilizer or feed for two to three years until they reach table size of 350–400 g. Fish production is low, 600–1 200 kg/ha, although fish has high market value.

The Zhejiang Freshwater Aquaculture Institute is working with farmers and local officials to increase fish yields and therefore benefits the farmers while maintaining a balanced ecological system. Breeding sites have been set up and fry nursed before being stocked in rice fields and fed with formulated feed, increasing yields to 4 500 kg/ha of still tasty fish. Unfortunately some farmers have intensified their systems beyond the recommended level, causing stress to fish and making them susceptible to disease. In turn, fish with lower flesh quality are produced and sold at a much lower price.

With recent developments, local people, farmers and government are concerned about the sustainability of the traditional rice/fish system. In addition to adverse environmental effects of intensification such as eutrophication and increased water demand, there is a decline in farming population. Up to 50 percent of the population of the densely inhabited mountainous County has emigrated abroad. Young people continue to leave the area to seek better paying jobs. In recognition of the long history of the traditional Chinese rice/fish farming system in Qingtian County, it has been listed in 2005 by the Food and Agriculture Organization of the United Nations (FAO), United Nations Development Programme (UNDP) and the Global Environment Facility (GEF) as a Globally-important Indigenous Agriculture Heritage System (GIAHS) (Lu and Li, 2006). The purpose of the GIAHS is to develop appropriate policy, institutional support and technology to protect and promote important agricultural heritage such as this traditional Chinese mountain rice/fish system in Zhejiang Province. Other demonstration sites are also being set up in a wide range of other agro-ecologies so that farmers may learn to live with the new opportunities and challenges brought about by globalization.

Case study 2 – Rice/fish culture in lowland China

Rice/fish culture has increased by 13-fold during the last two decades in China and is now an important aquaculture system with a range of production systems and practices (Miao, 2010). Rice/fish culture remained a traditional practice until the late 1950s when integrated fish farming was promoted by the government. Although there was a significant setback of fish culture in rice fields in the 1960s and 1970s because of intensification of rice production, it entered a new development phase in the mid 1980s when promotion of aquaculture, particularly inland aquaculture, became an important development policy of the government to meet the increasing demand for aquatic products.

A challenging task for governments at different levels was also to improve the economic returns from the land to discourage farmers from migrating to the cities. The government supported the development of standard rice field engineering for different types of rice/fish culture practices with various species under different agronomic and social conditions, and these were disseminated to vast areas. Implementation of supporting policies by the central and local governments resulted to a rapid growth of rice/fish culture and production mainly took place during the period 1993–2002. However, expansion has been less compared with other aquaculture systems. There has also been a latitudinal expansion of rice/fish culture practices from south west, south central and eastern parts of China. Previously, it was mainly concentrated in the north eastern, northern, and north western parts of China, as well as topographic expansion from hilly and mountainous areas to lowland and peri-urban areas. Rice/fish culture has also been expanded across economic boundaries as it was mainly practiced in economically undeveloped areas in China. But now, it is a popular practice in many economically advanced areas.

Chinese rice farms are small-scale family operations on usually between 0.2 to 1 ha, with an average farm size of only 0.52 ha. Farmers obtain long-term (30–50 years) leases from the government and are well organized through farmer associations. Marketing facilities are also established close to large rice/fish culture areas so that farmers can obtain reasonable prices. As farming traditional crops such as rice, wheat and maize makes a maximum net profit of only USD1 500/ha even with a good harvest, it is impossible to significantly increase the income of rural farmers through such plant crops. Traditional practices of rice/fish culture with mainly carps and tilapia were also unattractive to farmers because of low farm gate price. This led to the introduction of high-value finfish and crustaceans such as swamp eel (*Monopterus albus*), pond loach (*Misgurnus anguillicaudatus*), giant freshwater prawn (*M.nipponense* and *M. rosenbergii)*, freshwater crab (*Eriochir sinensis*) and red swamp crawfish (*Procambarus clarkii*). Introduction of these high-value species significantly improved the economic return from rice/fish culture even though production per unit area remains similar or even slightly lower.

Concurrent rice/fish farming is the most typical system for fish and crustaceans. The present average fish production from rice/fish culture has now reached about 780 kg/ha compared to 126 kg/ha in 1985 with the yield of fish usually ranging from 300 to 900 kg/ha and that of prawn and crab from 300 to 750 kg/ha. About 30 aquatic animal species are cultured in rice fields in different parts of China. Rice/crustacean culture has gradually become a mainstream practice in many parts of China, driven by both high-market value and adaptability to the rice field environment. In Jiangsu province in central eastern China, one of the most economically developed provinces in China, rice/fish culture is now practiced in 90 percent of its over 60 counties. Jiangsu province began to promote rice/fish culture with high-value aquatic species in 1997. The total rice/fish culture area reached 136 615 ha in 1999 with more than 80 percent of the area culturing high-value species. The gross net profit of rice/fish culture reached an average of USD2 912/ha. In Maxi village in Yancheng City, 146 ha of rice fields were utilized for rice/crab seed production with an average net profit of over USD11 000/ha. Economic returns from rice/crustacean culture are much higher than rice/finfish culture and net income usually ranges between USD2 500-4 000/ha. However, rice/crustacean culture requires installation of shelter and more careful management because crustaceans are especially sensitive to chemicals and pesticides used in rice cultivation.

Rice/fish culture provides a way to increase farm household income as the average production of 780 kg/ha fish can bring the farmer USD1 500–4 000/ha income, an increase of two to four times that of farming rice only. The income of some two to three million rural households has been significantly improved through rice/fish culture in China. The total area of trench and pit usually accounts for 10–15 percent of the rice field area to maintain the same production of rice, although well-managed rice/fish culture also increases the unit production of rice by 5–15 percent. With the present area of 1.55 million ha of rice/fish culture, it is estimated that an additional 1 million tonnes of rice are produced annually.

Rice/fish culture has been gradually transformed into a green, organic food production system with certification and labeled green. Organic rice and aquatic products bring farmers more income and also contribute to sustainable rural development.

Case study 3 – Rice/giant prawn integration in the Mekong Delta, Viet Nam

Alternative rice-prawn (*M. rosenbergii*) farming is an important system on small-scale farms usually between 0.7 to 1.0 ha, in Can Tho City and in An Giang Province in the Mekong Delta with areas of 376 ha and 747 ha in 2005, respectively (Nguyen *et al*., 2006; Nguyen *et al*., 2007). The main part of the field is a platform for rice cultivation between prawn crops with a surrounding ditch varying from 20 to 25 percent of the total area. The water depth in rice field is 0.7 m and that of the ditch is a little deeper at 0.8 m. Farms are sited near main canals to permit weekly exchange of water during prawn culture. Two kinds of feed are used for prawn culture: a) fresh feed such as paddy crab, trash fish and golden snail are used by more than 80 percent of the farms as they are cheap and readily available at farm sites, especially during flooding season; b) commercial pellets are also used either for the full cycle or just for the first two months followed with fresh feed. Most farmers grow one crop of prawn for six to seven months between April and December and one crop of rice between January and April. The average yield of prawn is 1 135 kg/ha/crop, giving a net income of USD3 000/ha/crop, much higher than that from rice only. Farmers have made great changes in the technical and economical aspects during the development of this model.

Rice/prawn alternative culture fits well with the Vietnamese Government decree that now allows the conversion of unproductive rice land to more profitable crops, including aquaculture. As the profit from rice/prawn farming is much higher than from rice cultivation alone, a significant increase in the area of rice/prawn farming has been predicted.

Asia, inland aquaculture, pond grow-out

Case study 4 – Traditional IAAS, Red River Delta, Viet Nam

The Red River Delta (RRD) with 15 million people on a total area of 1.5 million km^2 is one of the most densely populated areas of the world. Its average population density is over 1 000 person per km^2 and most agricultural holdings are only 0.3–0.5 ha per household (Hambrey *et al*., 2008). There is a traditional small-scale integrated farming system known as VAC, an acronym for the Vietnamese words *vuon* (garden), *ao* (pond) and *chuon*g (livestock quarters) on the rice-dominated farms. Most farming households have small ponds, 1.0–1.2 m deep, located near the house. These ponds were formed out of the diggings made by the people to get soil that was used as filling material to raise the level of the land for the homestead and surrounding garden. A polyculture of carps is raised in the household-level ponds integrated with livestock and crops (fruit and vegetables). Farmers traditionally stock a polyculture of common carp (*Cyprinus carpio*), Chinese carps (grass carp, *Ctenopharyngodon idella*, and silver carp, *Hypophthalmichthys molitrix*) and Indian major carps (mrigal, *Cirrhinus mrigala*; rohu, *Labeo rohita*). The three main traditional pond nutritional inputs are rice bran, grass and pig manure with yields ranging from less than 0.1 to 6.7 tonnes/ ha/ season. Ponds are traditionally multipurpose: domestic water, watering vegetables, cultivation of floating aquatic plants for feeding pigs, and harvesting wild fish.

The VAC system has long been recognized as important for household food security and increasingly as a source of income as the rice-based economy is diversified. However, aquaculture in the RRD is changing rapidly through introduction of new or improved higher value species such as hybrid common carp and tilapia. These are also raised in polyculture but increasingly with a more limited number of species, or in monoculture. Intensification is also taking place, especially in areas with a ready market near cities, through integration with feedlot livestock and/or use of pelleted feed. Some fish farms are now rather large and may cover several hectares which have been facilitated by the emergence of a land market with rural households leasing land in or out. Land rental markets allow more productive farming households to gain access to land and increase output, as well as allow other households to pursue non-farm income opportunities. Vietnam also has a policy of agricultural diversification as rice farming does not provide an adequate household income. Since 1991, government policy allowed conversion of poor quality land on which agriculture was not profitable to be converted into fish ponds.

There seems to be no specific studies on the role of SSA in poverty reduction in the RRD although it has surely benefited the poor in general through provision of fish for household consumption and income from sale of fish from household farms. For the non-farming poor, SSA has helped increase fish supply. Leasing out land and taking up non-farm employment may have benefited the poor more than SSA, unless the aquaculture component of the household VAC system has been intensified through integration with feedlot livestock or use of pelleted feed.

Poverty reduction in Viet Nam is one of the greatest success stories in economic development as poverty has been halved in less than a decade from 58 percent of the population living in poverty in 1993 compared with 29 percent in 2002, i.e. almost a third of the total population has been lifted out of poverty in less than 10 years. Creation of jobs by the private sector and the increased integration of agriculture in the market economy have been the main drivers of poverty reduction. The proportion of people who mainly work on their own farm dropped from almost two thirds to slightly less than half. However, increased incomes from farming have also been important in poverty reduction with farm households more oriented towards the market.

Case study 5 – Traditional IAAS, India

Traditional carp polyculture in India has a long history but was extensive with wild seed of native carps (mainly catla, *Catla catla*; rohu; mrigal, *Cirrhina mrigala*) stocked in ponds without nutritional inputs (Edwards, 2008). Indian scientists developed the so called "composite culture", a six species polyculture with the above three native species and three exotic species – common carp, grass carp and silver carp. The new system also involves eradication of predatory and weed fish, liming, stocking large fingerlings, fertilization with cow manure and chemical fertilizers, supplementary feeding with a 1:1 mixture of groundnut or mustard oil cake and rice bran or wheat bran, and provision of aquatic or terrestrial vegetation for grass carp The technological package was widely disseminated in India through an International Development Research Center (IDRC) funded project, with the majority of farmers attaining extrapolated annual yields as high as 6-7 tonnes/ha (Tripathi, 1979).

The State of West Bengal in India, the number one state for both fish seed and table fish production, benefited considerably from demonstrations of the above technology. There is no information on land size classification for fish farms in West Bengal, only for agriculture in general, but about 96 percent of the almost seven million holdings in the state are less than 2 ha (S. Biswas, personal communication, 2010). Hence, aquaculture in West Bengal may also be dominated by small-scale farmers in terms of both numbers and production. There is a strong labour union in the state that requires people to share resources. Various species of Chinese and Indian major carps, silver barb (*Barbonymus gonionotus*) and Nile tilapia (*Oreochromis niloticus*) are raised semi-intensively in polyculture and are fed with broken rice, rice bran, mustard oil cake, mahua oil cake and sometimes pelleted feed, with average productivity ranging from 3 000 to 4 000 to over 10 000 kg/ha (M.C. Nandeesha, personal communication, 2010). In areas with saline water influence, productivity of carps is low (about 3 000 kg/ha) but farmers also raise giant freshwater prawn with carps and earn good income from the carp/prawn polyculture system. In Chargaht, farmers cultivate rice from December to March and following the increase in salinity, they pump saline water into the field to culture tiger shrimp (*Penaeus monodon*) for the next three to four months, followed by giant freshwater prawn for six months after the monsoon lowers the salinity. Around Kolkata City, there are small-scale farmers with ponds less than 1 ha who use wastewater to fertilize fish ponds, as well as large cooperative farms. Unfortunately, because of population pressure and poverty, there is also widespread poisoning and poaching problems – two social evils that adversely affect small farmer investment in aquaculture, and especially so with the absence of insurance.

The Kolleru Lake region of Andhra Pradesh has been transformed into the "fish bowl" of India (Edwards, 2008). Many of the 22 000 fish farmers in the Kolleru are medium to large-scale farmers, although almost 30 percent are marginal or small-scale farmers with fish farms less than 2 ha based on the sample of farmers seeking government extension advice (R. Ramakrishna, personal communication, 2010). The ponds were constructed through conversion of rice fields, many of which were previously subjected to seasonal flooding, to fish ponds. The local farmers have developed a much simplified semi-intensive carp technology with just two species, rohu as the dominant species and catla, at a ratio of 80–90: 10–20 percent, respectively. As rohu has the highest market demand in Kolkata to which much of the fish are exported, farmers increased its stocking level from less than 20 percent recommended by Indian scientists to more than 80 percent of stocked fish. Fish are mainly fed with so-called "farm-made feeds", a mixture of mainly de-oiled rice bran and oil cake meal fed to fish in perforated sacs suspended in the pond. This technique was also developed by farmers. Ponds are fertilized with feedlot chicken manure and chemical fertilizers although some pelleted feed is used. Extrapolated annual yields range from 7.5 to 12.5 tonnes/ha with a total annual carp production now of 800 000 tonnes from about 80 000 ha of ponds in Andhra Pradesh (R. Ramakrishna, personal communication, 2010.). This impressive production is due mainly to semi-intensive and indirect IAA rather than intensively through pelleted feed.

Case study 6 – IAAS, Bangladesh

Freshwater aquaculture plays an important role in rural livelihoods in Bangladesh. A survey of 100 households which owned ponds was conducted in Kishoreganj District in the main aquaculture area in Greater Mymensingh as part of a study by the Asian Development Bank to assess the role of small-scale inland aquaculture in poverty reduction (ADB, 2005). Traditionally, ponds have been constructed as borrow pits, dug for soil to raise the level of land for village homesteads and roads on the flood plain. Surveyed households farmed a carp polyculture of up to nine fish species, comprising mainly Indian major carps and Chinese carps. There was an abundant carp seed supply, as is the case in many parts of Bangladesh, from a large number of hatcheries and nursing of fry to fingerlings which is commonly carried out by household-level small-scale nurseries in villages, providing employment to owners and hired labour. Traveling seed traders carry a few thousand fingerlings each in aluminium containers on foot or bicycle. Almost all used cow manure and urea as pond fertilizers and mainly rice bran and oil cake as supplementary feed. The productivity of the fishponds was high because of the relatively sophisticated, semi-intensive aquaculture practice introduced through projects consisting of both direct and indirect IAA with an average extrapolated annual fish pond yield of 3.1 tonnes/ha.

The small-scale farming households benefited from both consumption and sales of fish, consuming an average of 56 kg of fish and selling an average of 244 kg of fish for an average net income of Tk.5 400 (USD1 = Tk. 58 approximately). The marketing chain for fish was short with most farmers selling their fish locally, either in their own village or at a nearby sub-district market. Most farmers did not sell directly to consumers but dealt with market intermediaries, further generating employment.

Fish pond owners may be generally categorized as relatively better-off among rural households in the context of rural Bangladesh but they do not necessarily escape from poverty. Among small landowners in Bangladesh with moderate access to land of 0.5–1 ha, including fish ponds, 34 percent live below the poverty line. They do not produce much surplus from farming and are vulnerable to crises. Even some fish pond owners who may be categorized as medium-size landowners with 1–2 ha of land are also vulnerable. In fact, 25 percent of them live below the poverty line, with the rest precariously above it. They can even easily slide into poverty when faced with unexpected crisis such as illness of household members, shortage of food, and damage due to floods, erosion, heavy rains or cyclones.

Case study 7 – Striped catfish culture, Bangladesh

There has been a recent rapid development in Bangladesh of intensive pond culture of striped catfish (*Pangasianodon hypophthalmus*) (Ahmed and Hassan, 2007). Striped catfish are commonly farmed in monoculture with pelleted feed, either farm-made minced, small-scale factory produced pellets of poor quality or large-scale factory produced pellets of high quality. Striped catfish can be stocked in ponds at a much higher density than carps while maintaining a fast growth rate with average annual yields of over 8 tonnes/ha, almost three times greater than that of about 3 tonnes/ha for carps.

A study of striped catfish farming in two villages in Mymensingh was conducted (Haque, 2009). Village 1 had a relatively small number of farms (35) compared with village 2 with 150 farms. Out of these numbers, village 1 had 10 and village 2 had 50 farms with small ponds (0.6 ha). There were 20 and 80 farms with medium-sized ponds (0.60–1.20 ha) in village 1 and 2, respectively. Village 1 has five farms with large ponds (less than 1.20 ha) while village 2 has 25. While only 11 percent of farmers were characterized as being poor in village 1, 44 percent of the farming households were poor in village 2. In village 2, all the rice farms had been converted to fish farms as the farmers could not continue to farm rice because of water logging of the fields from adjacent fish farms. Striped catfish farming led to several direct benefits to fish farming households such as increased fish consumption and increased income. They were able to send their children to school, too. Non-farming households benefited from increased availability of the cheapest fish which was also reported to be good for children because of its freshness and lack of intermuscular bones. There was also an increase in employment opportunities as farm workers and in provision of seed, feed and marketing. Striped catfish farming is more capital intensive than carp polyculture (B. Belton, personal communication, 2010). Relatively few of those currently engaged in catfish farming in Bangladesh were previously either agriculture or fish farmers. Majority are involved in various types of business, indicating the entrepreneurial orientation of most catfish farming operations.

Case study 8 – Intensive tilapia pond culture, Philippines

Central Luzon, a major lowland agricultural region, is also the major area for pond farmed tilapia in the Philippines. Tilapia pond farming is a profitable livelihood in which many small-scale farmers are involved. Small-scale tilapia culture was defined in an ADB study in 2005 by farmers using ponds of a maximum of 1 ha total area. Almost half of the surveyed small-scale households farming tilapia were living below the official national poverty line. The majority (86 percent) were owner-operators with an average size of landholding of 2.5 ha, with the remainder either lessees, caretakers or share-croppers. About 39 percent of tilapia farmers were previously rice farmers and had converted rice fields into tilapia ponds. Most heads of tilapia farming households (89 percent) had more than one occupation, but about half (46 percent) reported tilapia farming as their primary occupation, with major secondary and other occupations being rice farming (21 percent), vegetable farming (12 percent) and livestock raising (12 percent), as well as driving, vending/trading, office employment and carpentry. Some 36 percent of tilapia farmers continued to grow rice in separate plots on their farm.

Majority of tilapia farmers (68 percent) fed their fish intensively with commercial pelleted feed rather than using either direct or indirect IAA, obtaining yields of 8–9 tonnes/ha/3–3.5 month cycle; only about a quarter of the farmers combined use of pelleted feed with pond fertilization and feeding rice bran.

In terms of financial returns, tilapia farming was 5–6 times more profitable per ha than rice farming but was much more capital intensive and risky, especially due to floods, poaching and predators. The mean contribution from tilapia farming to total household income was 39 percent, with farmers also drawing an average of 29 percent of their income from rice and 6 percent from vegetables.

In Central Luzon, several channels of effects have facilitated tilapia pond farming: access to land (through land ownership and lease arrangements with guaranteed tenure rights); reliable water supply and water pump ownership; access to working capital (from family savings and/or from external sources, such as feed suppliers, relatives, friends, and financiers); availability of infrastructure and other related facilities (roads, transport facilities, and communication facilities); access to markets and positive financial returns from tilapia farming; dissemination of improved tilapia breeds through various hatcheries; availability of commercial feed; and provision of training, extension and related services by private and government organizations

Case study 9 – Intensive striped catfish culture, Viet Nam

Traditional cage culture of catfish started in the Mekong River Delta in Viet Nam in the 1960s, followed by that of pen and pond culture in the 1990s (Hambrey *et al*., 2008). The explosive development of striped catfish (*P. hypophthalmus*) farming is driven by the increasing demand for white fillets marketed in more than 80 countries with production exceeding 1 million tonnes worth USD1 billion in 2007 (Nguyen and Dang, 2010). Caged and penned fish were traditionally fed trash fish and rice bran but most production is now pellet-fed ponds. Air-breathing striped catfish is stocked at high densities of 10–20 individual 10–15 cm fingerlings/m^2 in 1.5–6.0 m deep earthen ponds, mostly converted from rice fields. Pond water is exchanged daily in the second half of the culture cycle at 20–30 percent of pond water volume with the Mekong River. Yields of 0.8–1.5 kg fish after 8 months of culture are up to 400–600 tonnes/crop/ha.

The growth of catfish culture, especially striped catfish, took off at the beginning of 2000 when artificial propagation techniques for striped catfish were developed and mass-scale seed production became possible. Striped catfish products have also been exported mostly as frozen fillets to over 80 countries and territories although there are more than 40 value added products for domestic and international markets. Striped catfish culture in the Mekong Delta is considered to be a success story of aquaculture in Vietnam, if not globally (Nguyen and Dang, 2010) with diverse local and international benefits.

Farm size is highly skewed with 72 percent farms being less than 5 ha, and only 9 percent being 10 ha or greater in size (Nguyen and Dang, 2010). Almost 60 percent of farms have 1 pond, 36 percent have 2 ponds and 6.5 percent have more than 4 ponds, though some large farms may have up to 26 ponds, with pond size being quite similar at around 0.4 ha. Somewhat different numbers are given by Phan *et al*. (2009): farm size and water surface area range from 0.2 to 30 ha (mean 4.09 ha) and 0.12 to 20 ha (mean 2.67 ha), respectively; the number of ponds per farm and pond size range from 1 to 17 (mean 4) and 0.08 to 2.2 ha (mean 0.61), respectively.

According to both the above groups of authors, catfish farming in the Mekong Delta is considered to be primarily based on relatively small holdings, farmer owned, operated and managed even though total costs were reported to be USD 230 188/ha. An average rice farming household in the Mekong Delta with a small-scale farm of 1.2 ha obtains a yield of 6.1 tonnes/ha from which it could expect to earn USD 470, a sum insufficient to provide enough feed to maintain a 1 ha striped catfish pond for a single day (Belton, Little and Sinh, 2011). According to these authors, the tendency to characterize catfish as SSA, a form of production which is fundamentally peasant in nature, is erroneous, even though the most commonly reported former occupation of farmers of less than 1 ha was agriculture (mainly rice or fruit production). In contrast, owners of medium and larger farms originated mainly from non-farming entrepreneurs, managers or civil servants. Most of the recent striped catfish farmers are investors from other sectors as it requires a high level of investment. Because of the increasing demand for high quality striped catfish fingerlings, a number of large-scale grow-out farms have built hatcheries to produce their own seed. Most processing factories now have their own large farms which supply the bulk of their fish with the result that smaller independent farmers may not be able to sell their fish when there is a market glut (L.T. Luu, personal communication, 2010). About 30 percent of catfish farms stopped producing in 2009 and most of these would have been small-scale farms.

Case study 10 – Intensive African catfish culture, Indonesia

The culture of African catfish or *lele* (*Clarias gariepinus*) has recently expanded rapidly in Indonesia as it can be raised at high density in small ponds. It can also be marketed at a relatively small size of 125–200g, the traditional Javanese size for eating fish. About 100 families in Mangkubumen Village, Boyolali Regency near Yogyakarta in Central Java raise catfish with almost all the rice fields in the village converted into 1 600 small ponds. Most of the ponds were very small (about 40–50 m^2) with most families having 10-16 ponds with a range from 6 to160 ponds per family (Edwards, 2010). Fingerlings are mainly produced in another village, Tulungagung, in East Java. Production in the pellet-fed ponds ranges from 800 to 1 200 kg/pond per 3.0–3.5 month grow-out cycle, equivalent to an extrapolated 160–300 tonnes/ha. Such high small-pond production makes it very attractive for small farmers. Harvested fish are sorted into three categories: large fish which fetch a lower price and are processed; optimal-sized fish which are marketed fresh; and small fish which are restocked. There is also village-level processing of fish by women to make fried fish skin and fried flesh which are marketed in attractively designed packages.

Asia, inland aquaculture, cage grow-out

Case study 11 – Extensive cage culture, Nepal

Cage fish culture was successfully introduced in lakes of the Pokhara Valley in the early 1970s to provide about 300 families of the landless and deprived Jalari community of fishers with livelihood (Gurung *et al*., 2010). Production is extensive, based only on natural food, without external fertilizer or feed inputs through the use of plankton-feeding fish and is thus attractive to small-scale farmers. Fingerlings 3–5 g of bighead carp (*Aristichthys nobilis*) and silver carp (*Hypophthalmichthys molitrix*) are stocked in nursery net cages of 5 × 5 × 2 m with a mesh size of 5–10 mm, grown for about 8–12 months, and are then stocked at 10–15 fingerlings/m^3 in simple grow-out cages of 5 × 5 × 2 m with mesh of 25–50 mm hung on bamboo frames that also function as floats.

Kulekhani Reservoir, a small 220 ha water body situated in the mid-hills of Central Nepal was impounded in 1982. About 80 percent of the 500 families from ethnic communities displaced by the reservoir adopted cage fish farming in the reservoir. Sixty percent of the population in the area was classified as poor, of which 36 percent were living below the poverty line. Most of the cages are owned by individual small-scale farmers with support from the government for provision of 1–3 g fingerlings to stock nursery cages. However, there are also several medium and large-scale cage farmers, one of whom has built a house in Kathmandu and runs a hotel in Kulekhani with the profit from cage culture. Fish production over the past two decades has resulted in significant improvements to their livelihoods that includes providing education for their children from primary to university levels. A total of 231 families are now organized into 11 fish farmer groups. The farmer groups were formally registered and promote cage fish farming, control poaching, resolve conflicts and develop marketing channels. Total fish production from the reservoir has risen to 165 tonnes, mostly from cage culture. Fish farming in the reservoir has also stimulated the development of a capture fishery, based on escapees and naturally recruited species, although most fishers also own cages in the reservoir.

Case study 12 – Intensive tilapia cage culture, Philippines

This case study is based on a survey conducted in 2003 of 100 tilapia cage farmers and 81 nursery pond farmers in and around Lake Taal, Batangas province, Philippines (ADB, 2005). Cage culture of Nile tilapia (*Oreochromis niloticus*) began in Lake Taal, a 60 m deep flooded caldera of a volcano in the 1970s. Official average annual cage production of tilapia in Lake Taal was about 20 000 tonnes, the biggest production of tilapia from freshwater cages in the Philippines, although a more recent and thorough estimate of tilapia cage production in Lake Taal is over 100 000 tonnes (Palerud *et al*., 2007). Cage farming in Lake Taal has been considered as SSA (Bondad-Reantaso and Prein, 2009).

Tilapia cage culture in Lake Taal is intensive with improved tilapia breeds and almost total reliance on commercial feeds. Most cages consist of bamboo frame and flotation, with a synthetic net enclosure of 10x10 m dimension and a depth of 6–7 m. Tilapia is grown throughout the year, usually in two 5–6 month cycles. Average production is 3 tonnes /cycle /cage or 6 tonnes /year. The waters of Lake Taal are owned by the State and cage farming sites are leased. As cage ownership is limited to local residents, they make profit sharing arrangements with non-resident or absentee-investors as most residents are unable to finance cage aquaculture. Local residents, therefore, serve either as caretakers or as permanent cage workers on farms that are usually registered in their names. Cage culture is mainly sustained by external funding as high operating costs and risks of fish farming deter local people from using their own limited financial assets. Most of the local people involved in aquaculture are comfortable working as caretakers because they lack the financial capital required to carry out aquaculture alone. Most fish farmers have multiple employment to reduce risks and provide additional financial security. The main sources of income for cage farmers in 2002 were cage farming (74 percent), trading (6 percent) and fishing (6 percent).

Case study 13 – Intensive tilapia cage culture, Thailand

Nile tilapia is traditionally considered a low value species in Thailand, with relatively small mixed-sexed fish frequently having off-flavour but the Thai market is becoming increasingly segmented (Belton and Little, 2006; Belton *et al*., 2009). Commercial monosex tilapia fry production from the mid 1990s onwards led to production of large all-male fish (more than 400g) which appeal to affluent consumers and command higher retail prices. More recently Charoen Pokphand (CP) Company has created and promotes a new premium fish, red tilapia or *pla tap tim* (ruby fish), initially sold live through restaurants. The popularity of the product grew rapidly and it is now also retailed in ice in local markets. The production of red tilapia in cages has been estimated at 30 000 tonnes/year, about 10 percent or more of total Thai tilapia production.

CP initiated contract farming of red tilapia. The company supplies fry and feed to franchised aquatic feed dealerships which nurse fry to a size of 25–50 g for stocking in cages, sell feed and harvest and market fish when they reach at least 600 g. Cages typically have steel tubular frames, polypropylene mesh nets and metal drums or plastic containers as floats. Farmers own between 4–25 cages each with an average volume of 62.5 m^3. All male fish are stocked at 1 500–2 500/cage and about 1 tonne/cage is harvested after four months grow-out. This system proved attractive to small and medium-scale farmers as cages are floated in public water bodies, usually rivers and canals. The culture techniques were simple to learn, and feed dealerships provided initial technical support and feed on credit. Cage farmers have diverse backgrounds such as agriculture, retail, construction and the civil service. For many, the activity is a secondary one, but a significant percentage of farmers have abandoned previous occupations such as rice or shrimp farming because of the favourable returns to effort which cage culture offers.

Contract farming is convenient for producers as CP arranges harvesting or locates buyers for farmed tilapia. It was also relatively risk free for farmers because all fish over 600 g were purchased at a set price upwards of USD1/kg. However, farmers contracted to CP have reported problems such as inconsistent availability of fingerlings and delayed harvesting at times of oversupply which disrupt production cycles. Farmers began to produce red tilapia independently using seed bought from smaller hatcheries and nurseries, fed cheaper catfish pellets, and sold their fish to middlemen. CP controls about 60 percent of red tilapia production in cages with the remainder of the market divided up between several feed companies operating similar contract systems and farmers producing and marketing fish on an independent basis. However, cage-based tilapia production now appears increasingly unsustainable due to increasing pollution in rivers, disease, and rapidly rising cost of pelleted feed. Cage culture may move to intensive cage-based production within aerated ponds to reduce adverse external environmental conditions. This would require greater capital investment which may be disadvantageous to small-scale farmers.

Case study 14 – Intensive tilapia cage culture, Bangladesh

Modern cage culture with pellet-fed sex-reversed Nile tilapia has recently been successfully introduced in Bangladesh by a DoF officer after participating in a training programme at the Asian Institute of Technology, Thailand in 2002 where he observed commercial tilapia cage culture (M. Baqui, personal communication, 2009). More than 3 000 cages are installed in rivers in Chandpur and Laxmipur districts. Each 30 m^3 floating cage is stocked with 1 000 sex-reversed 18–25g Nile tilapia fingerlings. After five to seven months, the fish are graded to maintain a uniform size, and in another month, each cage produces about 800 fish weighing a total of 350–400 kg. The total capital and operating cost for one cage is about USD265. Most cages are operated by better-off farmers but about 5 percent are small-scale farmers, some of whom are women organized into three main groups. One group has 50 members while the other two groups have 30 members each, some of whom belong to riverside landless families. Funding was provided by the government, the military or loans from the Bangladesh Rural Advancement Committee (BRAC), a leading NGO. The number of cages is increasing at the two sites. Fisheries officers and groups of farmers from around the country visited the sites with the purpose of possibly replicating the system elsewhere in the country. However, the poor may find it difficult to look for enough cash to purchase fish feed, especially during the later stage of grow-out when the fish are large.

The above initiative contrasts with an earlier unsuccessful attempt to introduce cage culture to the poor in Bangladesh (Hambrey *et al.*, 2008). About 10 000 small-scale 1 m^3 cages were provided to mainly poor landless people through the Department for International Development (DFID)/CARE cages project to help the poorest members of society. Although superficially financially viable, these small enterprises have almost all failed. Both the level of investment and return may have been inadequate even for the poorest to encourage the required level of commitment and husbandry. There were also technical constraints e.g. the tiny cage mesh were quickly clogged and the farm-made feeds were of poor quality, leading to low fish survival and growth. Furthermore, few poor farmers had tenure or even secure access to a water body and installation of cages in open access and privately owned water bodies was not sustainable.

Asia inland aquaculture, aquatic plants

Case study 15 – Water spinach, Cambodia

Aquatic plants, especially water spinach (*Ipomoea aquatica*), account for nearly half of the total sales of fresh vegetables in Phnom Penh, Cambodia (Khov *et al.*, 2005). The majority of the water spinach is grown in untreated city wastewater, the largest area on the surface of the northern side of a lake, Boeung Cheung Ek, in the southern part of Phnom Penh close to where the main city sewage is discharged into the lake. The plant is grown in floating beds secured by stakes. Livelihoods of the relatively poor communities which farm aquatic vegetables are diverse and also include employment in local factories, taxi driving and rearing livestock. Aquatic plant farmers may also transport their produce to markets in and around the city. Although poor households benefit from farming aquatic plants, aquatic vegetable growers are often affected by health problems, particularly wastewater related skin conditions from daily contact with wastewater in the lake. The government has a policy to promote aquatic plant production through recycling wastewater by using low-lying natural water bodies around the city. But with an expanding city and increasing numbers of factories and industries around the lake, the future livelihood of the people who live around and depend on the lake is uncertain.

Case study 16 – Culture-based and community-based fisheries in reservoirs, Viet Nam

Most reservoirs in northern Vietnam were constructed after 1960, primarily for hydroelectric power generation and irrigation but government policy in recent years has encouraged farmers to use them for fish production and small reservoirs are leased to farmers or farmer groups for aquaculture. (Nguyen *et al.*, 2001; De Silva *et al.*, 2006). Surveys of 20 small reservoirs in northern Viet Nam revealed stocking densities of 27–145 kg/ha for small farmer-managed reservoirs of 5–30 ha. Fish species stocked were Chinese carps (bighead, grass and silver carp), Indian major carps (mrigal and rohu), common carp, silver barb and Nile tilapia. Fish are normally harvested once a year from March to May when the water level is the lowest due to water drawdown to irrigate rice, with average fish yields ranging from 115 to 429 kg/ha. Stocked fish contributed more than 80 percent of the total harvest. Although yields and proceeds from sale of fish are low, the supplementary income is significant in mountainous northern Vietnam, one of the poorest regions of the country. As most small irrigation reservoirs are located in remote areas, culture-based fisheries have the potential to produce a significant amount of cheap animal protein and generate income in poor rural areas in the country. Research revealed that the water was poor in nutrients with fish yield closely correlated to conductivity and chlorophyll *a* concentration. Fish yields are below optimum due to lack of scientifically determined stocking and harvesting strategies, with current fishery management based on trial and error The current yield in small reservoirs in Vietnam averaging 100–500 kg/ha/year is one of the lowest in Asia, indicating that their fishery potential is not fully realized. The development of a best-practice model is expected to significantly increase the net gains from culture-based fisheries (Nguyen, 2006). The Government of Vietnam considers reservoir fishery research and development to be a priority, as well as training farmers in appropriate practice.

Case study 17 –Floodplain and community-based aquaculture, Bangladesh

Farmers in flood-prone, rice-based agro-ecosystems in Bangladesh grow high yield varieties of rice in shallow flooded fields during the dry season, followed by either deep water rice or a fallow period during the flood season and capture of wild fish from the flooded fields (Dey *et al*., 2005; Dey and Prein, 2006). The introduction of irrigation-based "green revolution" technology has increased the total rice production from about 2 to 6 tonnes/ha/year but the wild fish harvest has declined from about 200 to less than 100 kg/ha/year. Land ownership is based on dry season tenure. Although the rice fields are privately owned and farmed during the dry season, the fields, when submerged during the 4–6 months of flood become community property. This is the season when all members of the local community, including the poor and landless, are allowed to catch wild fish.

Groups, each with about 20 households comprising landowners, fishers and landless labourers, were organized by a WorldFish project to stock fish fingerlings in fenced areas during the flood season. Stocked fish were a polyculture of Chinese and Indian major carps which thrive with small indigenous fish species naturally present. Fish production was increased by about 600 kg/ha in shallow flooded areas and up to 1 500 kg/ha in deep-flooded areas without a reduction in either rice yield or in wild fish catch, and additional income of USD135–437/ha. Fish production from fenced and stocked floodplain areas can thus be increased 2–10 fold over the wild fish catch. The system is largely extensive as the fish benefit from residual nutrients from the preceeding rice crop as well as nutrients brought by floodwaters. Rice bran may occasionally be fed to the fish for a few weeks after the waters have receded and fish are confined to a smaller area in the enclosed floodplain. However, the sites need to be topographically suitable, with as much of the area as possible partially enclosed on existing embankments such as roads to reduce the high cost of fencing. The main technical limitation is the vulnerability of the system during heavy floods which can destroy fences leading to large loss of stocked fish.

The returns from the sale of fish were shared among group members and were especially significant for the landless. Neighbouring communities to trial sites over the 3-year period (1998-2000) of the project widely adopted the technology. However, another study reported that participants in the seasonal floodplain aquaculture (FPA) system do not allow any other community member to fish (Mustafa and Brooks, 2009). The floodplain aquaculture system requires considerable investment and generates benefit for only certain sectors of the community, especially landowners, at the cost of the livelihoods of poor people, especially fishers. A further study also found that FPA tends to exclude a large number of poor households from the floodplains through denying them their common property rights (Toufique and Gregory, 2008).

Asian inland aquaculture, seed production

Case study 18 – Seed production networks, Indonesia

The freshwater fish seed industry in Indonesia is dominated by small-scale farmer-operated hatcheries which supply about 80 percent of the national seed demand (Budhiman, 2007). There are over 26 000 small-scale hatcheries owned by individual small-scale farmers or farmer groups. Most of the farmers use traditional technology to breed common carp, giant gouramy, silver barb and tilapia. Wastewater is traditionally used as a pond fertilizer for seed production in Bandung, Cianjur and Sukabumi with polluted surface waters diverted into fish ponds in peri-urban areas (Edwards, 2009). Seed from these three areas comprises the major source of fingerlings in various grow-out systems, and especially pellet-fed cage culture of common carp and tilapia in reservoirs which is reported to provide about 80 percent of the domestic fish supply in West Java. Small-scale farming households with one to two up to five ponds breed and nurse common carp and tilapia in Cisaat, the main fish farming location of Cianjur. There are four groups of farmers involved in the various stages of seed production: fry production followed by three successive stages of first stage nursing of fry to 2–3 cm; second stage nursing of 2–3 cm fingerlings to 3-5 cm; and finally third stage nursing of 3–5 cm fingerlings to 5-8 cm fingerlings, after which they are mostly transported from the area to be stocked in cages in reservoirs. Fish seed provides the main year-round household income. Cash flow is good because of the short duration of nursing which is an attractive aspect of seed production, as well as the free source of nutrients in the wastewater for these relatively small farming households. As Cisaat is a suburb of the city of Sukabumi, some families have additional livelihoods, including involvement in the seed transport business.

Rice fields used to be a major source of fingerlings but the practice of rice field nursing has declined significantly. It is estimated that less than 10 percent of fingerlings are now nursed in rice fields in Cianjur, a major nursing area as the same amount of fry stocked in a nursery pond converted from a rice field would produce double the harvest of fingerlings, 100kg in the same 40 day period, than in a rice field nursery (Edwards, 2009).

Traditional small-scale wastewater-fed ponds are probably still the major source of seed for common carp and Nile tilapia. However, because of the tremendous increased demand for fingerlings to stock grow-out systems, especially cages in reservoirs, these two species are also produced in pellet-fed nursing systems in areas close to the reservoirs (Edwards, 2010). In Gembor Village, Pegaden subdistrict, Subang more than 1 000 former rice farmers, each having a minimum of one 0.5–1.5 ha nursing pond for common carp and Nile tilapia, provide fingerlings for running water pond systems in Cisalat sub-district, Subang and cages in Cirata Reservoir. Six large farmers in the village with each having a network of 70–100 small-scale nursing farmers facilitate input supply, credit and marketing of fingerlings.

Many small-scale farmers nurse high-value species such as giant gourami (*Osphronemus gouramy),* pacu (*Piaractus brachypomus*) and striped catfish (Edwards, 2010). The small-scale farmers who nurse the fry to fingerlings are linked to hatcheries which supply the fry. After nursing, the hatcheries buy back the fingerlings which they later sell to buyers. Mr Imsa, a large-scale seed producer in the Darmaga area of West Java has 6 hatcheries with a network of 10 small-scale farmers to whom he supplies eggs and one-day old larvae and from whom he buys back 21–40 day-old nursed fingerlings for subsequent sale. He supplies the farmers with feed, an aquarium production facility for nursing and credit, if needed. Each farmer has 70–100 units of 100–120 l aquaria. Each aquarium is stocked with 200 000 to 400 000 larvae/batch with an average of seven batches/year. Most of the small-scale nursers used to be solely rice or vegetable farmers. Now, they have a most profitable extra livelihood. Some nursers were laid-off from other jobs or were government officers. Nursing now provides them with 70–100 percent of their total income.

Case study 19 – Decentralized seed production, Bangladesh

Decentralized seed production has been developed through projects over the past decade in northwest Bangladesh with poor farming households having been taught how to breed and produce large fingerlings of common carp and tilapia in irrigated rice fields (Barman *et al*., 2007). Common carp was initially introduced to the poor villagers who used the fingerlings nursed in rice fields for subsistence rather than commercial seed production. However, following the introduction of rice field-based breeding and nursing of tilapia in areas where common carp was established, significant increases in seed productivity meant that in addition to domestic consumption, households had fingerlings for sale as well as for stocking their grow-out systems. Moreover, said technology which has been initially introduced to four households in one community spread rapidly from one farmer to another farmer in surrounding communities until it was adopted by 121 households in 20 communities within 3 years time, without further formal or institutional support. The technology was pro-poor because of its low cost (less than USD15), simplicity, and ease of integration with a small 0.1 ha rice plot. It was also compatible with other occupations, especially for women and children. Two thirds of the adopting households were defined by community key informants as poor, owning less than 0.4 ha of land, earning less than USD4 600/household, and with home grown rice supporting the family for less than 6 months/year. The approach has since been incorporated into the aquaculture development programs of the NGO CARE across the country.

Asia, coastal aquaculture, grow-out

Case study 20 – Shrimp, Thailand

Shrimp farming in Thailand is widely believed to be predominantly SSA and defined as 'small-scale owner-managed and operated practices with an average farm size of 1.6 ha' (Kongkeo and Davy, 2010). Shrimp farms with an area of not more than 1.6 ha are regarded by the Thai Department of Fisheries (DoF) as small-scale. Commercial semi-intensive culture of *P. monodon* using hatchery produced fry commenced in the early 1970s, but the industry was later affected by various diseases. According to Kongkeo and Davy (2010), Thai shrimp farmers were able to reduce production costs by using small-scale operations and shifting to low cost species like *P. vannamei*, while maintaining high standards and quality of their products.

The Thai Government has made it a matter of policy to promote shrimp culture and assist the poor small-scale operator (Kongkeo and Davy, 2010). Infrastructure facilities which were critically important, such as roads, electricity and water were provided to shrimp farming areas. Free technical assistance was also provided by the DOF to small-scale farmers. DOF policies for disease prevention strictly regulated the importation of SPF *P. vannamei* from Hawaii which was the only source allowed entry into the country. Price stabilization policies also helped small scale farmers to sell their products with guaranteed prices offered through the Agricultural Bank. The Agricultural Bank usually provides loans with minimal interest rate only to small-scale farmers. The Government also provides income tax exemption schemes to small-scale farmers if their net profits do not reach the ceiling.

According to the Thai DOF, total shrimp production was 523 370 tonnes in 2007 from 30 311 registered farms covering a total area of 68 492 ha or an average farm size of 2.2 ha (K.Yamamoto, personal communication, 2010). Although about 30 000 shrimp farms are registered, it is difficult for the DOF to determine how many are small-scale as the registration system is being circumvented by single owners dividing up their total area of ponds as farms larger than 8 ha must have settling ponds of not less than 10 percent of the area of the rearing ponds to treat the effluents before discharge into common water sources (Tokrisna, 2006).

Today there is disagreement about the extent of involvement of small-scale farmers in shrimp grow-out. Early shrimp farmers in Thailand had various occupational backgrounds from both private as well as public sectors, including agricultural farmers with only a limited number from fishers and aquaculture (Tokrisna, 2006). However, "shrimp farming required a level of investment that was beyond the reach of most small-scale fish farmers and fishermen". According to the DOF, the cost of production for a crop of *P. vannamei* in 2009 ranged between USD47 000-56 000, depending on the size of shrimp produced for an upper limit small-scale farm of 1.6 ha (K. Yamamoto, personal communication, 2010), which seems rather high to qualify for SSA. Although about 30 000 farms are registered in 2010, only about 8 000 are currently in operation, with mostly small-scale farms ceasing operation. Thus, it appears that there has been considerable consolidation of the shrimp farming industry over the last five years as the number of small-scale farmers has been reduced. Thai shrimp culture is probably still dominated in number by SSA, probably better called SMEs, although large farms likely dominate production.

Case study 21 – Shrimp, India

Coastal aquaculture in India is synonymous with shrimp aquaculture and is mainly carried out by small-scale farmers on holdings of less than 2 ha; these farms account for 90 percent of the total area utilized for shrimp culture (Umesh *et al.*, 2010). The Network of Aquaculture Centres in Asia Pacific (NACA), in collaboration with the Marine Products Export Development Authority (MPEDA), Government of India, conceived and implemented a project for "Shrimp disease control and coastal management" to address disease and environmental problems in the shrimp industry in India, and ensure that small shrimp farmers meet high standards for biosecurity, food safety, and environmental protection. The project aimed to address capacity building in shrimp health and quality management at the grassroots level by organizing small-scale farmers into aquaculture clusters.

The process commenced with the organization of small-scale farmers into groups or clusters (aquaclubs) in a given area, drawing on common resources such as a common water supply channel, and inducing the farmers to act collectively rather than individually for the betterment of all. The outcomes include improved shrimp yields, less impact on the environment, improved product quality, and better relations among players in the market chain. It facilitated the adoption and implementation of BMPs to provide benefits to the farmers, the environment and society. As a consequence, shrimp production increased from 4 tonnes in 2002 to 870 tonnes in 2006. Such clusters and/or aquaclubs were later transformed into Societies with a legal standing. The National Center for Sustainable Aquaculture was established in 2007 to monitor society functioning and dissemination of technical know-how to other areas. The eco-friendly low density aquaculture practices of society farmers may lead to the implemention of the first Indian Organic Aquaculture Project with possible eventual certification by Naturland against Naturland organic standards, providing market access with premium-price products.

Case study 22 – Marine finfish cage culture

Farming of marine carnivorous finfish by small-scale farmers is widely practised in East (China, Hong Kong SAR, Taiwan Province of China) and Southeast Asia (Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam) (Sim *et al.*, 2005a, b; Rimmer, 2008) as carnivorous marine finfish species bring high prices in both local and export markets, thus are attractive for farmers.

A study of grouper cage culture in southern Thailand where coastal households have been culturing high-value marine finfish since the 1970s showed that culture of grouper as an alternative to destructive fishing practices can make a substantial contribution to household incomes (Sheriff *et al.*, 2008). Grouper culture was not confined to any wealth category but was equally distributed among poor as well as middle income and wealthy households in their livelihood portfolios. In all except one of the surveyed villages, cage aquaculture was practiced by only a few percent of the households as it was constrained above all by lack of financial resources for investment. However, in one village, a DOF project provided a package comprising nets, floats and seed as well as training that enabled 69 percent of the fishing households to adopt fish culture with substantial contribution to household incomes. This indicates that fishing and aquaculture should be considered as complementary rather than competing livelihoods of coastal fishers. Cage farming villagers were able to substitute to some extent natural capital for financial capital as they were able to catch wild grouper seed and small fish to feed caged fish.

In contrast to the above, 400–450 small floating cages are operated by formerly poor inshore fishers at Catba Island, Viet Nam who produce a total of 800–1 000 tonnes annually (L.T. Luu., personal communication, 2010). The cages are stocked with groupers, cobia, red drum and snappers, and are mainly fed with "trash fish". The cage farmers used to be called "boat family" as they were landless who came from various provinces along the coast to farm fish when the catches of wild fish were insufficient for livelihood. It is government policy to promote SSA along with tourism and small-scale processing to find alternative livelihoods for 50 000 inshore small-scale fishers.

Case study 23 – Mariculture parks, Philippines

Mariculture parks have been set up in the Philippines over the past decade to generate employment and reduce poverty through marine fish culture as an alternative source of livelihood for marginalized coastal people (Rosario, 2008). Several areas have been developed with appropriate equipment and infrastructure to allow fishers, fish farmers and investors to operate cost-effectively and securely through development of technical skills and promotion of environmentally friendly inputs and farm management practices. The mariculture parks are being implemented at the village level with local government participation to zoning a parcel of at least 100 ha of coastal water for each mariculture park. Modern floating cages that can tolerate 2–3 m wave action that will last for at least 5 years with little maintenance are being installed. Well-defined sites with supporting infrastructure are being developed for investment by small and medium, as well as large-scale investors.

Case study 24 – Seaweed farming, Philippines

Seaweed culture is an important and major livelihood in several coastal areas of the Philippines, with many other potential areas for farming (Rosario, 2008). The Philippines is among the top producers of seaweeds in the world, especially red seaweeds. Red algae *Kappaphycus alvarezii* and *Eucheuma denticulatum* are the major species cultivated, mainly by fixed bottom monoline and floating monoline in shallow coastal waters with good water movement. Between 90 000 and 110 000 small-scale farmers cultivate seaweed for processing into the phyco-colloid carrageenan. There are many problems and constraints facing seaweed cultivation in the Philippines such as pollution in production areas; inadequate supply of dried seaweeds for processing leading to processors' losses; the peace and order situation in seaweed-producing areas in the southern Philippines; diseases affecting seaweeds such as 'ice-ice'; inconsistency in quality because of adulteration of the processed product with foreign materials; and increasing competition in production from other countries such as Malaysia, Indonesia and some African nations such as Tanzania.

Case study 25 – Mollusks, Thailand

Thailand has been farming shellfish for more than 100 years using traditional techniques such as the widespread bamboo stake culture that was introduced by Chinese immigrants (Chalermwat *et al*., 2003). Shellfish aquaculture in Thailand has generally been considered as a small-scale traditional activity producing seafood for local markets. Although traditional aquaculture techniques are still prevalent, new techniques such as oyster rafts and mussel long-lines have been introduced. Shellfish are farmed in every coastal province. Major shellfish are green mussel, blood cockle and three species of oyster. Green mussels were initially raised as a secondary opportunistic crop that formed on bamboo poles used to construct off-shore fish traps. Bamboo poles and palm stakes substrates were later introduced as mussels became to be viewed as a feasible primary crop. The government has only recently become involved in shellfish planning and management because of increasing water quality issues such as faecal wastes, industrial pollutants and red tides.

One of the most productive coastal areas in the country is Bandon Bay, Surat Thani province (Kaewnern and Yakupitiyage, 2008). Cockle farms averaged 15.37 ha and ranged in size from 0.32 to 192 ha. Oyster farms averaged 1.42 ha and ranged in size from 0.16 to 6.4 ha. Most farms appeared to be small-scale with farmers themselves managing their crops without hiring additional labourers. There were times when farmers hired workers to plant and maintain cultches on the mud flats and assist during harvest. Cost-benefit analysis showed net returns for oyster and cockle of USD4 905 and USD1 257/ha/year, respectively.

Mollusk farming is recognized as appropriate for small-scale farmers because it can be practiced with traditional or improved traditional methods relying on natural feed in the water. A majority of mollusk farmers reported that shrimp pond effluents were beneficial as they provide nutrients which stimulate phytoplankton production but were concerned about the possibility of excessive effluent discharge, calling for integrated management of the water body.

Asia, coastal aquaculture, seed production

Case study 26 – Backyard shrimp hatcheries, Thailand

Backyard hatcheries refer to small scale, usually family-owned and operated, seed production operations that are most often located in the backyard of the owners

(Kongkeo and Davy, 2010; Kongkaew, New and Sukumasavin, 2008). These hatcheries usually purchase shrimp nauplii from larger-scale hatcheries located near the open sea for better water quality and circulation needed in the maturation process. More accurately, they should be referred to as nurseries rather than hatcheries. Backyard hatcheries were first developed through a DOF-FAO giant freshwater prawn project that started in 1974. The project developed technical know-how, but many of the technical staff began to produce PLs at home, adapting the technology to less conventional water storage containers. Close proximity to the family home was critical as it provided family labour and almost round the clock vigilance which were the key reasons for success.

These simple backyard hatcheries were later easily and cheaply modified to produce marine shrimp PLs (*Penaeus monodon*, *P. vannamei*) and marine finfish such as groupers (*Epinephalus* spp.) and seabass (*Lates calcarifer*) fingerlings. This backyard hatchery concept was revolutionary in terms of the low initial investment on land and physical facility construction, limited need for costly equipment, and the operation costs were relatively low because of the simple techniques and small-scale operation. These innovations demonstrated the resourcefulness of small farmers and their ability to innovate.

According to Kongkeo and Davy (2010), there are more than 2 000 small-scale hatcheries in Thailand which produce more than 80 billion PLs/year or 90 percent of the total marine shrimp larvae for the country, even though they have suffered from competition with large-scale hatcheries that supply SPF PLs. However, it is likely that the contribution of backyard hatcheries has declined recently as CP Company has a number of modular mega-hatcheries supplying their feed customers, as well as independant farmers. Also, several other large corporate hatcheries supply the market. Backyard hatcheries are also facing other new challenges such as traceability of broodstock and certification requirements of developed countries.

Case study 27 – Backyard finfish hatcheries, Indonesia

Techniques developed by GRIM in Bali, Indonesia have been widely adopted by small-scale farmers in the northern part of Bali (Siar *et al.*, 2002). Small-scale hatcheries are defined as those where the capital costs and technologies are accessible at relatively low cost, and which focus on the hatchery (larval rearing) and nursery aspects of fingerling production. Small-scale hatcheries do not hold broodstock but purchase fertilized eggs or newly hatched larvae from larger hatcheries. Several million seed, equivalent to around Rupiah 20 billion (AUD 4 million) have been marketed domestically and exported to neighbouring countries such as China, Chinese Taipei, Hong Kong SAR, Malaysia, Philippines and Singapore. The hatchery techniques developed at GRIM have now been transferred to the private sector, reportedly contributing to farmers' incomes, job opportunities and export earnings. However, little is known about the social and economic aspects of small-scale hatcheries. Small-scale marine finfish hatcheries operate throughout Southeast Asia, including Malaysia, Thailand, the Philippines, Vietnam and China, as well as Indonesia. The popularity of small-scale marine fin fish hatcheries can be ascribed to the following advantages: low capital inputs (e.g. in Indonesia the capital cost for constructing a small-scale hatchery is around USD2 850); simple construction; ease of operation and management; and flexibility as they can be used for a range of species such as milkfish and grouper. Because capital and operating costs are low, the return on investment is rapid. An economic assessment of small-scale hatcheries in Indonesia indicated that seven out of the 11 hatcheries surveyed had capital payback periods of less than 1 year. Today, if a milkfish hatchery is not owned or managed by a staff of GRIM, it is owned by a Javanese or somebody from outside Bali. People from Jakarta, Surabaya, and even Chinese Taipei moved to Bali to buy land and set up hatcheries in the Gondol area. Thus, there is a lot of competition for the small-scale hatcheries.

The small-scale hatchery industry in Bali began with milkfish. The demand for milkfish fry is high in Indonesia and the Philippines, so there has been heavy foreign investment from the Chinese community of Indonesia and Chinese Taipei to expand the industry. Milkfish fry production still remains as the staple product for the majority of hatcheries in Indonesia. But with more than 2 000 hatcheries producing milkfish in the Indonesian provinces with a production volume of 300–450 million fry/month, supply commonly exceeds demand causing prices for milkfish seed to fall in price by 90 percent. This has led to hatcheries seeking to produce a diversity of products such as grouper fingerlings for grow-out as well as the aquarium trade. The development and success of the Backyard Multispecies Hatchery System (BMHS) at GRIM supported by the Japan International Cooperation Agency (JICA) and Australian Centre for International Agricultural Research (ACIAR), has seen a rapid uptake of grouper by the local hatcheries. GRIM assisted the development of the local industry by developing training programs, manuals, and setting up a prototype tank system. The leaders in the development of the hatchery industry are predominantly workers in the employ of GRIM who have set up hatcheries to produce grouper for private benefit. The extension of the techniques is direct toward the private industry. GRIM supplied the eggs in the initial stages for free and provided appropriate rearing diets.

Africa, inland aquaculture, grow-out

Case study 28 – Peri-urban pond culture, Cameroon

A 5-year study of SSA was conducted in the peri-urban and rural zones surrounding the large urban market of Yaoundé, Cameroon (R. E. Brummett, personal communication, 2010). Productivity, intensity and profitability increased more significantly in peri-urban areas with good market access, compared with rural areas. Among farmers with good market access, increases in fish pond income rose from USD94 up to USD1 649. In the peri-urban domain, prices were 48 percent higher, number of buyers was three times greater, and the average purchase per customer was nearly double than that of the rural domain. Therefore, peri-urban producers sold 300 percent more fish, were 72 percent more productive, and operated at 11 times the production scale of rural producers. At least USD20 000 and an annual fish production of about 5 tonnes/year are required to provide the necessary return on investment of about 30 percent for improved fed-pond aquaculture technology to be adopted. Without extension subsidies in the form of technical assistance, communications, marketing and logistics, only those farmers in areas of higher market access generated earnings of sufficient magnitude to keep them interested in aquaculture. Within 3 years of the end of extension support, rural farmers had returned to pre-project production levels, whereas peri-urban farms had stabilized or improved their productivity and profitability.

However, food security in Africa is largely a rural concern. Policies aimed primarily at keeping food prices low for the benefit of urban populations are generally counterproductive, discouraging production, and exacerbating overall food insecurity. Rural farmers must somehow be targeted for assistance to provide rural food security. In much of Africa where up to 80 percent of the population are low-income, small-scale farmers achieving food security will require a concentrated effort on the rural poor, probably by subsidizing extension, and especially marketing support. According to R.E. Brummett (personal communication, 2010), in areas with little or no access to markets, the number of fish ponds and fish farmers could be increased and yields improved, increasing local food supplies. However, sustainability in the absence of extension subsidies is questionable. If market access could somehow be achieved, then perhaps small-scale farmers would evolve in the direction of increasing revenues and operations of a larger scale. The best small-scale fish ponds in Central Cameroon generate profits of about USD1 008/year, compared with an average of about USD4 860/year on sales of 1.7 tonnes of fish reported by what probably qualify as SMEs in the same area. Providing direct technical assistance to SME investors who want to build commercially viable farms may be the cheapest and quickest way to help rural farming communities out of poverty. Most African aquaculture extension systems to date are aimed directly at the rural poor, and thus favour technologies than can be easily scaled down while the opposite is needed for SME commercial investors.

Case study 29 – Intensive culture of African catfish in tanks, Nigeria

In Ijebu-Obe, south of Ibadan, Nigeria, there is a "Fish Farming Village" where African catfish (*Clarias gariepinus*) has been raised in concrete block tanks for five years (Miller and Atanda, 2007). There are now about 175 cooperative fish farmers in this scheme with some having several fish production units. The village site has a year-round stream and a well with good water quality from which water is pumped to the tanks. The tanks measuring 8m x 2m x 1.2m are made of concrete blocks with a slightly sloping cement bottom. Construction of one tank costs about USD600 including labour. Most farmers stock 2 000 5-6 g fingerlings per tank at a high density of 125 fish/m2. Two weeks after stocking, the fish are sorted to move the faster growing fish into another tank as they are cannibalistic; the fish are sorted again after another month, resulting in three size groups distributed in three tanks. With 80 percent survival, this equals a density of some 33 fish per m2 or 530 fish/tank. Fish are fed sinking or floating pelleted feed by technicians trained to feed according to feeding response. With high quality feed, feed conversions of less than 1.5 can be obtained. Farmers joining the "fish farm village" cooperative benefited from credit of USD1 153 which is sufficient to construct a tank and cover all start up costs for one crop of fish. All tanks are cooperatively managed by a team of one supervisor and two technicians who assist in all activities including maintaining water levels, stocking, feeding, sampling, record keeping and harvesting of the fish. A night watchman also resides on site. With some 175 members, the cost of managing the members' tanks is reduced to a minimum. In one year a farmer with three tanks could earn USD1 050 from this activity.

Growth of aquaculture in Nigeria which is dominated by African catfish is about 20 percent/year and there are some 5 000 fish farmers in the country. Even though there is a significant number of "Fish Farming Villages' in Nigeria, there is still a high unmet demand for catfish with an expanding population of 150 million people. Also, the country is one of the largest importers of fish in the world with more than 900 000 tonnes of fish imported in 2009 (J. Miller, personal communication 2010). Small concrete tanks require less investment and less land than earthen ponds. Many farmers have built tanks inside their household compounds for better management and also to prevent theft. Small tanks suit the technical skills and scale of management of the average Nigerian farmer. African catfish that tolerates poor water quality can be raised at high density in small tanks. Most new fish farmers in the country invest in tanks and it is estimated that up to 75 percent of the 140 000 tonnes of catfish production reported by the government comes from tank-based SSA. This success story also depends on the wide availability of high quality seed (hundreds of small-scale hatcheries) and feed (Nigeria now has 4 feed mills producing high quality floating pellets and there are 12 brands imported aside from the many small-scale producers of low-quality feed). The total value of the industry is USD800 million which includes the value of fingerlings, feed and farmed catfish.

Africa, coastal aquaculture

Case study 30 – Seaweeds, Tanzania

Coastal regions in Tanzania are among the poorest in the country with 85 percent of coastal villagers currently living on less than US$1 per day (Rice *et al.*, 2006). Today over 90 percent of commercial aquaculture production in Tanzania is dried carrageenophyte seaweeds, the farming of which is viewed as a good investment as well as appropriate for the development of poor coastal communities. The red seaweeds *Eucheuma denticulatum*, commonly known as 'spinosum' and *Kappaphycus alvarezii*, commonly known as 'cottonii', are sources of iota and kappa carrageenans, respectively. The global demand for carrageenan is increasing at 5–7 percent/annum as they are used worldwide as food additives and thickening agents in a number of commercial products. Therefore, supporting the continued development of the Tanzanian seaweed industry is important for the livelihoods of poor coastal communities. Seaweed farming began in Tanzania in the mid-1970s following introduction of *E. denticulatum* from the Philippines by a local university professor. An extension manual on seaweed farming was published in 1983 in Swahili, the local language and reports of the success of the pilot trials led to increased investment by international carrageenophyte buyers. In the early 1990s, the relatively more valuable *K. alvarezii* was also introduced from the Philippines and has been shown to grow successfully on a commercial scale in Tanzanian waters. Production of seaweeds of about 7 000 tonnes has been steady since 1999 although several factors constrain the growth of the industry: so-called ice-ice disease; epiphytic filamentous; grazing by rabbitfish; and poor transportation infrastructure with long distances to the key wholesale markets. Farm management has also been a problem as seaweed farms are located in the warm, shallow intertidal or slightly sub-tidal areas that expose the seaweeds to stressful salinity fluctuations during the rainy season. The farms are in shallow water because the key producers are coastal women who generally do not swim. One option is to move the seaweed farms into deeper waters with floating raft culture where seaweed farming would possibly be more lucrative. In a few villages, seaweed farming is becoming a family business with men adept at working in deeper waters, or men who have boats assisting in seaweed farming. There is also a need to form village producer associations to contract with seaweed buyers. A zoning system with the demarcation of designated seaweed areas to reduce coastal zone user conflicts has been initiated.

Latin America, inland grow-out

Case study 31 – Pond culture in Honduras

Promotion of SAA in Honduras and other Central American countries began in the 1950s with the introduction of Java tilapia *(O. mossambicus*) and common carp by FAO (D. Meyer, personal communication, 2010; Meyer and Meyer, 2010)). From the 1950s to the 1970s many non-commercial ponds were constructed on rural farms and stocked with tilapia fry donated by government agencies or NGOs to provide animal protein to improve the diets of rural families. As the local image of tilapia was that of a "poor man´s fish", little attention was given to aquaculture by the educated members of society, and most of these projects were not sustainable in rural Honduras. Following the establishment of the first commercial tilapia farm in Costa Rica around 1985 to export fresh fillets to North America and the subsequent development of commercial tilapia farms in all Central American countries, a new and improved local image of tilapia led to greater demand. In all of these countries, tilapia in several forms is now for sale in supermarkets, public markets, and restaurants throughout the region. Furthermore, tilapia can now be sold locally at a price that offers an attractive profit margin for small and medium-scale fish farmers. Most SSA complements other livelihoods. Some fish farmers are company employees, most farm crops such as coffee, while some also raise livestock. As SSA farmers try to imitate the large commercial farms, they use expensive pelleted floating fish feed. Most fish are sold at the farm to neighbours or in local markets, live for USD2.20 to 2.60/kg or gutted and scaled USD2.50 to 3.00/kg.

Case study 32 – Pond culture in Guatemala

A project was implemented in the 1980s to improve nutrition and income for poor farm families in eastern, coastal and northern Guatemala through promotion of SSA (Lovshin *et al*., 2000; FAO, 2000). Over 1 000 small ponds of 100–200 m2 involved construction or renovation on the individually owned small farms which had an average size of 0.9 ha and an average total annual household income of USD700. About 15 percent of the ponds were integrated with animals and 21 percent with vegetable gardens. An evaluation team re-visiting about a decade later conducted a survey of a representative sample of about half of the farm families known to have had functioning ponds when external financing was withdrawn. It was found that only 13 percent of the ponds were well managed, 48 percent were under-utilized, and 39 percent had been abandoned. Without a ready source of manure to fertilize the fish ponds, the farmers used kitchen and table scraps, and on-farm by-products to feed the fish which were insufficient to obtain high fish yields. Although the net annual income from fish sales was modest, the net cash value of the fish crop was equivalent to approximately two months of wages of a rural labourer. However, a strong motive for retaining an active fish pond for almost half of the farmers was the need for water during the dry season for irrigation and livestock watering. Most farmers irrigated their vegetable gardens from government controlled irrigation canals and as water was rationed during the dry season, fish ponds were filled to capacity when water was available for later use.

Case study 33 – Brazil

Freshwater fish culture is practiced in every state in Brazil and primarily in small earthen ponds with most production for local consumption (Valenti, 2007). An estimated 100 000 freshwater fish farms, over 85 percent less than 2 ha, produce about 179 000 tonnes/year. Carps (common, bighead, grass and silver carp) and tilapia dominate production, contributing over 60 percent of total production. Carps are commonly farmed in polyculture, sometimes with tilapia and integrated with pig production. The farming of native pacu (*Piaractus brachypomus*) and tambaqui (*P. macropomum*) and their hybrid tambacu is important all over the country. Currently, Santa Catarina leads the Brazilian aquaculture industry with 11 172 ha of fish ponds in 2005 (Fracalossi *et al*., 2009). Two types of fish culture are practiced in the State: traditional subsistence SSA that does not adopt modern technologies and provides only occasional profit; and commercial enterprises which represent the main source of income for approximately 4 500 farmers who usually employ the techniques learned in specialized training courses. Commercial aquaculture, presumably through SMEs, has kept farmers on their land and contributes to the local economy by employing many people in rural areas. Production costs in Santa Catarina are low because aquaculture is integrated with livestock which reduces the use of artificial feed. Pond primary productivity provides the initial feed for fish until they are 150 g, after which it is supplemented with artificial feed.

ACKNOWLEDGEMENTS

Ben Belton, Randy Brummett, Harvey Demaine, Dan Fegan, Tom Hecht, Le Thanh Lu, David Little, Dan Meyer, James Miller, Francis Murray, Simon Wilkinson and Sena De Silva are thanked for discussion and providing information.

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FAO FISHERIES AND AQUACULTURE PROCEEDINGS 31

Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development

FAO Expert Workshop
21–24 April 2010
Hanoi, Viet Nam

Informed by 18 technical papers consisting of reviews, country experience papers, case studies, assessment studies and project studies tackling different issues confronting the small-scale aquaculture (SSA) sector including lessons learned, and enhanced by the particular expertise and knowledge by participating experts, this expert workshop analysed and came up with a list of internal attributes (strengths, weaknesses) and external attributes (opportunities and threats) of the three pillars of food security, poverty alleviation and socio-economic development as they pertain to the SSA sector. Using this analysis, the workshop identified entry points, action plans, guiding principles and elements of a planned technical guidelines to guide and strengthen the SSA sector's contribution to these three pillars.

Enabling policies focusing on support to SSA producers as well as taking into actions the World Food Summit (2009) commitments are needed. Information availability is changing rapidly, thus, utilization of currently available methods of measurement (e.g. Nha Trang indicator system, household surveys, impact assessment studies) offer good guidance as a starting point. More systematic assessment is needed based on a clear framework that fully considers resource systems/agro-ecological zones and the importance of putting aquaculture in 'context' in any assessment. The current renewed interest in agriculture and the recent food crisis give an opportune time to 'mainstream' aquaculture, better link it to dominant development discourses and consider its relationship to the larger-scale aquaculture, aquaculture-based fisheries and agriculture. The role that the SSA sector plays in poverty alleviation is only one among many options. The Sustainable Livelihoods Approach has good potential to help the current thinking on SSA. However, other new alternative frameworks that put people at the center should also be explored particularly giving more attention to SSA producers and how to improve their resilience to threats, risks, and shocks affecting the aquaculture sector.