



Catalog: 2013-18

# Publications Catalog 2012





WorldFish, a member of the CGIAR Consortium, is an international, nonprofit research organization. CGIAR is a global partnership that unites organizations engaged in research for a food secure future. CGIAR research is dedicated to reducing rural poverty, increasing food security, improving human health and nutrition, and ensuring more sustainable management of natural resources. It is carried out by the 15 centers who are members of the CGIAR Consortium in close collaboration with hundreds of partner organizations, including national and regional research institutes, civil society organizations, academia, and the private sector.

WorldFish is committed to meeting two key development challenges: 1) improving the livelihoods of those who are especially poor and vulnerable in places where fisheries and aquaculture can make a difference and, 2) achieving large scale, environmentally sustainable, increases in supply and access to fish at affordable prices for poor consumers in developing countries.

This catalog lists publications published by WorldFish, CGIAR Research Program on Aquatic Agricultural Systems (AAS) and papers contributed by the Center's scientists in 2012. It reflects the outcomes of research carried out in collaboration with partners from 27 countries through the generous support from international investors. The majority of which are members of the CGIAR.



The catalog is divided into four sections:

- Corporate publications*
- Staff Refereed publications*
- Staff Non-refereed publications*
- Other Key WorldFish publications and AAS publications*

They are sorted alphabetically by the surname of the primary author and abstracts are provided. The index of WorldFish authors at the end of this catalog will lead you to specific pages for easy referencing.

The number of contributions at the time of publishing this catalog is:

	2012
• Corporate publications	02
• Staff Refereed publications	47
• Staff Non-refereed publications	17
• Other Key WorldFish publications	25
• AAS publications	20

## **WorldFish annual report 2011/12. Penang, Malaysia.**

This year's report contains the Director General's and Chairman's statements. Also highlighted in the reports, are stories of projects with different partners: 1) CGIAR Research Program on Aquatic Agricultural Systems (AAS) in Zambia. 2) Wetland Alliance project in the Mekong delta. 3) Projects with CARE, the humanitarian organisation in Egypt. 4) Tilapia breeding program with Water Research Institute (WRI) in Ghana. 5) Partnerships with the private sector on sustainable aquaculture enterprise in developing countries.

## **2011 Publications catalog. Penang, Malaysia.**

This catalog lists publications published by WorldFish and papers contributed by the Center's scientists in 2011. It reflects the outcomes of research carried out in collaboration with partners from 27 countries through the generous support from international investors. The majority of which are members of the CGIAR.

Aheto, D.W. ; Asare, N.K. ; Tenkorang, E.Y. ; Asare, C. ; Okyere, I 2012.  
Profitability of small-scale fisheries in Elmina, Ghana.  
*Sustainability* 4(11): 2785-2794.

In order to achieve sustainable fishing livelihoods in coastal communities, data on profitability of small-scale fisheries relative to fish species caught and gear types used by fishermen is required as part of a broader fisheries management strategy. This study was undertaken with this in mind. Interviews were conducted among 60 fishermen between February and March 2010. Economic assessment of small-scale fishing activities were done using questionnaires based on direct market pricing and contingent valuation methods. The results indicate that highly profitable fish species include *Epinephelus aeneus*, *Sparus caeruleostictus*, *Dentex angolensis* and *Lutjanus goreensis* valued at US\$2.97, US\$2.87, US\$2.85 and US\$2.63 per kilogram respectively. The less profitable species include *Dasyatis margarita*, *Caranx crysos* and *Sardinella aurita* valued at US\$0.34, US\$0.66 and US\$ 0.85 per kilogram respectively. Although *Sardinella aurita* was among the less valuable fish species, it was the main species driving profits for the fishermen due to its high share volume among the fish catches. Findings from this study suggest high rates of exploitation, in that stocks generally cannot provide for increased economic return in the face of increased investment. This is a clear indicator that the open-access nature of Ghanaian fisheries is not sustainable, and management reform is well overdue.

Ahmed Ibrahim, N. ; Abou Zaid, M.Y. ; Khaw, H.L. ; El-Naggar, G.O. ; Ponzoni, R.W. 2012.  
Relative performance of two Nile tilapia (*Oreochromis niloticus* Linnaeus) strains in Egypt: The Abbassa selection line and the Kafr El Sheikh commercial strain.  
*Aquaculture Research* [online first 29 July].

The Abbassa selection line (developed by selective breeding) and the Kafr El Sheikh commercial strain (widely used in Egypt), both *Oreochromis niloticus*, were compared at two stocking densities (two and four fish m<sup>-2</sup>). Harvest weight, length, depth, width and head length were recorded. The Abbassa line showed a superior harvest weight (28 per cent) over the Kafr El Sheikh strain. Males were heavier than females, but the between-sex difference was greater in the commercial than in the Abbassa line (39 and 31 per cent respectively). Females in the Abbassa line grew almost as fast as males in the commercial line. Both strains grew faster at the lower density, and the percentage reduction in harvest weight at the higher density was about the same for both strains (27 per cent). The advantage of the Abbassa line was 28 per cent at both densities. Both strains had a similar survival rate (approximately 80 per cent) during the grow-out period. We conclude that the Abbassa line is ready for release to the tilapia industry in Egypt. Further evidence is being sought in currently underway on-farm evaluations. Measures should be taken to ensure the long-term viability of the Abbassa line.

Ali, H. ; Haque, M.M. ; Belton, B. 2012.  
Striped catfish (*Pangasianodon hypophthalmus*, Sauvage, 1878)  
aquaculture in Bangladesh: an overview.  
*Aquaculture Research [Online first]*.

Farming of the striped catfish, *Pangasianodon hypophthalmus*, is a major aquaculture activity in Bangladesh, particularly in the district of Mymensingh. However, pangasius farm management practices and the socio-economic impacts of pangasius farming systems in Mymensingh have not yet been adequately described in the literature. This article provides an overview of the present status and characteristics of pangasius culture in Bangladesh based on data from a study conducted in Mymensingh district during 2009. The mean productivity of pangasius was 36.9 MT ha<sup>-1</sup>, where 87.9% of the farms produced between 15 and 65 MT ha<sup>-1</sup> of pangasius, with an additional 10-20% Indian major and Chinese carps and Nile tilapia. Pangasius aquaculture in Bangladesh has improved the economic and social status of a variety of stakeholders in communities where the fish is farmed.

Allison, E.H. ; Ratner, B.D. ; Asgard, B. ; Willmann, R. ; Pomeroy, R. ; Kurien, J. 2012.  
Rights-based fisheries governance: from fishing rights to human rights.  
*Fish and Fisheries 13(1): 14-29*.

In the last twenty years, policy prescriptions for addressing the global crisis in fisheries have centred on strengthening fisheries governance through clarifying exclusive individual or community rights of access to fishery resources. With a focus on small-scale developing country fisheries in particular, we argue that basing the case for fishery governance reform on assumed economic incentives for resource stewardship is insufficient when there are other sources of insecurity in people's lives that are unrelated to the state of fishery resources. We argue that more secure, less vulnerable fishers make more effective and motivated fishery managers in the context of participatory or rights-based fisheries governance, and we further suggest that insecurity among fishers living in poverty can be most effectively addressed by social and political development that invokes the existing legal framework supporting the Universal Declaration of Human Rights. This perspective goes well beyond the widely advocated notion of 'rights-based fishing' and aligns what fishery sector analysts call the 'rights-based approach' with the same terminology used in the context of international development. Embedding the fisheries governance challenge within a broader perspective of human rights enhances the chances of achieving both human development and resource sustainability outcomes in small-scale fisheries of developing countries.

Appeltans, W.; [Bailly, N.] et al. 2012.  
The magnitude of global marine species diversity.  
*Current Biology 22(23): 2189-2202*.

The question of how many marine species exist is important because it provides a metric for how much we do and do not know about life in the oceans. We have compiled the first register of the marine species of the world and used this baseline to estimate how many more species, partitioned among all major eukaryotic groups, may be discovered.

Armitage, D. ; Béné, C. ; Charles, A.T. ; Johnson, D. ; Allison, E.H. 2012.  
The interplay of well-being and resilience in applying a social-ecological perspective.

*Ecology and Society* 17(4): 15.

Innovative combinations of social and ecological theory are required to deal with complexity and change in human-ecological systems. We examined the interplay and complementarities that emerge by linking resilience and social well-being approaches. First, we reflected on the limitations of applying ecological resilience concepts to social systems from the perspective of social theory, and particularly, the concept of well-being. Second, we examined the interplay of resilience and well-being concepts in fostering a social-ecological perspective that promises more appropriate management and policy actions. We examined five key points of interplay: (1) the limits of optimization thinking (e.g., maximum sustainable yield), (2) the role of human agency and values, (3) understandings of scale, (4) insights on "controlling variables," and (5) perspectives on thresholds and boundaries. Based on this synthesis, we offer insights to move incrementally towards interdisciplinary research and governance for complex social-ecological systems.

Beare, D. ; Machiels, M. 2012.

Beam trawlermen take feet off gas in response to oil price hikes.

*ICES Journal of Marine Science* 69(6): 1064-1068.

Average towing speed by Dutch beam trawlermen has fallen substantially between 2002 and 2009. Changes in towing speed are related to changes in oil price. The price of their valuable main target species (sole, *Solea vulgaris*) did not influence towing speed. The aim of this Short Communication is to explore the hypothesis that changes in trawling speeds are directly related to changes in oil price using time-series data.

Bell, R.J. ; Collie, J.S. ; Jamu, D. ; Banda, M. 2012.

Changes in the biomass of chambo in the southeast arm of Lake Malawi: A stock assessment of *Oreochromis spp.*

*Journal of Great Lakes Research* 38: 720-729.

Lake Malawi has one of the most diverse fish faunas in the world (500-650 species) and is a major source of protein for the people of Malawi. Chambo (*Oreochromis spp.*) is one of the most important food fishes; its abundance has declined sharply over the last twenty-years. Surveys by the Malawi Department of Fisheries have shown a decrease in chambo density in the southeast arm of the lake and the annual harvest has dropped substantially since 1985. We conducted a dynamic stock assessment of *Oreochromis spp.* which included all vessel and gear types and covered the entire southeast arm of Lake Malawi. Chambo biomass peaked in 1982 and then declined continuously through the early 2000s. The biomass is highly correlated with the mean lake height two years prior suggesting that recruitment may be linked to increased nutrient input, and spawning and nursery habitat associated with the flooding of low lying areas. The main driver of chambo biomass, however, was

fishing pressure which was above the level that would achieve maximum sustainable yield during the entire time series. This study provides a baseline from which to measure changes due to future management actions or climate variations.

**Belton, B. 2012.**

**Culture, social relations and private sector development in the Thai and Vietnamese fish hatchery sectors.**

*Asia Pacific Viewpoint 53(2): 133-146.*

This paper provides a comparative analysis of the social and cultural dimensions of fish hatchery development in Vietnam and Thailand. Two detailed case studies highlight the importance of a variety of culturally mediated, informal interpersonal relationships in facilitating the establishment of new hatchery enterprises. The analysis reveals that in both Vietnam and Thailand, informal relationships are extremely effective conduits for the transfer of productive technologies from public institutions to private entrepreneurs and for the subsequent development of private enterprises. It is concluded that if current policies aimed at promoting private sector development are to be more successful, they must be better tailored to the contours of specific cultural geographies in locations where they are implemented.

**Belton, B. ; Azad, A. 2012.**

**The characteristics and status of pond aquaculture in Bangladesh.**

*Aquaculture 358-359: 196-204.*

Very rapid developments are widely believed to have occurred within Bangladesh's aquaculture sector in recent years, but have yet to be adequately documented. This paper addresses the information gap based on a comprehensive review of literature and data. The current status of pond based aquaculture in Bangladesh is summarized in terms of the quantities and species of fish produced and the technical and social characteristics of the production systems from which they originate. The main systems of pond aquaculture practiced in Bangladesh are analyzed, paying particular attention to the technical, social and economic characteristics of two dominant forms of production. These are categorized here as homestead pond culture (carp dominated low intensity production conducted on a semi-subsistence basis, requiring limited management, labor and capital investment) and entrepreneurial pond culture (semi-intensive or intensive culture entered into as a productive investment with moderate or high capital costs and frequently employing labor). An estimate of national fish production and consumption disaggregated by culture system is presented. The discussion section synthesizes these results and considers their present and future implications.



Belton, B. ; Haque, M.M. ; Little, D.C. 2012.

Does size matter? Reassessing the relationship between aquaculture and poverty in Bangladesh.

*Journal of Development Studies* 48(7): 904-922.

Aquaculture has long been promoted by development institutions in Bangladesh on the understanding that it can alleviate poverty. Most of this attention has focused on forms of the activity commonly referred to as 'small-scale'. This article draws on concepts from the literature on agricultural growth and elaborates a typology of aquaculture based on relations of production which suggests that, in Bangladesh, quasi-capitalist forms of aquaculture may possess greater potential to reduce poverty and enhance food security than the quasi-peasant modes of production generally assumed to do so. The implications of this conclusion are explored.

Bentsen, H.B. ; Gjerde, B. ; Nguyen, N.H. ; Rye, M. ; Ponzoni, R.W. ; Palada de Vera, M.S. ; Bolivar, H.L. ; Velasco, R.R. ; Danting, J.C. ; Dionisio, E.E. ; Longalong, F.M. ; Reyes, R.A. ; Abella, T.A. ; Tayamen, M.M. ; Eknath, A.E. 2012.

Genetic improvement of farmed tilapias: Genetic parameters for body weight at harvest in Nile tilapia (*Oreochromis niloticus*) during five generations of testing in multiple environments.

*Aquaculture* 338-341: 56-65.

The main objective of this paper was to report more reliable estimates of the genetic variation and the genotype by test environment interaction for harvest body weight in the GIFT population in the Philippines than could be obtained from the base population by using the data from the five generations following the base population and that covers a wider span of test environments than the later experiments referred to above. Included are also estimates of the genotype by sex interactions for body weight. The importance of the latter is to investigate to what degree the expression of growth in both sexes is determined by different genes and thus should be treated as different traits in a breeding program, in particular since monosex culture is widespread in Nile tilapia.

Brummett, R.E. ; Beveridge, M.C.M. ; Cowx, I.G. 2012.

Functional aquatic ecosystems, inland fisheries and the Millennium Development Goals.

*Fish and Fisheries [online first]*.

Freshwater allocation in an environment of increasing demand and declining quality and availability is a major societal challenge. While biodiversity and the needs of local communities are often in congruence, the over-riding necessity of meeting national demands for power, food and, increasingly, mitigation of the hydrological effects of climate change, often supersedes these. Sophisticated models of ecosystem function to establish environmental flows are difficult to implement and consequently have generally failed to reduce rates of biodiversity and habitat loss, resulting in disenfranchisement of local communities resulting

from dam construction and water abstraction for industry and agriculture. There are no agreed standards upon which a fairer allocation of resources can be made and thus a pragmatic approach to the resolution of these conflicts is clearly needed. While having generally negative impacts on biodiversity and traditional lifestyles, creation of new infrastructure and active management generates national economic growth and much-needed employment. Intensification of usage in watersheds already expropriated for human enterprise can spare land needed for the biodiversity that will fuel adaptation for the future. Taking advantage of a range of mitigation technologies and building their cost into the investment plans for water management infrastructure can improve the cost/benefit ratio of water control infrastructure and may be a more practical and efficacious approach to the valuation of fisheries and the maintenance of other essential services from functional aquatic ecosystems.

**Debnath, P.P. ; Karim, E. ; Haque, M.A. ; Uddin, M.S. ; Karim, M. 2012.**  
**Prevalence of White Spot Syndrome Virus in brood stock, Nauplii and Post-larvae of Tiger shrimp (*Penaeus monodon Fabricius, 1798*) in Bangladesh.**

*Journal of Advanced Scientific Research 3(3): 58-63.*

Bangladesh enters into international shrimp market in early 1970s but now it takes second places in the source of foreign currency earning. Now this sector facing a serious problem with a disease named White Spot Syndrome Virus which causes 100% mortality in the shrimp farm within two weeks. In Bangladesh, outbreak of White Spot Syndrome Virus has been a serious problem since 1995. In the present study, it was observed the present situation of White Spot Syndrome Virus prevalence in wild tiger shrimp brood, nauplii and post-larvae in Bangladesh. The result shows that prevalence of White Spot Syndrome Virus in wild tiger shrimp brood was in decreasing trend, but post-larvae during the study period. White Spot Syndrome Virus prevalence in tiger shrimp brood, nauplii and post larvae was found highest in the month of March and April and after that it was decreasing up to July and again increases in the month of August.

**Debnath, P.P. ; Karim, M. ; Kudrat-E-Kabir, Q.A.M. ; Haque, M.A. ; Khan, M.S.K. 2012.**  
**Production performance of white fish in two different culture systems in Patuakhali, Bangladesh.**

*Journal of Advanced Scientific Research 3(4): 55-67.*

The present study was carried out to compare the production performance of white fish from traditional and modified traditional culture system in Patuakhali with the following objectives: 1) To know the production performance in traditional and modified traditional culture systems. 2) To observe the economic feasibility of two culture methods 3) To find out the effect of stocking density on survival and production in different culture system. 4) To know the socio-economic status of the fish farmers involved in both culture system.

Fontaine, B. ; van Achterberg, K. ; Alonso-Zarazaga, M.A. ; Araujo, R. ; Asche, M. ; Aspöck, U. ; Audisio, P. ; Aukema, B. ; Bailly, N. et al. 2012.

New species in the old world: Europe as a frontier in biodiversity exploration, a test bed for 21st century taxonomy.

*PLOS One* 7(5): e36881.

The number of described species on the planet is about 1.9 million, with ca. 17,000 new species described annually, mostly from the tropics. However, taxonomy is usually described as a science in crisis, lacking manpower and funding, a politically acknowledged problem known as the Taxonomic Impediment. Using data from the Fauna Europaea database and the Zoological Record, we show that contrary to general belief, developed and heavily-studied parts of the world are important reservoirs of unknown species. In Europe, new species of multicellular terrestrial and freshwater animals are being discovered and named at an unprecedented rate: since the 1950s, more than 770 new species are on average described each year from Europe, which add to the 125,000 terrestrial and freshwater multicellular species already known in this region. There is no sign of having reached a plateau that would allow for the assessment of the magnitude of European biodiversity. More remarkably, over 60% of these new species are described by non-professional taxonomists. Amateurs are recognized as an essential part of the workforce in ecology and astronomy, but the magnitude of non-professional taxonomist contributions to alpha-taxonomy has not been fully realized until now. Our results stress the importance of developing a system that better supports and guides this formidable workforce, as we seek to overcome the Taxonomic Impediment and speed up the process of describing the planetary biodiversity before it is too late.

Garces, L.R. ; Pido, M.D. ; Tupper, M.H. ; Silvestre, G.T. 2012.

Evaluating the management effectiveness of three marine protected areas in the Calamianes Islands, Palawan Province, Philippines: Process, selected results and their implications for planning and management.

*Ocean & Coastal Management* [online first July].

Evaluating the management effectiveness of marine protected areas (MPAs) has been a continuing challenge in marine conservation in the tropics. This paper describes the process involved, the chosen indicators and the selected results of the evaluation of management effectiveness of three MPAs in the Calamianes Islands, Palawan Province, Philippines. The evaluation was a participatory process that involved several institutions: academe, an externally-funded project, local governments, national government agencies and research organizations. Twenty-three indicators were used for evaluation: six biophysical indicators that largely measured the status of capture fisheries and coastal habitats; eight socioeconomic indicators that largely assessed the economic status and the perceptions of coastal communities; and nine governance indicators that measured the various facets of MPA management. Key lessons learned indicate the need to correlate the perceptions of coastal stakeholders with scientific findings as some perceptions did not reflect the results of biophysical surveys. We illustrate that a multidisciplinary approach and engagement of key stakeholders provides a comprehensive assessment and consensus for measuring the success of MPAs.

Hair, C.A. ; Pickering, T.D. ; Mills, D.J. (eds.). 2012.  
**Asia–Pacific tropical sea cucumber aquaculture.**  
*Proceedings of an international symposium held in Noumea, New Caledonia, 15–17 February 2011. ACIAR Proceedings No. 136. Australian Centre for International Agricultural Research, Canberra. 209 p.*

ACIAR, in collaboration with the Secretariat of the Pacific Community (SPC), organised a symposium on tropical sea cucumber aquaculture at SPC Headquarters in Noumea, New Caledonia, in February 2011. Although the principal focus was on ACIAR work, particularly in the Asia–Pacific region, researchers from other parts of the world were invited to provide additional expertise. The symposium identified knowledge gaps and highlighted researchable topics for future developments in sea cucumber aquaculture.

Haque, A.B.M.M. ; Visser, L.E. ; Dey, M.M. 2012.  
**Institutional arrangements in seasonal floodplain management under community-based aquaculture in Bangladesh.**  
*Asian Journal of Agriculture and Development 8(1): 1-18.*

Seasonal floodplains under private and public ownership in the Indo-Ganges river basin provide food and income for millions of people in Bangladesh. Floodplain ownership regimes are diverse, covering the whole spectrum from public to private ownership. The paper compares community-based fish culture projects in these floodplains and analyzes the institutional arrangements of three different Floodplain Management Committees (FMC). The paper aimed to understand the complex institutional relations that govern ownership, access, and control of the floodplains under community-based fish culture (CBFC) to increase fish production and the livelihoods of the poor. We followed the stakeholders representing the various institutions and organizations such as the Department of Fisheries (DoF), Department of Land (DoL), and FMC. Other important stakeholders were the lease-holders of public water bodies in the floodplains, private landowners, seasonal and professional fishers. The analysis demonstrates a significant increase of benefits to all stakeholders, including the poor, through the sharing of benefits derived from their involvement in the project. The willingness of different social classes to work together, the adoption of new technologies, and the societal embeddedness of local government institutions appear to be important inputs for policy making.

Hasan, M. ; Khan, M.S.K. ; Haque, M.A. ; Karim, E. ; Debnath, P.P. 2012.  
**Livelihood strategies of tiger shrimp post larvae collectors in backkhali river estuary, cox's bazar of Bangladesh.**  
*International Journal of Sustainable Agricultural Technology 8(9): 1-7.*

This study aim was to understand the livelihoods of tiger shrimp (*Penaeus monodon*, Fabricius, 1798) post larvae collectors in the Backkhali river estuary areas under Cox's Bazar district in Bangladesh during November 2010 to April 2011 where shrimp fry are caught. There are about 130-140 families and about 1000 people are living in the adjacent area. Most of the

fry collectors have no land or house. They build house on Government (khas) land near the coast, the housing is mainly with earthen/bamboo or polythen. It was found that per month income of 30% of fry collector 5000-6000 taka and 48.3% have no toilet. Also it was found that 43.3% respondents had 2 meals per day only. The main occupations of this community are shrimp post larvae collecting, small treading, day labor, hilsha fishing, fishing labor, fish drying, salt production and farming.

Hughes, S. ; Yau, A. ; Max, L. ; Petrovic, N. ; Davenport, F. ; Marshall, M. ; McClanahan, T.R. ; Allison, E.H. ; Cinner, J.E. 2012.

**A framework to assess national level vulnerability from the perspective of food security: The case of coral reef fisheries.**

*Environmental Science & Policy 23: 95-108.*

Measuring the vulnerability of human populations to environmental change is increasingly being used to develop appropriate adaptation policies and management plans for different economic sectors. We developed a national-level vulnerability index that is specific to food security policies by measuring nations' relative vulnerabilities to a decline in their coral reef fisheries. Coral reef fisheries are expected to decline with climate and anthropogenic disturbances, which may have significant consequences for food security. The vulnerability measure was composed of exposure, sensitivity, and adaptive capacity indicators specific to fisheries, reef management, and food security. The vulnerability index was used to evaluate 27 countries, as data required to fully populate the theoretical framework was limited. Of these, Indonesia and Liberia were identified as most and Malaysia and Sri Lanka as least vulnerable nations. Our analysis revealed two common national vulnerability characterizations: low income countries with low adaptive capacity and middle-income countries with higher adaptive capacity but high sensitivity. These results suggest developing context-specific policies and actions to build adaptive capacity in the low-income countries, and to decrease sensitivity in middle-income countries. Comparing our food security evaluation to a more general vulnerability approach shows that they produce different priority countries and associated policies.

Hüsken, S.M.C. ; Heck, S. 2012.

**The 'Fish Trader+' model: reducing female traders' vulnerability to HIV.**

*African Journal of AIDS Research 11(1): 17-26.*

Analysis from research and practice in Africa shows that fishing communities are hardly reached by HIV-related services, education, and business services, partly because of the efforts and costs involved and a lack of good practice in reaching out to these often remote areas. At the same time, fish traders, especially women, travel regularly to remote fishing camps to purchase fish. Although female fish traders may be exposed to HIV, violence and abuse in their interactions and relationships with fishermen, economic necessity keeps them in this trade. Good health among fisherfolk is a basic mainstay of productive and sustainable fisheries, providing food and income to fishing communities and the nation at large. However, these benefits are severely at risk as per-capita fish supplies in several African countries are declining, and fisherfolk are among the populations most vulnerable to HIV

and AIDS. Under the regional programme 'Fisheries and HIV/AIDS in Africa: Investing in sustainable solutions,' WorldFish conducted a socioeconomic assessment in the Kafue Flats fishery in Zambia to identify factors related to HIV/AIDS vulnerability among people in the fishing communities, particularly female fish traders. The study identified a variety of factors, hence the 'Fish Trader+' model of intervention was developed to reduce female fish traders' vulnerability to HIV by building on their economic rationale through the formation of savings groups. This article outlines the implementation of the Fish Trader+ model in Zambia and examines its potential to empower female fish traders so as to reduce poverty and vulnerability to HIV in fishing communities.

Jerry, D.R. ; Kvingedal, R. ; Lind, C.E. ; Taylor, J.J.U. ; Safari, A.E. 2012.

Donor-oyster derived heritability estimates and the effect of genotype X environment interaction on the production of pearl quality traits in the silver-lip pearl oyster, *Pinctada maxima*.

*Aquaculture 338-341: 66-71.*

The aim of this study was to estimate donor-oyster derived heritability and genetic correlations for pearl quality traits in the silver-lipped pearl oyster, *P. maxima*; namely pearl size, colour, lustre, shape and complexion. As future breeding programs for pearls are likely to involve oysters that will be reared in geographically disparate locations we also evaluated the potential impact environment G x E interactions may have on the realization of genetic gains for pearl quality traits.

Khaw, H.L. ; Ponzoni, R.W. ; Hamzah, A. ; Abu-Bakar, K.R. ; Bijma, P. 2012.

Genotype by production environment interaction in the GIFT strain of Nile tilapia (*Oreochromis niloticus*).

*Aquaculture 326-329: 53-60.*

Three discrete generations of GIFT fish (Nile tilapia strain, *Oreochromis niloticus*; a total of 10,065 fish with pedigree and phenotypic information) were tested in pond and cage culture environments to determine genotype by production environment interaction between both environments in Malaysia. Live weight (selected trait), standard length, body depth and width were recorded. A bivariate animal model was used to estimate variance and covariance components, whereby the homologous body traits in pond and cage environments were treated as genetically distinct traits. The heritabilities estimated for these body traits ranged from 0.19 to 0.40 in the pond environment, and from 0.23 to 0.34 in the cage environment. Across all traits the maternal common environmental effects ranged from 0.14 to 0.26 and were greater for the pond than for the cage environment. The genetic correlations between the pond and cage environments were  $0.73 \pm 0.09$  for live weight,  $0.81 \pm 0.09$  for standard length,  $0.78 \pm 0.10$  for body depth, and  $0.85 \pm 0.13$  for body width. Coupled with the total selection responses for live weight after two generations of selection, being 35% for the pond environment and 45% for the cage environment, we concluded that genotype by environment interaction for GIFT strain between pond and cage environments was not important. Hence, it would not be necessary to have two separate selective breeding programs for the GIFT strain in Malaysia.

Lind, C.E. ; Brummett, R.E. ; Ponzoni, R.W. 2012.

Exploitation and conservation of fish genetic resources in Africa: issues and priorities for aquaculture development and research.

*Reviews in Aquaculture* 4(3): 125-141.

Africa harbours a rich biological diversity of native fish resources. Recognition of the potential to use these resources to make significant contributions towards improving African food security through aquaculture has existed for some time. A key challenge, however, is achieving compatibility between the two urgent, but sometimes conflicting, goals of reducing poverty and food insecurity in Africa through aquaculture development while paying due attention to the conservation of natural biodiversity and fish genetic resources (FiGR). In this paper we highlight the overarching challenges concerning the conservation and exploitation of FiGR for the long-term development of aquaculture for food production in Africa. We address the major issues requiring attention in genetic improvement programs in order to take full advantage of the highly diverse wild FiGR in Africa, and we expand on strategies such as zoning, environmental risk analysis and molecular characterization approaches that can be used to minimize the potential harm to wild FiGR arising from aquaculture activities and future development. Finally, we discuss the challenge of strengthening local capacity. The enhancement of local capacity is essential because it will enable the fundamental link required to achieve the desired outcome of increasing the productivity of aquatic animals for food in Africa in a sustainable manner. We trust that this paper will provide a good basis for an in-depth discussion of the subject, as well as guidance on future research and development priorities for the compatible exploitation and conservation of FiGR in Africa.

Lind, C.E. ; Evans, B.S. ; Elphinstone, M.S. ; Taylor, J.J.U. ; Jerry, D.R. 2012.

Phylogeography of a pearl oyster (*Pinctada maxima*) across the Indo-Australian Archipelago: evidence of strong regional structure and population expansions but no phylogenetic breaks.

*Biological Journal of the Linnean Society* 107(3): 632-646.

This study investigates the genetic structure and phylogeography of a broadcast spawning bivalve mollusc, *Pinctada maxima*, throughout the Indo-West Pacific and northern Australia. DNA sequence variation of the mitochondrial cytochrome oxidase subunit I (COI) gene was analysed in 367 individuals sampled from nine populations across the Indo-West Pacific. Hierarchical AMOVA indicated strong genetic structuring amongst populations ( $F_{ST} = 0.372$ ,  $P < 0.001$ ); however, sequence divergence between the 47 haplotypes detected was low (maximum 1.8% difference) and no deep phylogenetic divergence was observed. Results suggest the presence of genetic barriers isolating populations of the South China Sea and central Indonesian regions, which, in turn, show patterns of historical separation from northern Australian regions. In *P. maxima*, historical vicariance during Pleistocene low sea levels is likely to have restricted planktonic larval transport, causing genetic differentiation amongst populations. However, low genetic differentiation is observed where strong ocean currents are present and is most likely due to contemporary larval transport along these pathways. Geographical association with haplotype distributions may indicate signs of early lineage sorting arising from historical population separations, yet an absence of divergent

phylogenetic clades related to geography could be the consequence of periodic pulses of high genetic exchange. We compare our results with previous microsatellite DNA analysis of these *P. maxima* populations, and discuss implications for future conservation management of this species.

Lind, C.E. ; Ponzoni, R.W. ; Nguyen, N.H. ; Khaw, H.L. 2012.  
 Selective breeding in fish and conservation of genetic resources for aquaculture.

*Reproduction in Domestic Animals* 47(Suppl.4): 255-263.

To satisfy increasing demands for fish as food, progress must occur towards greater aquaculture productivity whilst retaining the wild and farmed genetic resources that underpin global fish production. We review the main selection methods that have been developed for genetic improvement in aquaculture, and discuss their virtues and shortcomings. Examples of the application of mass, cohort, within family, and combined between-family and within-family selection are given. In addition, we review the manner in which fish genetic resources can be lost at the intra-specific, species and ecosystem levels and discuss options to best prevent this. We illustrate that fundamental principles of genetic management are common in the implementation of both selective breeding and conservation programmes, and should be emphasized in capacity development efforts. We highlight the value of applied genetics approaches for increasing aquaculture productivity and the conservation of fish genetic resources.

Little, D.C. ; Barman, B.K. ; Belton, B. ; Beveridge, M.C. ; Bush, S.J. ; Dabaddle, L. ; Demaine, H. ; Edwards, P. ; Haque, M.M. ; Kibria, G. ; Morales, E. ; Murray, E.J. ; Leschen, W.A. ; Nandeesh, M.C. ; Sukadi, F. 2012.

Alleviating poverty through aquaculture: progress, opportunities and improvements.

p. 719-783. In: Subasinghe, R.R.; Arthur, J.R.; Bartley, D.M.; De Silva, S.S.; Halwart, M.; Hishamunda, N.; Mohan, C.V.; Sorgeloos, P. (eds.) *Farming the waters for people and food. Proceedings of the Global Conference on Aquaculture 2010. Phuket, Thailand. 22-25 September 2010. FAO, Rome and NACA, Bangkok.*

Significant changes in our understanding of the interrelationships between aquaculture and poverty have occurred in the last decade. In particular, there is a growing realization that the impacts of aquaculture need to be assessed from a value-chain perspective rather than through a narrow production focus. In recent years, understandings of poverty and the forms, outcomes and importance of aquaculture have also shifted. Terms in current use are first clarified, including those related to scale and location of aquaculture. The evolution of aquaculture from traditional to modern forms and its role as a central feature or more secondary part of household livelihoods are considered. Definitions of poverty and resilience and the potential roles of aquaculture in supporting poorer people are discussed in the light of recent research. The role and impacts of targeted interventions to support poverty



alleviation are discussed and the potential negative impacts of aquaculture on poor peoples' livelihoods are presented. The concept of "well-being" is presented to support interpretation of the potential impacts of aquaculture on food and nutritional security. Strategies to ensure self sufficiency of aquatic foods at the household, community, national and international scale are considered. Access and food security issues affecting aquaculture and capture fisheries and the nature of farming are critiqued in the light of a broader literature. The role of ponds in meeting broader nutritional security needs and within rural livelihoods is discussed and the importance of incorporation into both local and more extended value chains examined. Since its take off as a major food-producing activity in the last few decades, aquaculture in many places remains a family business. Private governance through certification has emerged as a potential game changer in aquaculture, bringing with it the potential for exclusion of poorer producers from global value chains and associated implications for poverty alleviation. A distinction between the dynamic changes accompanying quasi-commercial and commercial aquaculture development, often in transforming economies, is contrasted with the incremental benefits associated with "quasi-peasant" aquaculture previously most associated with poverty alleviation through interventions supported by national and international organizations. A rethink regarding how poverty is most effectively reduced or its alleviation supported through aquaculture by supporting actors within value chains rather than with a sole-producer focus is advanced. An agenda allied to that proposed in the World Development Report 2008 (World Bank, 2007) for agriculture generally is proposed. This assesses the importance of aquaculture development as part of the measures to mitigate water scarcity and to support sustainable intensification of food production generally, while acknowledging the need to strengthen rural-urban linkages and continue the development of appropriate safety nets for the poorest groups.

Lorenzen, K. ; Beveridge, M.C.M. ; Mangel, M. 2012.

Cultured fish: integrative biology and management of domestication and interactions with wild fish.

*Biological Reviews* 87(3): 639-660.

Fish aquaculture for commodity production, fisheries enhancement and conservation is expanding rapidly, with many cultured species undergoing inadvertent or controlled domestication. Cultured fish are frequently released, accidentally and deliberately, into natural environments where they may survive well and impact on wild fish populations through ecological, genetic, and technical interactions. Impacts of fish released accidentally or for fisheries enhancement tend to be negative for the wild populations involved, particularly where wild populations are small, and/or highly adapted to local conditions, and/or declining. Captive breeding and supplementation can play a positive role in restoring threatened populations, but the biology of threatened populations and the potential of culture approaches for conserving them remain poorly understood. Approaches to the management of domestication and cultured-wild fish interactions are often ad hoc, fragmented and poorly informed by current science. We develop an integrative biological framework for understanding and managing domestication and cultured-wild fish interactions. The framework sets out how management practices in culture and for cultured fish in natural environments affect domestication processes, interactions between cultured and wild fish, and outcomes in terms of commodity production, fisheries yield, and conservation. We also

develop a typology of management systems (specific combinations of management practices in culture and in natural environments) that are likely to provide positive outcomes for particular management objectives and situations. We close by setting out avenues for further research that will simultaneously improve fish domestication and management of cultured-wild fish interactions and provide key insights into fundamental biology.

Macfadyen, G. ; Nasr-Alla, A.M. ; Al-Kenawy, D. ; Fathi, M. ; Hebicha, H. ; Diab, A.M. ; Hussein, S.M. ; Abou-Zeid, R.M. ; El-Naggar, G. 2012.

**Value-chain analysis: an assessment methodology to estimate Egyptian aquaculture sector performance.**

*Aquaculture 362-363: 18-27.*

Egypt's aquaculture production (705,490 tonnes in 2009) is by far the largest of any African country and places it 11th in terms of global aquaculture production. The aquaculture sector in Egypt is now a mature one having developed over a period of more than 30 years, but the financial performance of the sector is not well understood or documented, even though value-chain analysis provides a methodological tool to do so. To provide a better understanding of the sector, a WorldFish study completed in September 2011 and funded by the Swiss Agency for Development and Cooperation, conducted a value-chain analysis of the pond fish farming sector. The sector concentrates on the production of tilapia with additional production of mullet, catfish and carp from earthen ponds. The study mapped the value-chain and showed that there is no processing and virtually no export of farmed fish, a short time-period from harvest to final consumption by the consumer (typically around one day) due to the live/fresh nature of all sales, and very low rates (< 1%) of post-harvest losses.

Merino, G. ; Barange, M. ; Blanchard, J.L. ; Harle, J. ; Holmes, R. ; Allen, I. ; Allison, E.H. ; Badjeck, M.C. et al. 2012.

**Can marine fisheries and aquaculture meet fish demand from a growing human population in a changing climate?.**

*Global Environmental Change 22(4): 795-806.*

Expansion in the world's human population and economic development will increase future demand for fish products. As global fisheries yield is constrained by ecosystems productivity and management effectiveness, per capita fish consumption can only be maintained or increased if aquaculture makes an increasing contribution to the volume and stability of global fish supplies. Here, we use predictions of changes in global and regional climate (according to IPCC emissions scenario A1B), marine ecosystem and fisheries production estimates from high resolution regional models, human population size estimates from United Nations prospects, fishmeal and oil price estimations, and projections of the technological development in aquaculture feed technology, to investigate the feasibility of sustaining current and increased per capita fish consumption rates in 2050. We conclude that meeting current and larger consumption rates is feasible, despite a growing population and the impacts of climate change on potential fisheries production, but only if fish resources

are managed sustainably and the animal feeds industry reduces its reliance on wild fish. Ineffective fisheries management and rising fishmeal prices driven by greater demand could, however, compromise future aquaculture production and the availability of fish products.

Mills, D.J. ; Duy, N.D.Q. ; Juinio-Meñez, M.A. ; Raison, C.M. ; Zarate, J.M. 2012. Overview of sea cucumber aquaculture and sea-ranching research in the South-East Asian region.

*p. 22-31. In: Hair, C.A. ; Pickering, T.D. ; Mills, D.J. (eds.) Asia-Pacific tropical sea cucumber aquaculture. Proceedings of an international symposium held in Noumea, New Caledonia, 15-17 February 2011. ACIAR Proceedings No. 136. Australian Centre for International Agricultural Research, Canberra. 209 p.*

South-East Asia has traditionally been the global centre of production of tropical sea cucumbers for Chinese markets. Early research into culture methods took place outside this region, notably in India, the Pacific region and China. However, recent investment in *Holothuria scabra* (sandfish) culture has led to some significant advances within this region. The Philippines and Vietnam have been at the forefront of recent efforts, with involvement from substantial national programs and local institutions as well as international donors and scientific organizations. Smaller programs are ongoing in Thailand, Malaysia and Indonesia. Recent advances and simplifications in hatchery techniques are a major step forward, having promoted the development of experimental-scale sea-ranching ventures, and given rise to a small, commercial pond-based culture industry in Vietnam. Technology developments in nursery systems are likely to provide opportunities for culture enterprises in a broader range of environments than is now possible. A major research thrust in the Philippines towards developing cooperative sea-ranching enterprises has demonstrated good potential, and institutional/ legislative arrangements to ensure adequate property rights have been tested. Rotational culture with shrimp is proving successful in Vietnam, while the possibility of proximate co-culture of sandfish and shrimp has largely been ruled out. Small-scale experiments in the Philippines raise the possibility of co-culture in ponds with a number of finfish species. Current research directions are looking at diversifying technology to increase success in a range of coastal conditions, better understanding the social and biophysical conditions required for success, and finding ways of effectively scaling-out developed systems and technology.

Morand, P. ; Kodio, A. ; Andrew, N. ; Sinaba, F. ; Lemoalle, J. ; Béné, C. 2012. Vulnerability and adaptation of African rural populations to hydro-climate change: experience from fishing communities in the Inner Niger Delta (Mali).

*Climatic Change 115(3-4): 463-483.*

In this paper we examine ways Sahelian floodplain fishers have adapted to the strong environmental variations that have affected the region in the last two decades. We analyze their vulnerability and adaptive capacity in the face of expected changes in rainfall combined

with the predicted effects of dam construction. Data from the Inner Niger Delta in Mali were used to show that fishers were highly sensitive to past and recent variations in the hydro-climatic conditions. Moreover, it appears their traditional livelihood strategies, although diversified, sophisticated and well suited to historical conditions, offer a limited set of options to adapt to increased environmental constraints. For fish-dependent households that have adopted a mixed set of activities through farming, the high seasonality and constraints characterizing both their main activities (fishing and farming) does not allow switching between activities. For those households that undertake seasonal fishing migrations, there is little opportunity to modify migration routes or find new settlements sites inside the delta because of the high population density in this area. In sum, although the adoption of diversified and spatially discrete patterns in livelihood activities is often presented as a strategy to reduce vulnerability, such a strategy does not appear sufficient to allow fishers of the delta to successfully face the increasing constraints associated with the changes in hydro-climatic conditions. In such a context, fishing communities will be driven towards more drastic strategies of adaptation and/or coping such as switching to new activities based on agricultural innovations or emigration from the delta. Both strategies present many hazards, particularly in the absence of supportive public policy.

Nagabhatla, N. ; Beveridge, M. ; Mahfuzul Haque, A.B.M. ; Nguyen-Khoa, S. ; van Brakel, M. 2012.

**Multiple water use as an approach for increased basin productivity and improved adaptation: a case study from Bangladesh.**

*International Journal of River Basin Management* 10(1): 121-136.

This study, supported by the Challenge Program Water and Food (CPWF-Project 35), demonstrates the case of multiple-use of water through seasonal aquaculture interventions for improved rice–fish production systems in the Bangladesh floodplains. The project focused on community-based fish culture initiatives, increasingly adopted in the agro-ecological zones of the major floodplains of the Padma, Testa, and Brahmaputra basin. The productivity of water and fish is used as an indicator to explain this case. We hypothesize that seasonal aquaculture supported by the management of floodplains for multiple-use of water can significantly increase the productivity of rice–fish systems. Recognizing the need for innovative ways to manage human-dominated landscapes and climate-sensitive ecosystems such as floodplains, we have analyzed seasonal aquaculture interventions along with local adaptation of water management strategies, including the consideration of groundwater mechanisms. The results, supported by quantitative analysis and qualitative arguments, demonstrate the significant contribution of seasonal aquaculture in improving the rice–fish production systems of the selected floodplain sites. This was achieved through the increased productivity of water and fish and the reduction of the risk posed by arsenic contamination. The study is also illustrative of the diversification in livelihood-generating activities to cope with the extended period of flooding cycle in the region. We highlight the value of multiple resource-use approaches to enhance the social and ecological resilience of floodplains, and the need to re-consider basin water management options to recognize the water requirements of other sources of food such as fish produced by capture fisheries and aquaculture.

Perez, M.L. ; Brown, E.O. 2012.

Market potential and challenges for expanding the production of sea cucumber in South-East Asia.

*p. 177-188. In: Hair, C.A. ; Pickering, T.D. ; Mills, D.J. (eds.) Asia-Pacific tropical sea cucumber aquaculture. Proceedings of an international symposium held in Noumea, New Caledonia, 15-17 February 2011. ACIAR Proceedings No. 136. Australian Centre for International Agricultural Research, Canberra. 209 p.*

The marketing system for sea cucumber in South-East Asia is generally inefficient, and marketing channels are multilayered. Information asymmetry encourages proliferation of redundant players in the distribution system, while high transaction costs keep the overall marketing margin high but the price received by collectors low. This paper is limited to establishing the major features of the marketing system for sea cucumber in South-East Asia. The opportunities and challenges associated with this system, especially in relation to expanding production in response to a growing demand, is the primary focus. The potential for aquaculture is also explored. The paper uses secondary data on production and marketing, as well as information/data generated from relevant studies conducted in the Philippines, Vietnam and Hong Kong. The paper also provides a synthesis of results and discussion from available literature on the subject. The first section outlines the marketing system, particularly in terms of features common to countries in South-East Asia. The second section discusses the marketing opportunities and challenges to expanding sea cucumber production in the region. The third section provides a synthesis of common marketing issues, and offers a set of recommendations on how to explore the opportunities, overcome the challenges, and deal with the various issues plaguing the sea cucumber industry in the region.

Phillips, M. ; Collis, W. ; Demaine, H. ; Flores-Nava, A. ; Gautier, D. ; Hough, C. ; Luu, L.T. ; Merican, Z. ; Padiya, P.A. ; Palmer, R. ; Pant, J. ; Pickering, T. ; Secretan, P. ; Umesh, N.R. 2012.

Servicing the aquaculture sector: role of state and private sectors.

*p. 627-642. In: Subasinghe, R.R.; Arthur, J.R.; Bartley, D.M.; De Silva, S.S.; Halwart, M.; Hishamunda, N.; Mohan, C.V.; Sorgeloos, P. (eds.) Farming the waters for people and food. Proceedings of the Global Conference on Aquaculture 2010. Phuket, Thailand. 22-25 September 2010. FAO, Rome and NACA, Bangkok.*

This paper was prepared by a group of authors of complementary experiences and presented during the Thematic Session V: Improving knowledge and information sharing, research and extension in aquaculture at the Global Conference on Aquaculture 2010, Farming the Waters for People and Food held in Phuket, Thailand on 22-25 September 2010. The paper, which draws particularly on experiences in Asia, the Pacific and Europe, reviews the role of aquaculture services, recent changes in requirements and delivery of services, and future opportunities and needs, with special reference to roles and responsibilities of state and private sectors. It concludes with recommendations drawn from the discussions at the

conference, where the importance of investment in services across the sector was emphasized, noting the particular significance of equitable service delivery to smaller aquaculture enterprises in developing countries, including emerging aquaculture countries in Africa.

Purcell, S.W. ; Hair, C.A. ; Mills, D.J. 2012.

**Sea cucumber culture, farming and sea ranching in the tropics: Progress, problems and opportunities.**

*Aquaculture 368-369: 68-81.*

Tropical sea cucumber mariculture has potential to become a profitable industry and contribute towards natural population replenishment. Here, we synthesize the fields of progress, current impediments and research opportunities in tropical sea cucumber aquaculture arising from recent studies and an Indo-Pacific symposium. We present novel comparisons of data from hatcheries, earthen ponds and sea pens from published and unpublished studies in various countries. Of the few tropical species to have been cultured, only the sandfish *Holothuria scabra* has been bred extensively. While risks from hatchery-produced sea cucumbers are recognized, more genetic research is needed in farming and sea-ranching programmes. Advances have been made in the culture and nursery rearing of tropical sea cucumber juveniles but few have been published. Sandfish larvae have now been grown successfully on just one micro alga species, but experimental studies to optimize culture conditions are needed urgently. Disease of tropical sea cucumbers in culture is infrequent but the treatment of disease and parasites is understudied. Earthen ponds are currently most effective for nursery rearing of juvenile sandfish to a size for stocking. Growth rates and survival of sandfish in ponds to market size are also favorable, and should improve via studies on stocking density, feeding regimes and pond management. Sea pens confer ownership of released stock and can provide a means of limiting predation in natural habitats but the costs of materials, maintenance and surveillance against poaching can diminish profitability. Sea ranching has minimal material costs but needs a large leased area and may require juveniles to be marked prior to release. Retail prices of sandfish in Hong Kong increased exponentially with body size. A cost-benefit analysis illustrated that labor and utility costs in pond farming will preclude profitability of monoculture in some cases, forcing proponents to look towards co-culture or gamble with uncertain survival in sea ranching. Better governance and consultation regarding the stocking of sea cucumbers have been advocated. We conclude that well-designed experiments and meta-analyses are needed to fill critical knowledge gaps if sea cucumber mariculture is to expand in the tropics as it has in temperate Asia. Co-culture remains a burgeoning frontier despite poor success of initial studies. Sea cucumbers have superb potential to diversify mariculture industries in the tropics and potentially ameliorate the detrimental effects of mariculture on coastal ecosystems.

Ratner, B.D. ; Allison, E.H. 2012.

**Wealth, rights, and resilience: An agenda for governance reform in small-scale fisheries.**

*Development Policy Review 30(4): 371-398.*

The diversity of social, ecological and economic characteristics of small scale fisheries in developing countries means that context-specific assessments are required to understand and address shortcomings in their governance. This article contrasts three perspectives on governance reform focused alternately on wealth, rights and resilience, and argues that - far from being incompatible - these perspectives serve as useful counterweights to one another, and together can serve to guide policy responses. In order to better appreciate the diversity in governance contexts for small-scale fisheries it puts forward a simple analytical framework focused on stakeholder representation, distribution of power, and accountability, and then outlines principles for identifying and deliberating reform options among local stakeholders.

Ratner, B.D. ; Oh, E.J.V. ; Pomeroy, R.S. 2012.

**Navigating change: Second-generation challenges of small-scale fisheries co-management in the Philippines and Vietnam.**

*Journal of Environmental Management 107: 131-139.*

Early efforts to apply the concept of fisheries co-management in Southeast Asia focused primarily on building the effectiveness of local management institutions and advocating the merits of the approach so that it would be applied in new sites, while gradually learning and adapting to a range of obstacles in practice. Today, with co-management widely embraced by the research community and adopted as policy by an increasing number of governments, a second-generation perspective has emerged. This perspective is distinguished by efforts to navigate and influence change in the broader institutional and governance context: (a) a more sophisticated appreciation of politics, power relations, and the role of the state, (b) efforts to manage resource competition beyond the fisheries sector, (c) building institutions for adaptation and learning, and (d) recognizing divergent values and goals influencing fisheries management. This paper traces the evolution of this second-generation perspective, noting how it has built on learning from early practice and how it has been cross-fertilized by theoretical innovations in related fields, notably resilience thinking and political ecology. We illustrate this evolution through analysis of experience in the Philippines, with a relatively long experience of learning and adaptation in fisheries co-management practice, and Vietnam, where fisheries co-management policies have been embraced more recently. Characterizing the second-generation perspective helps identify points of convergence in the research and policy community about what needs attention, providing a basis for more systematic cross-country and cross-regional learning.

Rimmer, M.A. ; Phillips, M.J. ; Padiyar, P.A. ; Kokarkin, C. ; Raharjo, S. ; Bahrawi, S. ; Desyana, C. 2012.

Cooperation in aquaculture rehabilitation and development in Aceh, Indonesia.

*Development in Practice 22(1): 91-97.*

Post-tsunami rehabilitation and reconstruction activities in Aceh have been criticized as focusing on vertical reporting at the expense of lateral coordination, leading in some cases to “overlaps and redundancies, mistargeting and hastily planned and implemented programs”. Our experience is that effective coordination between implementing agencies, linked to appropriate Indonesian government agencies, can effectively improve the delivery of services, in this case to coastal aquaculture farmers in Aceh. Most importantly, in an environment where numerous agencies are undertaking rehabilitation activities across a broad geographic area, this approach enables the provision of a consistent and standardized technical message to farmers.

Salayo, N.D. ; Perez, M.L. ; Garces, L.R. ; Pido, M.D. 2012.

Mariculture development and livelihood diversification in the Philippines.

*Marine Policy 36(4): 867-881.*

This paper aims to evaluate mariculture as sustainable livelihood diversification option for coastal fishers in the Philippines and guide policy development in this direction. Mariculture in the Philippines refers to the culture of finfishes, shellfish, seaweeds and other commodities in cages, pens, stakes and rafts in marine environment. This paper evaluates the biophysical and socioeconomic contexts in which mariculture operate. Ten years after launching the first mariculture park organized and managed by the country's government fishery agency, and the nationwide promotion of this program, only 273 ha or 0.54% of the 50,150 ha total area planned for development has been established. Mariculture has not met its expected results due to a number of problems. This paper revisits the policies, organization, governance and administration of mariculture parks in the country. It also discusses the issues and challenges with mariculture as a livelihood diversification option within the context of ecosystems approach to fisheries management in the Philippines.

Santos, A.I. ; Nguyen, N.H. ; Ponzoni, R.W. ; Yee, H.Y. ; Hamzah, A. ; Ribeiro, R.P. 2012.  
Growth and survival rate of three genetic groups fed 28% and 34% protein diets.

*Aquaculture Research [online first 3 Aug].*

The strain by nutrition interaction in body weight and survival rate was examined by testing three genetic groups (Selection and Control lines of the GIFT strain, and Red tilapia) at two levels of protein in the diet (28% and 34%). The GIFT strain of Nile tilapia (*Oreochromis niloticus*) has been selected for high-breeding values for body weight, whereas the Control was contemporaneously maintained and selected for breeding values of body weight close to the population mean. The Red tilapia (*Oreochromis spp*) was unselected at the



time of the experiment. There were a total of 6000 fish at stocking in the study (2000 fish per genetic group). During the grow-out period of 147 days, within each genetic group, the fish were randomly assigned to either a 28% or a 34% protein diet. Survival rate during grow-out averaged 72%. A total of 4335 fish were harvested, with individual body measurements and survival recorded. The effect of genetic group accounted for the largest proportion of variation in body weight and survival, followed by sex and protein level. Across the two dietary protein levels, the GIFT strain had the highest growth. The difference in body weight between the Control and Red tilapia was not statistically significant ( $P > 0.05$ ). Responses in growth to dietary protein levels also differed between genetic groups. No differences ( $P > 0.05$ ) in body weight were found in the GIFT selection and Control fish fed 28% or 34% protein diets. However, body weight of Red tilapia was greater in the high than in the low-protein diet. In contrast to body weight, survival rate from stocking to harvest was affected by protein level. The high-protein diet significantly improved survival rate, averaging 24% across the three strains. The overall results indicate significant effects of genetic group and dietary protein level on both body weight and survival rate; however, the interaction between strain and dietary protein levels was small and possibly unimportant for these traits. It is concluded that the 28% protein diet used in the selection programme for the GIFT strain results in the selection of genotypes that can perform well under commercial feeds.

Subasinghe, R. ; Ahmad, I. ; Kassam, L. ; Krishnan, S. ; Nyandat, B. ; Padiyar, A. ; Phillips, M. ; Reantaso, M. ; Miao, W. ; Yamamoto, K. 2012.

Protecting small-scale farmers: a reality within a globalized economy?. p. 705-717. In: Subasinghe, R.R.; Arthur, J.R.; Bartley, D.M.; De Silva, S.S.; Halwart, M.; Hishamunda, N.; Mohan, C.V.; Sorgeloos, P. (eds.) *Farming the waters for people and food. Proceedings of the Global Conference on Aquaculture 2010. Phuket, Thailand. 22-25 September 2010.* FAO, Rome and NACA, Bangkok.

Aquaculture is still the fastest-growing food-producing sector and plays an important role in enhancing global food security and alleviating poverty. Tens of millions of people are engaged in aquaculture production, the majority of whom are small-scale farmers who have limited resources and are faced with difficulties due to increasing globalization and the resultant trade liberalization of aquaculture products. Despite these challenges, small-scale farmers remain innovative and continue to contribute to global aquaculture production.

Thilsted, S.H. 2012.

The potential of nutrient-rich small fish species in aquaculture to improve human nutrition and health.

p. 57-73. In: Subasinghe, R.R.; Arthur, J.R.; Bartley, D.M.; De Silva, S.S.; Halwart, M.; Hishamunda, N.; Mohan, C.V.; Sorgeloos, P. (eds.) *Farming the waters for people and food. Proceedings of the Global Conference on Aquaculture 2010. Phuket, Thailand. 22-25 September 2010. FAO, Rome and NACA, Bangkok.*

Small fish are a common food and an integral part of the everyday carbohydrate-rich diets of many population groups in poor countries. These populations also suffer from under nutrition, including micronutrient deficiencies - the hidden hunger. Small fish species, as well as the little oil, vegetables and spices with which they are cooked enhance diet diversity. Small fish are a rich source of animal protein, essential fatty acids, vitamins and minerals. Studies in rural Bangladesh and Cambodia showed that small fish made up 50-80 percent of total fish intake in the peak fish production season. Although consumed in small quantities, the frequency of small fish intake was high. As many small fish species are eaten whole; with head, viscera and bones, they are particularly rich in bioavailable calcium, and some are also rich in vitamin A, iron and zinc. A traditional daily meal of rice and sour soup, made with the iron-rich fish, "trey changwa pliang" (Mekong flying barb, *Esomus longimanus*), with the head intact can meet 45 percent of the daily iron requirement of a Cambodian woman. Small fish are a preferred food, supplying multiple essential nutrients and with positive perceptions for nutrition, health and well-being. Thus, in areas with fisheries resources and habitual fish intake, there is good scope to include micronutrient-rich small fish in agricultural policy and programmes, thereby increasing intakes which can lead to improved nutrition and health. The results of many studies and field trials conducted in Bangladesh with carps and small fish species have shown that the presence of native fish in pond polyculture and the stocking of the vitamin A-rich small fish, "mola" (mola carplet, *Amblypharyngodon mola*), did not decrease the total production of carps; however, the nutritional quality of the total fish production improved greatly. In addition, mola breeds in the pond, and partial, frequent harvesting of small quantities is practiced, favouring home consumption. A production of only 10 kg/pond/year of mola in the estimated four million small, seasonal ponds in Bangladesh can meet the annual recommended intake of six million children. Successful aquaculture trials with polyculture of small and large fish species have also been conducted in rice fields and wetlands. Thus, aquaculture has a large, untapped potential to combat hidden hunger. To make full use of this potential, further data on nutrient bioavailability, intra-household seasonal consumption, nutrient analyses, cleaning, processing and cooking methods of small fish species are needed. Advocacy, awareness and nutrition education on the role small fish can play in increasing diet diversity and micronutrient intakes must be strengthened. Measures to develop and implement sustainable, low cost technologies for the management, conservation, production, preservation, availability and accessibility of small fish must be undertaken. Also, an analysis of the cost-effectiveness of micronutrient-rich small fish species in combating micronutrient deficiencies using the Disability-Adjusted Life Years (DALYs) framework should be carried out.

Williams, M.J. ; Agbayani, R. ; Bhujel, R. ; Bondad-Reantaso, M.G. ; Brugère, C. ; Choo, P.S. ; Dhont, J. ; Galmiche-Tejeda, A. ; Ghulam, K. ; Kusakabe, K. ; Little, D. ; Nandeesh, M.C. ; Sorgeloos, P. ; Weeratunge, N. ; Williams, S. ; Xu, P. 2012. Sustaining aquaculture by developing human capacity and enhancing opportunities for women. *p. 785-874. In: Subasinghe, R.R.; Arthur, J.R.; Bartley, D.M.; De Silva, S.S.; Halwart, M.; Hishamunda, N.; Mohan, C.V.; Sorgeloos, P. (eds.) Farming the waters for people and food. Proceedings of the Global Conference on Aquaculture 2010. Phuket, Thailand. 22-25 September 2010. FAO, Rome and NACA, Bangkok.*

Women are active participants in aquaculture supply chains, but a dearth of gender-disaggregated information hampers accurate understanding of their contribution. Research results and FAO National Aquaculture Sector Overview (NASO) fact sheets show that female participation rates vary by type and scale of enterprise and country. Women are frequently active in hatcheries and dominate fish processing plant laborers. Women's work in small-scale aquaculture frequently is unrecognized, under or unpaid. Most aquaculture development projects are not gender sensitive, and aquaculture success stories often do not report gender dimensions; projects can fail if their designs do not include gender. Gender should be put firmly on the policy agenda and built into normative instruments, old and new, complemented by the collection of gender-disaggregated data for aquaculture supply chains. Women should be empowered through gender equity in access to financial, natural, training and market resources. Women in aquaculture should not be stereotyped as "small-scale" and poor. Women are often hampered by systemic barriers such as lack of legal rights. Women should be encouraged to build their management, leadership and entrepreneurial skills. In circumstances where rural men have migrated for work, small-scale aquaculture has proven a suitable livelihood option to reduce the pressure on women. Because postharvest processing and fish trade are feminized occupations, gender equity deserves special attention in fair trade and fish certification schemes. HCD and gender are receiving more attention in rehabilitation efforts to assist survivors from disease and natural disasters.

Zak, T. ; Deshev, R. ; Benet-Perlberg, A. ; Naor, A. ; Magen, I. ; Shapira, Y. ; Ponzoni, R.W. ; Hulata, G. 2012.

Genetic improvement of Israeli blue (Jordan) tilapia, *Oreochromis aureus* (Steindachner), through selective breeding for harvest weight. *Aquaculture Research [online first 9 Nov].*

Genetic parameters and selection responses were obtained for harvest body weight of blue tilapia (*Oreochromis aureus*) from data collected over three generations in a selected population. A total of 18,194 records representing 186 sires and 201 dams were used in the analysis. Within generation heritability estimates for harvest body weight ranged from 0.18 to 0.58. When data from more than one generation were included in the analysis, heritability estimates became more stable (0.33-0.40) and it was 0.33 when all data were included in the analysis. The common full-sib effect accounted for 10% of the phenotypic variance in the full data set. Heritability for survival from stocking to harvest was estimated at 0.01 and

0.09 in actual units (fitting an animal model) and in the logit (sire model) scale respectively. The genetic correlation between harvest body weight and survival was 0.22 and not significantly different from zero. The total selection response for harvest body weight over the three generations of selection measured as the difference between least-squares means of selected and control lines was 17.7%. The corresponding figure when response was measured as the difference between mean breeding values of selected and control lines was 19.6%. The average inbreeding coefficient was 0.003 after three generations of selection. These results indicate that there are good prospects for the genetic improvement of harvest body weight in blue tilapia.

Ziv, G. ; Baran, E. ; Nam, S. ; Rodriguez-Iturbed, I ; Levin, S.A. 2012.

**Trading-off fish biodiversity, food security, and hydropower in the Mekong River Basin.**

*Proceedings of the National Academy of Sciences of the United States of America* 109(15): 5609-5614.

The Mekong River Basin, site of the biggest inland fishery in the world, is undergoing massive hydropower development. Planned dams will block critical fish migration routes between the river's downstream floodplains and upstream tributaries. Here we estimate fish biomass and biodiversity losses in numerous damming scenarios using a simple ecological model of fish migration. Our framework allows detailing trade-offs between dam locations, power production, and impacts on fish resources. We find that the completion of 78 dams on tributaries, which have not previously been subject to strategic analysis, would have catastrophic impacts on fish productivity and biodiversity. Our results argue for reassessment of several dams planned, and call for a new regional agreement on tributary development of the Mekong River Basin.

Alexander, T. ; Manele, B. ; Schwarz, A.M. ; Topo, S. ; Liliqeto, W. 2012.  
Principles for best practice for community-based resource management (CBRM) in Solomon Islands.  
*Coral Triangle Support Partnership, Indonesia. 14 p.*

This document is one outcome from a workshop held in Gizo in October 2010 attended by 82 representatives from government, NGO's private sector, and communities. The target audience for the document is primarily organizations planning to work with coastal communities of Solomon Islands to implement Community-Based Resource Management (CBRM). It is however also envisaged that the document will serve as a reference for communities to better understand what to expect from their partners and also for donors, to be informed about agreed approaches amongst Solomon Islands stakeholders.

Bailly, N. 2012.  
FishBase and SeaLifeBase: the database structure can manage data and information on aquatic genetic resources for all marine and freshwater organisms.  
*p. 24-27. In: Halwart, M. ; Hett, K. ; Gómez, R.G. ; Bartley, D.M. (eds.) Improving the information base for aquatic genetic resources for the state of the world's aquatic genetic resources. FAO International Expert Workshop. 1-4 March 2011. Madrid, Spain. FAO.*

An overview of FishBase and SeaLifebase was given.

Baran, E. ; Borin, U. 2012.  
The importance of the fish resource in the Mekong River and examples of best practices.  
*p. 136-141. In: Gough, P., Philipsen, P. ; Schollemma, P.P. & Wanningen, H. 2012. From sea to source; International guidance for the restoration of fish migration highways.*

The Mekong is an exceptional river in many ways. In terms of fish biodiversity, it is the world's second richest river after the Amazon ([www.fishbase.org](http://www.fishbase.org)). With 6 to 18% of the global freshwater fish catch, it is also home to the largest freshwater fisheries in the world. The productive Mekong fisheries are essential to the food security of the 60 million people of the Lower Mekong Basin. Fish contributes 81% of the population's protein intake in Cambodia and 48% in Laos. Mekong inland fisheries also provide employment to 1.6 of the 14 million Cambodians. In the Mekong Delta in Vietnam, 60% of the people are part-time fishers (An Giang province) and 88% of 'very poor' households depend on fisheries. The combination of high fish biodiversity, high productivity, high exploitation rate and long distance migrations makes dam development a major concern in the Mekong Basin.

Baran, E. ; Chum, N. ; Fukushima, M. ; Hand, T. ; Hortle, K.G. ; Jutagate, T. ; Kang, B. 2012.

Fish biodiversity research in the Mekong Basin.

*p. 149-164. In: Nakano, S. ; Yahara, T. ; Nakashizuka, T. The Biodiversity Observation Network in the Asia-Pacific Region: Toward Further Development of Monitoring. Ecological Research Monographs. Tokyo, Springer.*

The Mekong River is one of the great rivers of the world and is characterized by high fish biodiversity. A number of organizations are working at observing and protecting aquatic biodiversity in this hotspot of global importance. Among them are international organizations such as the WWF, Wetlands International, the International Union for Conservation of Nature (IUCN), and the United Nation Environment Program (UNEP) but also regional institutions and national line agencies or nongovernmental organizations (NGOs). We review in this chapter the activities of five international, regional, and national organizations involved in Mekong fish biodiversity research. These organizations include WorldFish, Conservation International (CI), The Mekong River Commission (MRC), Ubon Ratchathani University, and the Japan National Institute for Environmental Studies (NIES). For each institution, we detail recent projects, modes of operation, issues faced, and priorities for improved observation and protection of biodiversity.

Beare, D. 2012.

Fisheries and aquaculture: The importance of fish for food and nutritional security.

*p. 55-67. In: Thornton, P. ; Cramer, L. (eds.) Impacts of climate change on the agricultural and aquatic systems and natural resources within the CGIAR's mandate. CCAFS Working Paper 23. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen.*

This working paper is an attempt to distil what is known currently about the likely impacts of climate change on the commodities and natural resources that comprise the mandate of CGIAR and its 15 Centres. In this WorldFish contribution, a summary is given on the importance of fisheries and aquaculture on food nutrition and security.

Béné, C. ; Phillips, M. ; Allison, E.H. 2012.

The forgotten service: food as an ecosystem service from estuarine and coastal zones.

*Wolanski, E. ; McLusky, D. (eds.) Treatise on Estuarine and Coastal Science. Ecological Economics of Estuaries and Coasts. 12: 147-180.*

In this chapter, we review in detail the existing body of literature and knowledge related to the provision of food in estuaries and coastal zones. Both aquatic and terrestrial commodities are considered. The chapter highlights not only the importance of the terrestrial zone in overall food provision but also the substantial contribution of aquatic coastal

resources. The various problems that the coastal zone faces in sustaining this important provisioning service in the face of increasing pressure and demands from other sectors are highlighted. Despite the important contribution of aquatic resources to food provision, these are often undervalued and underrepresented in coastal and national planning processes.

**Bush, S.R. ; Belton, B. 2012.**

**Out of the factory and into the fish pond: can certification transform Vietnamese Pangasius?.**

*p. 257-290. In: Spaargaren, G. ; Oosterveer, P. ; Loeber, A. (eds.) Food practices in transition: changing food consumption, retail and production in the age of reflexive modernity. Routledge, London.*

This chapter examines pangasius catfish aquaculture in Vietnam in the context of changing social relations of production, European consumer trends and regulation. In particular we are interested in how the rise of 'sociotechnical' environmental regulatory networks in the form of quality standards and third-party certification have altered power relations between consumers and producers across global space.

**Descheemaeker, K. ; Molden, D. ; Bunting, S. ; Bindraban, P. ; Muthuri, C. ; Sinclair, F. ; Beveridge, M. ; van Brakel, M. ; Herrero, M. ; Fleiner, R. ; Clement, F. ; Boelee, E. 2012.**

**Increasing water productivity in agriculture.**

*p. 140-164. In: Boelee, E. (ed.). Managing Agroecosystems for Sustainable Water and Food Security. CABI. Cambridge.*

Water productivity is defined as the amount of agricultural output per unit of water depleted and can be applied to crops, trees livestock and fish. This chapter reviews challenges and opportunities to improve water productivity in socially equitable ways and in different agro-climatic systems. In areas with ample water supply, developing new and making better use of existing water resources are options, whereas in areas with physical water scarcity, better water harvesting and storage is warranted. However, in all situations it is important to think beyond biophysical technologies and foster enabling institutions to ensure adoption of improved practices and equitable and sustainable benefits. Further improvements can be obtained from reducing post-harvest losses and waster of food in both developing and industrialized economies. Both in irrigated and rainfed cropping systems water productivity can be improved by choosing well-adapted crop types, reducing unproductive water losses, and maintain healthy, vigorously growing crops through optimized water, nutrient, and agronomic management.

Finlayson, M. ; Bunting, S.W. ; Beveridge, M. ; Tharme, R. ; van Brakel, M. ; Atapattu, S. ; Coates, D. ; Nguyen-Khoa, S. 2012.

Wetland agroecosystems.

*p. 94-118. In: Boelee, E. (ed.). Managing Agroecosystems for Sustainable Water and Food Security. CAB International, Cambridge.*

Commencing with a summary of the current status, importance and productivity of natural wetlands the contribution of wetland ecological functions to sustaining vital ecosystem services is then reviewed. Provisioning services, notably fish and water for irrigation or domestic and industrial purposes constitute important benefits derived by humanity from wetlands, whilst recognition is growing that supporting, regulating and cultural services supported by wetlands are critical for sustaining social-economic systems and ensuring human well-being. Examples of wetland ecosystem services contributing to water and food security are highlighted and likely consequences resulting from disruption to stocks and flows of these services discussed. Wetlands are vulnerable to a range of anthropogenic pressures, notably land-use change, disruption to regional hydrological regimes owing to abstraction and impoundment, pollution and excessive nutrient loading, invasive species introduction and overexploitation of biomass, plants and animals.

Mahé K. ; Cochard M.L. ; Quérou J.C. ; Sevin K. ; Bailly N. ; Tetard A. 2012.

First record of *Epinephelus marginatus* (Serranidae: Epinephelinae) in the eastern English Channel.

*Cybium 36(3): 485-486.*

This is the first record of the dusky grouper *Epinephelus marginatus* (Lowe, 1834) in the eastern English Channel. One specimen was caught on 10 June 2011 in the Bay of Seine. It measured 66 cm and weighed 5.5 kg. From the study of internal organs and scales, this specimen was a female of 12 years old that did not grow in the Channel, which confirms the fact of a stray specimen and not the sign of an extension of the distribution with an established population.

Nasr Alla, A. ; Kenawy, D. ; El-Naggar, G. ; Beveridge, M. ; van der Heijden, P.G.M. 2012.

Evaluation of the use of fresh water by four Egyptian farms applying integrated aquaculture-agriculture: study report.

*Report number CDI-12-005 Wageningen UR Centre for Development Innovation.*

This report describes a study done in 2010 by researchers of WorldFish on water use in Egyptian farms that apply aquaculture - agriculture integration. Two of the four farms that were monitored derived the main income from farming and selling fish, the two other farms were mainly agricultural farms that used reservoirs that were built to store irrigation water for growing fish. The volume of water in which fish were raised from fingerling to market size and that was subsequently used to irrigate agriculture crops was estimated. The water



quality was monitored, the quantity and value of the fish and the value of the agricultural crop were determined. Estimates were made of the amount of fertilizer that was saved by growing fish in irrigation water.

Pant, J. ; Shrestha, M.K. ; Bhujel, R.C. 2012.

**Aquaculture and resilience: Women in aquaculture in Nepal.**

*p. 19-24. In: Shrestha, M.K. ; Pant, J. (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.*

Farming-based rural livelihoods are becoming increasingly vulnerable to the effects of global climate change and sudden and profound changes in social and economic systems. Diversification of livelihood options is believed to be 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 Vietnam, are likely to be relevant in the context of mixed crop-livestock farming systems elsewhere as well. 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 farm pond in diversifying livelihoods and reducing vulnerability. A newly introduced aquaculture sub-system complemented well with the existing mixed crop-livestock systems by virtue of increased synergistic relationships among the three sub-systems. Food and nutrition security of the participating households increased due primarily to 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 improved 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.

Phillips, M. ; Subasinghe, R. 2012.

**Small-scale shrimp farmers and global markets: Trends, future prospects and adaptation.**

*Global Aquaculture Advocate March/April: 12-14.*

It is time to recognize the crucial role of small-scale farmers in Asian aquaculture production and trade. The socially and economically important small scale sector - the "mainstay" of Asian aquaculture - is innovative, but faced with constraints in modern markets. The sector needs investment from public and private sectors to compete and thrive. Another challenge is to develop certification programs in ways that promote responsible aquaculture expansion with due consideration to small-scale farming.

Shrestha, M.K. ; Pant, J. ; Bhujel, R.C. 2012.

Small-scale aquaculture development model for rural Nepal.

p. 71-75. In: *Shrestha, M.K. ; Pant, J. (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.*

The majority of rural farmers in Nepal are small holders and their livelihood is based on agriculture. Three projects on small-scale aquaculture, with focus on women's involvement, were completed in Kathar and Kawasoti Village Development Committees (VDCs) of Chitwan and Nawalparasi districts, respectively during 2000-2007. Based on the experience from these projects, guidelines/steps for the development of small-scale aquaculture in rural areas were drawn. They include: (i) selection of technically feasible site; (ii) identification of appropriate rural society/ethnic group; (iii) formation of homogenous fish farmers' groups; (iv) registration of these groups with District Agriculture Office; (v) involvement of household heads (both male and female) in training and other activities; (vi) providing technical and input support for one culture cycle; (vii) organizing regular monthly meeting of fish farmers' groups to discuss on-going and upcoming activities, with an emphasis on women; and (viii) establishment of fish farmers' cooperative and its registration with District Cooperative Office. Small-scale aquaculture should be developed in clusters or groups and not in a scattered pattern. Emphasis on "one household-one pond" wherever possible provides an opportunity to form clusters.

Thilsted, S.H. 2012.

Improved management, increased culture and consumption of small fish species can improve diets of the rural poor.

p. 176-181. In: *Burlingame, B. ; Dernini, S. (eds.) Sustainable diets and biodiversity: Directions and solutions for policy, research and action. FAO and Bioversity International, Rome.*

In many low-income countries with water resources, small fish species are important for the livelihoods, nutrition and income of the rural poor. The small size of fish favors frequent consumption by and nutrition of the rural poor, as these fish are captured, sold and bought in small quantities; used both raw and processed in traditional dishes; and are nutrient-rich. All small fish species are a rich source of animal protein, and - as they are eaten whole - have a very high content of bioavailable calcium. Some are rich in vitamin A, iron, zinc and essential fats. Measures to improve management and increase culture and consumption of small fish include community-based management of common water bodies; culture of small fish in ponds and rice fields; use of small marine fish for direct human consumption, especially in vulnerable population groups; and improved handling, transportation, processing - especially drying - and market chains to reduce loss and increase accessibility, especially in hard to reach population groups. Recent integrated initiatives such as Scaling Up Nutrition (SUN) Framework and Roadmap: 1,000 Days Global Effort, focusing on the linkages between agriculture and nutrition give good opportunities for promoting improved management, and increased culture and consumption of small fish species.

Tran, N. ; Wilson, N.L.W. ; Anders, S. 2012.

Standard harmonization as chasing zero (tolerance limits): the impact of veterinary drug residue standards on crustacean imports in the EU, Japan, and North America.

*American Journal of Agricultural Economics* 94(2): 496-502.

Food safety standards in the seafood trade between developing country exporters and developed country importers have been a topic of much discussion in the trade literature. As an important source of foreign currency earnings and employment for many lower income developing countries, stricter safety standards in seafood may have the potential to pose barriers to trade, especially for many Asian seafood exporters. This paper investigates the impact of stricter drug residue (chloramphenicol) standards on crustacean imports to Canada, the EU15, Japan, and the United States.

van der Heijden, P.G.M. ; Nasr Alla, A. ; Kenawy, D. 2012.

Water use at integrated aquaculture-agriculture farms: experiences with limited water resources in Egypt.

*Global Aquaculture Advocate July/Aug: 28-31: 28-31.*

Fish farming in Egypt is not formally recognized as an agricultural activity, so aquaculture cannot use water from irrigation canals. However, fish are raised as primary or secondary crops in combination with fruit and other plant crops. A study by WorldFish found farms could efficiently use well water to intensively raise tilapia in aerated tanks and use the effluent to irrigate fruit trees, vegetables and flowers. Two other farms used water from nearby Nile irrigation canals to fill water storage reservoirs stocked with tilapia. Crops and fruit were the main source of revenue for these farms, and fish reflected a minor secondary crop.

Béné, C. ; Chijere Asafu, D.G. ; Allison, E.H. ; Snyder, K. 2012.

Design and implementation of fishery modules in integrated household surveys in developing countries.

*WorldFish, Penang.*

Fish and other aquatic animals contribute to the food security of citizens of developing countries, both as a source of income and as a component of healthy diets, yet fishing is not currently captured in most integrated household surveys. This sourcebook provides essential technical guidance on the design of statistical modules and questionnaires aimed at collecting fishery data at the household level. Background on the main policies important to the fishery sector, information on the data needed to analyze issues of policy relevance, and methodology on the construction of survey questions to collect necessary data are also provided. The document is organized to provide essential technical guidance on how to design statistical modules and questionnaires aimed at collecting fishery data at the household level. It includes an overview of the main technical and statistical challenges related to sampling fishery-dependent households. The document starts with an introductory section identifying the potential reasons why fisheries and in particular small-scale fisheries have not been adequately included in national statistical systems in a large number of countries. The report then proposes a succinct review of what is known (and what remains unknown) about small-scale fisheries and their contribution to the livelihoods of households in sub-Saharan Africa. It also provides readers with background on the main policies that are important to the fishery sector, information on the data needed to analyze issues of policy relevance, and methodology on the construction of survey questions to collect necessary data.

Béné, C. ; Chijere Asafu, D.G. ; Allison, E.H. ; Snyder, K. 2012.

Uganda and Malawi field pilots of proposed LSMS fisheries module: summary report.

*Project Report 2012-16. WorldFish, Penang, Malaysia.*

While an overwhelming majority of sub-Saharan African countries exhibit serious weaknesses in statistics pertaining to crop and livestock sectors, the deficiencies in terms of nationally representative data on the fishery sector are even more acute. The very little data available on the sector are essentially derived from case studies of selected fisheries, and the limited nationally representative data available are generally derived from a few questions included in the livestock section of household surveys. These do not permit the detailed characterization of the fishery production systems. As a consequence in many countries the decision-makers and planners lack the most basic information about the role and importance of the fisheries sector to their national economy. As part of an initiative called the Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) project, a collaboration was developed between the World Bank and WorldFish to address this situation. This report provides detail on pilot testing of a fisheries module for living standards measurement surveys.

Braun, M. ; Saroar, M. 2012.

**Participatory action research on climate risk management.**

*Studies & Reviews: 2012-39. WorldFish. Penang, Malaysia.*

The rural populations of southern Bangladesh are some of the most vulnerable communities in the world to the future impacts of climate change. They are particularly at risk from floods, waterlogged soils, and increasing salinity of both land and water. The objective of this project was to analyze the vulnerability of people in four villages that are experiencing different levels of soil salinity. The study evaluated the strengths and weaknesses of current coping strategies and assessed the potential of an index-based insurance scheme, designed diversification and better information products to improve adaptive capacity.

Chap Sopanha ; Meng Kiman ; Tep Chansothea ; Joffre, O. 2012.

**Crab fisheries in Cambodia and the development of crab banks.**

*WorldFish ; Learning Institute. Cambodia.*

The crab (swimming crab; *Portunus pelagicus*) fishery in coastal Cambodia appears to have declined in recent years due to over-fishing and a growth in the number of fishermen, but remains an important source of income for households along the coast. Several initiatives have started since 2007, with support from NGOs, international organizations and the Fisheries Administration (FiA), to test stock enhancement techniques through the release of crab larvae. The so-called "crab bank" initiative involves keeping harvested gravid crabs alive in cages for a few days until they spawn, instead of immediately selling them for consumption or processing. In Cambodia, this initiative has developed within the framework of Community Fisheries (CFis) and thus implies a community-based approach. The FiA has promoted the continuation of such initiatives; however, the nature of crab fisheries and the results from crab bank initiatives have not been documented in detail. The scope of this study was to understand the diversity of approaches to crab bank development in Cambodia, as well as their operational status and the challenges faced at different sites.

Chiwaula, L. ; Jamu, D. ; Chaweza, R. ; Nagoli, J. 2012.

**The Structure and margins of the Lake Chilwa fisheries in Malawi: a value chain analysis.**

*Project Report 2012-12. WorldFish. Penang, Malaysia. 34 p.*

Small freshwater pelagic fisheries in closed lakes are very important to millions of people in sub-Saharan Africa providing livelihoods and nutritional security. However, returns from these fisheries have been shown to fluctuate in response to climatic variability. In order to understand the impact of these fluctuations on the livelihoods of people dependant on these fisheries, there is a need for information on how the fish value chain is organized and how it functions in response to variation in supplies. The results will feed into strategies that build resilience in fishing households against the uncertainties arising from unstable ecosystems. The Lake Chilwa fishery value chain is composed of fishers, processors, traders, fish transporters, boat owners, owners of fish processing shades, fisheries associations, gear owners, gear makers, firewood sellers, and traders of fishing gear and equipment. The value

chain employs many people and local authorities can consider using this information in the design of rural development strategies for employment generation in small-scale fishing communities. The findings from this study have a number of implications for the improvement of the livelihood of fishers and enhancing their capacity to mitigate against the effects of climate change.

**Culture and Environment Preservation Association ; WorldFish ; The Wetland Alliance. 2012.**

**The impact of climate change: adapting to climate change; Experiences of a community in Northeast Cambodia.**

*DVD. WorldFish. Cambodia.*

This DVD contains the results of two community produced media projects created by village communities in Stung Treng Province in North-eastern Cambodia. The first entitled Impact of Climate Change and the second entitled Adapting to climate change: experiences of a community in Northeast Cambodia. It is a part of community based adaptation project and ongoing social research initiative supported by CEPA and WorldFish, financial supports provided by SIDA through the Wetland Alliance & Swedish Environmental Secretariat for Asia (SENSA) and Small Grant Program (SGP/UNDP)

**Joffre, O. ; Kosal, M. ; Kura, Y. ; Pich, S. ; Nao, T. 2012.**

**Community fish refuges in Cambodia: Lesson learned.**

*Lessons Learned Brief 2012-03. WorldFish. Phnom Penh, Cambodia. 16 p.*

Cambodia's wetlands cover over 30 percent of the country's land area and support one of the largest, most diverse and intensive freshwater fisheries in the world. In the flood season (July-February), the flood waters from the Mekong River and Tonle Sap Lake catchments create a vast open water system on Cambodia's lowlands. During this period, inundated rice fields become open access fishing grounds for local villagers and migrant fishers. Fishing in rice fields and floodplain systems takes place throughout the flood season, but the peak season is when water is receding (from November to February). Rice field fisheries are estimated to contribute up to 28% of the wild capture fisheries in Cambodia. Rice field fisheries are seen as a promising sub-sector to increase fish catches and meet the domestic demand for food. Despite its importance in Cambodia's rural livelihoods, this complex system of rice field fisheries has not been a focus of detailed research or NGO projects until recently, with the advent of the Community Fish Refuge (CFR) approach. A Community Fish Refuge (CFR) is a form of stock enhancement or a fish conservation measure that is intended to improve the productivity of rice field fisheries. The idea behind refuge ponds is to create dry season refuges or sanctuaries for brood fish in seasonally inundated rice fields. Refuge ponds can be man-made ponds or natural ponds that can hold water throughout the year. During the dry season, these refuge ponds become disconnected from permanent natural water bodies.

Kam, S.P. ; Badjeck, M.C. ; Teh, L. ; Teh, L. ; Tran, N. 2012.

Autonomous adaptation to climate change by shrimp and catfish farmers in Vietnam's Mekong River delta.

*Working paper 2012-24. WorldFish. Penang, Malaysia.*

The Mekong River delta of Vietnam supports a thriving aquaculture industry but is exposed to the impacts of climate change. In particular, sea level rise and attendant increased flooding (both coastal and riverine) and coastal salinity intrusion threaten the long-term viability of this important industry. This working paper summarizes an analysis of the economics of aquaculture adaptation in the delta, focusing on the grow-out of two exported aquaculture species - the freshwater striped catfish and the brackish-water tiger shrimp. The analysis was conducted for four pond-based production systems: catfish in the inland and coastal provinces and improved extensive and semi-intensive/intensive shrimp culture.

Macfadyen, G. ; Allah, A.M.N. ; Kenawy, D.A.R. ; Ahmed, M.F.M. ; Hebicha, H. ; Diab, A. ; Hussein, S.M. ; Abouzied, R.M. ; Naggar, G.El. 2012.

Value-chain analysis of Egyptian aquaculture [in Arabic].

*Project Report 2012-48. WorldFish. Penang, Malaysia. 93 p.*

Egypt's aquaculture production (705,490 tonnes in 2009) is by far the largest of any African country and places it 11th in terms of global production. The aquaculture sector makes a significant contribution to income, employment creation and food security in the country, all of which are national priority areas given low per capita income levels, rising population, worsening food security indicators, and official unemployment levels which have remained at around 10% for the last ten years. Despite the fact that the aquaculture sector in Egypt is now a mature one, having developed over a period of more than 30 years, the economic performance of the sector is not well understood or documented. To help improve this understanding, this report presents the outputs of a value-chain study for the sector. The study focused on four of the most important governorates in terms of aquaculture production: Kafr el Sheikh, Behera, Sharkia, and Fayoum. Individual interviews and focus group discussions with fish farmers, traders/wholesalers, and retailers, were used to collect quantitative and qualitative information about financial performance, employment creation, and the critical factors impacting on the performance of each sub-sector of the value-chain.

Mills, D.J. ; Mutimukuru-Maravanyika, T. ; Ameyaw, G. ; Asare, C. 2012.

Ghana coastal fisheries governance dialogue: Presentations, discussions and outcomes from a stakeholder forum on issues for reforming governance of Ghana's coastal fisheries.

*WorldFish; USAID H n Mpoano Initiative, Ghana. 57 p.*

This meeting, the second national Fisheries Governance Dialogue, aimed to help stakeholders in the fisheries sector generate a shared understanding of critical lessons and pathways for fisheries co-management success in Ghana. This was a direct response to the call from both fisheries communities and the government of Ghana for a radical change from the way

fisheries resources are currently being managed. The meeting was attended by 60 men and women from stakeholder organizations and communities, and commenced with presentations on co-management experiences from local, regional and international participants. This was followed by panel discussions to extract lessons that specifically related to successfully implementing co-management in Ghana's fisheries. Finally, breakout groups addressed in greater detail some issues of importance to fisheries governance reform in Ghana. While fisheries co-management is not a new concept in Ghana, participants heard that previous attempts to initiate these systems proved unsustainable. A number of lessons were drawn from these past experiences.

**Perez, M.L. ; Pido, M.D. ; Garces, L.R. ; Salayo, N.D. 2012.**

**Towards sustainable development of small-scale fisheries in the Philippines: Experience and lessons learned from eight regional sites.**  
*Lessons Learned Brief 2012-10. WorldFish, Penang, Malaysia.*

The focus of this paper is on the governance of small-scale or municipal fisheries in the Philippines in light of the critical role they play in the livelihoods of coastal communities and in the nation as a whole. The information and insights presented in this lessons learned brief derive from the project entitled Strengthening Governance and Sustainability of Small-Scale Fisheries Management in the Philippines: An Ecosystem Approach. The project was funded principally by the Department of Agriculture's Bureau of Agricultural Research (DA-BAR), and implemented from 2008 to 2011 by WorldFish in collaboration with the Department of Science and Technology (DOST) and selected partners. The underlying project's goal was to 'strengthen governance and sustainability of small-scale fisheries management in the Philippines.' There were a variety of objectives spread across two project phases but the primary objectives relevant to this brief include: (1) identifying issues at project sites and assessing potential for an ecosystem based approach to fisheries management, and (2) assessing current fisheries management practices at different levels of governance and identifying best practices. The purposes of this paper are twofold. First, it aims to provide brief highlights of the project findings; second, it aims to present the lessons learned in project implementation covering substantive sectoral concerns as well as methodological issues. It wraps up with some strategic directions that need to be undertaken to reverse the deteriorating conditions of small-scale fisheries (SSF) while at the same time promoting their sustainable development.

**Ponzoni, R.W. ; Nguyen, N.H. ; Khaw, H.L. ; Rodriguez, B.M. Jr. 2012.**

**Considerations about effective dissemination of improved fish strains.**  
*Working Paper 2012-47. WorldFish. Penang, Malaysia.*

Aquaculture production systems in developing countries are largely based on the use of unimproved species and strains. As knowledge and experience are accumulated in relation to the management, feeding and animal health issues of such production systems, the availability of genetically more productive stock becomes imperative in order to more effectively use resources. For instance, there is little point in providing ideal water conditions and optimum feed quality to fish that do not have the potential to grow faster and to be harvested on time, providing a product of the desired quality. Refinements in the production



system and improvement of the stock used must progress hand in hand. In this paper we deal separately with genetic and non-genetic issues pertaining to the multiplication and dissemination of improved strains. The separation is somewhat arbitrary, and as will be evident from our discussion, there is frequent interaction between the two.

Shrestha, M.K. ; Pant, J. (eds.). 2012.

**Small-scale aquaculture for rural livelihoods: Proceedings of the Symposium on Small-scale aquaculture for increasing resilience of Rural Livelihoods in Nepal. 5-6 Feb 2009. Kathmandu, Nepal.**

*Proceedings 2012-15. Institute of Agriculture and Animal Science. Chitwan, Nepal and WorldFish. Penang, Malaysia. 189 p.*

Over the years, aquaculture has developed as one of the fastest growing food production sectors in Nepal. However, local fish supplies have been extremely inadequate to meet the ever increasing demand in the country. Nepal imports substantial quantities of fish and fish products from India, Bangladesh, Thailand, and elsewhere. Integration of pond aquaculture in existing crop-livestock-based farming system is believed to be effective in increasing local fish supply and diversifying livelihood options of a large number of small-holder farmers in southern plains (terai) and mid-hill valleys, thereby also increasing resilience of rural livelihoods. There is growing appreciation of the role of small-scale aquaculture in household food and nutrition security, income generation, and empowerment of women and marginalized communities. This book includes a total of 25 papers presented at the 'Symposium on Small-scale Aquaculture for Increasing Resilience of Rural Livelihoods in Nepal', held in Kathmandu on 5-6 February 2009. The papers cover technological, social, economic and environmental aspects of small-scale aquaculture development emerged from research and development initiatives of governmental, non-governmental and international research organizations in recent decades. All the papers have been reviewed and updated for their inclusion in the book.

**WorldFish. 2012.**

**A guide to mangrove rehabilitation in Solomon Islands.**

*Brochure 2012-08. WorldFish, Solomon Islands.*

There are about 30 species of mangroves in Solomon Islands, representing 40% of the world's mangrove species. They can be found on most islands and it is estimated that mangroves here cover an area of about 50,000 hectares. Mangroves are an important resource for livelihoods of rural coastal communities. However there is not an endless supply. Communities need to plan now to think about developing ways to help conserve and protect mangroves for future generations. This may include developing a management plan with rules for cutting down mangroves or re-invigorating traditional management methods.

WorldFish. 2012.

Aquaculture.

*WorldFish, Bangladesh.*

The Bangladesh Aquaculture Project is a 5 year transformative investment by USAID in aquaculture, focused on the 20 southern districts in Barisal, Khulna and Dhaka divisions of Bangladesh. The objectives of the project are to 1) improve fish and shrimp seed quality and availability 2) increase farm household pond and homestead production to raise incomes and improve nutrition 3) increase investment, employment and growth through support to commercial fish, shrimp and prawn production 4) work with government to support policy, regulatory implementation and institutional capacity.

WorldFish. 2012.

Aquaculture and fish consumption in Bangladesh.

*WorldFish, Bangladesh.*

WorldFish conducted a review in Bangladesh funded by IFAD in 2011 on the present status of aquaculture production and fish consumption. This brief summarizes the key findings of the review.

WorldFish. 2012.

Community-based resource management in Solomon Islands: a starter's guide.

*Brochure 2012-09. WorldFish, Solomon Islands.*

CBRM can be undertaken by a well organised community on their own with a little bit of help and information from an outside organisation. CBRM is a long-term process that should be able to be continued for generations and to become part of daily village life. Most communities already actively undertake stewardship or caring for resources. CBRM just builds on that existing role and responsibility. This leaflet describes some of the first steps that interested communities can take and where they can find further information about how to get started with CBRM.

WorldFish. 2012.

Recipe card [in Bengali].

*WorldFish, Bangladesh.*

WorldFish. 2012.

Recipe card: Amblypharyngodon mola [in Bengali].

*WorldFish, Bangladesh.*

WorldFish. 2012.

Recipe card: *Labeo rohita* [in Bengali].

*WorldFish, Bangladesh.*

WorldFish. 2012.

Recipe card: Rohu, Mola and mixed small fish.

*WorldFish, Bangladesh.*

WorldFish. 2012.

Responses to climate change: adaptation pathways to change.

*Project Flyer 2012-25. WorldFish. Penang, Malaysia.*

This project, Responding to Climate Change Using an Adaptation Pathways and Decision-making Approach, funded by the Asian Development Bank (ADB), aims to strengthen coastal and marine resource management in the Coral Triangle of the Pacific, by assisting communities in Fiji, Papua New Guinea, Solomon Islands, Timor Leste and Vanuatu to develop their own climate change adaptation implementation plans. The project aims to build capacity among inland and coastal communities living within this region that are dependent on natural resources for their livelihoods, to enable them to respond and adapt to climate related change.

Timmers, B. 2012.

Impacts of climate change and variability on fish value chains in Uganda.

*Project Report 2012-18. WorldFish. Penang, Malaysia.*

Fish are a significant source of income and food security in Uganda, highly vulnerable to climate and non-climate related drivers of change. This study examines the vulnerability of the fish sector in Uganda as it relates to the predicted impacts from climate change and variability, using the concept of the value chain. The specific purpose of the study was to identify current and potential impact pathways of climate change and corresponding adaptation strategies in fish value chains. By considering the value chains related to fisheries (Nile Perch and mukene) and pond aquaculture (Nile tilapia and African catfish) in Uganda, this report is able to present context- and sector-specific adaptation strategies for products contributing to domestic food security, livelihoods and national economic development.

Tran, N. ; Wilson, N. ; Hite, D. 2012.

Choosing the best model in the presence of zero trade: a fish product analysis.

*Penang, Malaysia. Working paper. 2012-50.*

The purpose of the paper is to test the hypothesis that food safety (chemical) standards act as barriers to international seafood imports. We use zero-accounting gravity models to test the hypothesis that food safety (chemical) standards act as barriers to international seafood imports. The chemical standards on which we focus include chloramphenicol required performance limit, oxytetracycline maximum residue limit, fluoro-quinolones maximum residue limit, and dichlorodiphenyltrichloroethane (DDT) pesticide residue limit. The study focuses on the three most important seafood markets: the European Union's 15 members, Japan, and North America.

UNEP ; FAO ; IMO ; UNDP ; IUCN ; WorldFish ; GRID-Arendal. 2012.

Green economy in a blue world: synthesis report.

*United Nations Environment Programme. Kenya. 23 p.*

The Green Economy in a Blue World report analyzes how key sectors that are interlinked with the marine and coastal environment (the blue world) can make the transition towards a Green Economy. The report covers the impacts and opportunities linked with shipping and fisheries to tourism, marine-based renewable energies and agriculture. The findings underline that a shift to sustainability in terms of improved human wellbeing and social equity can lead to healthier and more economically productive oceans that can simultaneously benefit coastal communities and ocean-linked industries.

Albert, J.A. ; Trinidad, A. ; Boso, D. ; Schwarz, A.J. 2012.

Coral reef economic value and incentives for coral farming in Solomon Islands.

*Policy Brief. CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia. AAS-2012-14.*

This brief was completed as part of the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF) National Program in the Solomon Islands. The research project, "Economic valuation of coral reefs and development of sustainable financing options in the Solomon Islands" was designed to assess the economic value of coral reefs using the aquarium and curio coral trades as an entry point. Two communities were selected from Central Islands Province, representative of areas with a known history of wild coral harvest for the aquarium and curio trade (referred to collectively in this report as 'coral trade' communities) and two from Western Province, representative of those with no known wild coral harvest (referred to as 'non-coral trade' communities). All four communities harvested live coral for the production of lime.

Albert, J.A. ; Warren-Rhodes, K. ; Schwarz, A.J. ; Duke, N.D. 2012.

Mangrove ecosystem services and payments for blue carbon in Solomon Islands.

*CGIAR Research Program on Aquatic Agricultural Systems. WorldFish, Solomon Islands. AAS-2012-06.*

The AusAID Development Research Project: Poverty Alleviation, Mangrove Conservation and Climate Change: Carbon offsets as payment for mangrove ecosystem services in Solomon Islands (# 49892) was designed to evaluate the potential for mangrove carbon revenue programs in Solomon Islands. The approach was to address three main questions: (1) How are mangrove ecosystem goods and services currently used and valued by coastal populations with a high reliance on a subsistence economy? (2) What is the total carbon stock held in mangrove ecosystems? and (3) Are carbon markets, whether compliance or voluntary, feasible options for Solomon Islands communities and government to alleviate poverty, reduce mangrove forest resource degradation and contribute to climate change adaptation and mitigation? The project was conducted through a partnership between WorldFish and the Solomon Islands Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM). Here we present the project's main research findings and concomitant policy implications for local communities and government agencies, NGOs and other stakeholders involved in climate change and REDD+ activities.

CGIAR Research Program on Aquatic Agricultural Systems. 2012.  
Annual report.

*CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia.  
AAS-2012-09.*

The program on aquatic agricultural systems (AAS) aims to change the way the CGIAR engages with aquatic agricultural systems and the poor and vulnerable communities who depend upon them. To do so the program has focused on three primary lines of work in its first six months: (i) preparing for implementation of the program in focal countries and geographical hubs; (ii) harnessing the best of earlier and ongoing research that contributes to the science themes of the program and which we wish to see expanded and integrated into the program as it develops; (iii) establishing innovative governance and management arrangements that will guide and implement the program. This report summaries the achievements and reviews the progress of the AAS program.

CGIAR Research Program on Aquatic Agricultural Systems. 2012.

**Building coalitions, creating change: An agenda for gender transformative research in development workshop report. 3-5 October 2012. Penang, Malaysia.**

*CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia.  
Workshop Report: AAS-2012-31.*

There is compelling evidence that increased gender equity can make a significant contribution towards alleviating poverty and increasing food security. But past efforts to integrate gender into agricultural research and development practice have failed to address the inequalities that limit women's access to agricultural inputs, markets, resources and advice. A Gender Transformative Approach (GTA) goes beyond just considering the symptoms of gender inequality, and addresses the social norms, attitudes, behaviors and social systems that underlie them. The CGIAR Research Program on Aquatic Agricultural Systems (AAS) has placed the GTA at the heart of its gender strategy. This workshop was an opportunity for researchers, practitioners and donors working in this area to address the challenge of how to translate this approach into actual research and development practice. The workshop recommended that a GTA should be adopted alongside, not instead of, existing efforts to reverse gender disparities in resources, technologies and markets. It is through this pairing that improved social and material outcomes can be achieved, with the expectation that when achieved together, both types of outcomes will be more lasting than if achieved individually.

CGIAR Research Program on Aquatic Agricultural Systems. 2012.  
CGIAR research program collaboration on NRM impact assessment:  
workshop report. 12-14 February.  
*CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia.  
AAS-2012-04.*

Natural Resource Management (NRM) Research in the CGIAR faces three interlinked impact challenges. First the CGIAR needs to pursue NRM research that achieves reductions in poverty and hunger and does so at scale; second we need to understand how this happens more quickly and efficiently; and third we need to measure our outcomes and impacts so that we can demonstrate these achievements in an appropriately critical manner. In order to review these challenges and consider how the CGIAR might best address them through some of the CGIAR Research Programs (CRPs) a workshop was held in Penang 14-15 February, 2012, in conjunction with a parallel meeting of the Independent Science and Partnership Council (ISPC) Stripe Review panel reviewing NRM research in the CGIAR. This report is a documentation of the workshop process and outputs.

CGIAR Research Program on Aquatic Agricultural Systems. 2012.  
CGIAR Research Program on Aquatic Agricultural Systems Roll-Out  
Handbook. Ver. 1.0. May, 2012.  
*Penang, Malaysia. AAS-2012-05.*

This handbook is a guide to procedures and practices that should be observed during hub roll-out by the teams coordinating the planning, implementation and reporting of the activities of the CGIAR Research Program on Aquatic Agricultural Systems (AAS-CRP). Given that the program promises to change the way research in development is planned, implemented and reported, it is important that similar practices be observed from the start. This will assist later cross-hub comparisons.

CGIAR Research Program on Aquatic Agricultural Systems. 2012.  
Communication strategy.  
*CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia.  
AAS-2012-11.*

The CGIAR Research Program on Aquatic Agricultural Systems (AAS) is one of the CGIAR's 15 research programs. Through a program of participatory action research, referred to as "Research in Development", the Program aims to improve the lives of the many millions of people who depend on aquatic agricultural systems. This Strategy will create the platform to capture, collect, produce, manage, brand and share information that is generated throughout the Program's life cycle.

## CGIAR Research Program on Aquatic Agricultural Systems. 2012.

### Gender strategy brief: A gender transformative approach to research in development in aquatic agricultural systems.

*CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia. Brief AAS-2012-03a.*

In July 2011, the CGIAR approved the CGIAR Research Program on Aquatic Agricultural Systems (AAS) in recognition of the importance of these systems and the potential they provide for reducing poverty. Our goal is to reduce poverty and improve food security for people whose livelihoods depend on aquatic agricultural systems. We believe we can achieve this by adopting a new and innovative research approach that will overcome past constraints and result in a deeper understanding of the multidimensional nature of poverty, the diversified livelihoods of the women and men who depend on these systems, and therefore unlock multiple opportunities for improvement. The AAS Gender Strategy will take a broader perspective, integrating efforts to redress gender disparities in resources, technologies and services with complementary efforts to promote more gender equitable systems within which poor women and men can use them. This requires a significant investment in building context-specific knowledge of the dynamics of social inequality. Key to the Program's success therefore is to understand the systemic nature of gender inequality across program contexts in order to identify ways to create more enabling socioeconomic environments for poor women and men alike.

## CGIAR Research Program on Aquatic Agricultural Systems. 2012.

### Gender strategy: a transformative approach to gender mainstreaming.

*CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia. Brief AAS-2012-03.*

In July 2011, the CGIAR approved the CGIAR Research Program on Aquatic Agricultural Systems (AAS) in recognition of the importance of these systems and the potential they provide for reducing poverty. Our goal is to reduce poverty and improve food security for people whose livelihoods depend on aquatic agricultural systems. We believe we can achieve this by adopting a new and innovative research approach that will overcome past constraints and result in a deeper understanding of the multidimensional nature of poverty, the diversified livelihoods of the women and men who depend on these systems, and therefore unlock multiple opportunities for improvement. Key to the Program's success is addressing the concerns of women and engaging their resources. The AAS Program proposes a two-pronged strategy to ensure that gender-related program activities are effective, adequately resourced and will deliver outcomes. To do so we will pursue gender mainstreaming across the CGIAR Research Program while also developing a targeted gender transformative theme.



**CGIAR Research Program on Aquatic Agricultural Systems. 2012.  
Program Partnerships.**

*CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia.  
AAS-2012-19.*

Effective partnership is central to the CGIAR Research Program on Aquatic Agriculture Systems (AAS). We recognize that many organizations are working to improve the lives of people living in aquatic agricultural systems, and together they spend hundreds of millions of dollars there each year. For the AAS Program to add value in this complex institutional environment, we therefore focus on where and how the program's science insights can support the work of our partners, and where the convening and catalytic roles we play can foster coalitions that, collectively, have a greater ability to deliver more effective development actions. Working in this way we aim to leverage the CGIAR's investment in aquatic agricultural systems to help achieve impact at scale.

**CGIAR Research Program on Aquatic Agricultural Systems. 2012.  
Report on progress 2.**

*CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia.  
AAS-2012-18.*

The CGIAR Research Program on Aquatic Agricultural Systems (AAS) began operations in July 2011, and a summary report on progress in the first eight months was produced in February 2012. Since that time the program has moved ahead with roll-out in focal countries, pursuing areas of science where particular innovation is needed, developing key partnerships, and establishing governance and management arrangements for the program. The present report on progress summarizes the main highlights from this work.

**CGIAR Research Program on Aquatic Agricultural Systems. 2012.**

**Resilient livelihoods and food security in coastal aquatic agricultural systems: Investing in transformational change.**

*CGIAR Research Program on Aquatic Agricultural Systems, Penang, Malaysia.  
Project Report: AAS-2012-28.*

Aquatic agricultural systems (AAS) are diverse production and livelihood systems where families cultivate a range of crops, raise livestock, farm or catch fish, gather fruits and other tree crops, and harness natural resources such as timber, reeds, and wildlife. Aquatic agricultural systems occur along freshwater floodplains, coastal deltas, and inshore marine waters, and are characterized by dependence on seasonal changes in productivity, driven by seasonal variation in rainfall, river flow, and/or coastal and marine processes. Despite this natural productivity, the farming, fishing, and herding communities who live in these systems are among the poorest and most vulnerable in their countries and regions. This report provides an overview of the scale and scope of development challenges in coastal aquatic agricultural systems, their significance for poor and vulnerable communities, and the opportunities for partnership and investment that support efforts of these communities to secure resilient livelihoods in the face of multiple risks.

### CGIAR Research Program on Aquatic Agricultural Systems. 2012.

#### Strengthening impact evaluation in natural resource management.

*Workshop Report, 4-5 September 2012, Penang, Malaysia. CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia. Workshop Report: AAS-2012-22.*

The workshop on Strengthening Evaluation in Natural Resource Management Research is part of an ACIAR-funded Small Research and Development Activity (SRA) on Assessing the Impacts of Natural Resource Management and Policy Research in Development Programs, with WorldFish and Commonwealth Scientific and Industrial Research Organization (CSIRO) as partners. The SRA objectives included a review of literature to identify challenges in assessing the impact of NRMR programs and to propose a framework that addresses them. An exploratory workshop was held in February 2012 to initiate collective action within the CGIAR Research Programs (CRPs) to identify and address their impact challenges and led to the creation of the NRMR impact community of practice (COP). This follow-up workshop brought together members of the COP and partners in the SRA to discuss and reach agreement on how to progress on our collective goals of building new and appropriate approaches for NRMR IE and how to put these approaches into action through our research programs. This report is a documentation of the workshop process and outputs.

### CGIAR Research Program on Aquatic Agricultural Systems. 2012.

#### Teaching the Adivasi to fish for a lifetime of benefit in Bangladesh.

*CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia. AAS-2012-24.*

The Adivasi Fisheries Project (AFP) set out in 2007 to help Adivasis in the north and northwest of Bangladesh find new and more sustainable livelihoods. It is based on 2 decades of WorldFish research in Bangladesh on aquaculture techniques for smallholders and community fisheries management and targeted disadvantaged rural minorities called Adivasi. The enduring effects of the Adivasi Fisheries Project (AFP) are still being felt, three years after the project ended. During the project, fish production increased five-fold, fish consumption nearly quadrupled and the average household income for members of this vulnerable population improved significantly, far outstripping project expectations. Many of the nearly 3600 households that participated in the project are still using the aquaculture techniques that they learned, and others in the community have also adopted the practices.

CGIAR Research Program on Aquatic Agricultural Systems. 2012.

Teaching the Adivasi to fish for a lifetime of benefit in Bangladesh [in Bangali].

*CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia. AAS-2012-24.*

The Adivasi Fisheries Project (AFP) set out in 2007 to help Adivasis in the north and northwest of Bangladesh find new and more sustainable livelihoods. It is based on 2 decades of WorldFish research in Bangladesh on aquaculture techniques for smallholders and community fisheries management and targeted disadvantaged rural minorities called Adivasi. The enduring effects of the Adivasi Fisheries Project (AFP) are still being felt, three years after the project ended. During the project, fish production increased five-fold, fish consumption nearly quadrupled and the average household income for members of this vulnerable population improved significantly, far outstripping project expectations. Many of the nearly 3600 households that participated in the project are still using the aquaculture techniques that they learned, and others in the community have also adopted the practices.

Ratner, B.D. 2012.

Collaborative governance assessment.

*Penang, Malaysia. Guidance Note: AAS-2012-27.*

This Guidance Note presents a simple approach to analyzing the governance context for development of aquatic agricultural systems; it is intended as an aid to action research, and a contribution to effective program planning and evaluation. It provides a brief introduction to the value of assessing governance collaboratively, summarizes an analytical framework, and offers practical guidance on three stages of the process: identifying obstacles and opportunities, debating strategies for influence, and planning collaborative actions.

Ratner, B.D. ; Barman, B. ; Cohen, P. ; Mam, K. ; Nagoli, J. ; Allison, E.H. 2012.

Strengthening governance across scales in aquatic agricultural systems.

*CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia. Working Paper. AAS-2012-10.*

Aquatic agricultural systems in developing countries face increasing competition from multiple stakeholders operating from local to national and regional scales over rights to access and use natural resources - land, water, wetlands, and fisheries - essential to rural livelihoods. A key implication is the need to strengthen governance to enable equitable decision-making amidst such competition, building capacities for resilience and transformations that reduce poverty. This paper provides a simple framework to analyze the governance context for aquatic agricultural system development focused on three dimensions: stakeholder representation, distribution of power, and mechanisms of accountability. Case studies from Cambodia, Bangladesh, Malawi/Mozambique, and Solomon Islands illustrate the application of these concepts to fisheries and aquaculture livelihoods in the broader context of intersectoral and cross-scale governance interactions.

Research Program on Aquatic Agricultural Systems. 2012.  
Report on progress 1.

*CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia. AAS-2012-01.*

The CGIAR Research Program on Aquatic Agricultural Systems (CRP AAS) began operations in July 2011 with an initial focus on establishing the key governance, management and science leadership capacities required for successful delivery. As this has progressed we have also started implementing a first suite of focal country activities, along with work to produce key science outputs to support country roll-out. This first report on progress summarizes the main highlights of our work so far.

Schwarz, A.M. 2012.

Research Program on Aquatic Agricultural Systems: Program summary:  
Solomon Islands.

*CGIAR Research Program on Aquatic Agricultural Systems. WorldFish, Solomon Islands. AAS-2012-08.*

The Program will achieve impact at multiple scales (household, community, province and national as well as amongst program countries) through pathways that include partnerships, knowledge sharing and learning. In Solomon Islands significant benefits will be achieved through direct engagement with partners, including communities in specific research sites in selected program hubs. Of a total population of just over half a million people, 75% of Solomon Islanders are subsistence-oriented small holder farmers and fishers. Most people live on the coastal margins of the almost 1000 island archipelago while those that live inland have little access to marine resources. More than 70% of women and 50% of men are engaged in subsistence agriculture while 50% of women and 90% of men are engaged in

Weeratunge, N. ; Chiuta, T.M. ; Choudhury, A. ; Ferrer, A. ; Hüsken, S.M.C. ; Kura, Y. ; Kusakabe, K. ; Madzudzo, E. ; Maetala, R. ; Naved, R. ; Schwarz, A. ; Kantor, P. 2012. Transforming aquatic agricultural systems towards gender equality: a five country review.

*CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia. Working Paper: AAS-2012-21.*

Aquatic agricultural systems (AAS) are systems in which the annual production dynamics of freshwater and/or coastal ecosystems contribute significantly to total household income. Improving the livelihood security and wellbeing of the estimated 250 million poor people dependent on AAS in Bangladesh, Cambodia, the Philippines, the Solomon Islands and Zambia is the goal of WorldFish-led Consortium Research Program (CRP), "Harnessing the development potential of aquatic agricultural systems for development." One component expected to contribute to sustainably achieving this goal is enhancing the gender and wider social equity of the social, economic and political systems within which the AAS function. The CRP's focus on social equity, and particularly gender equity, responds to the limited progress to date in enhancing the inclusiveness of development outcomes through interventions that offer improved availability of resources and technologies without addressing the wider social constraints that marginalized populations face in making use of them. The CRP aims to both offer improved availability and address the wider social constraints in order to determine whether a multi-level approach that engages with individuals, households and communities, as well as the wider social, economic and political contexts in which they function, is more successful in extending development's benefits to women and other excluded groups. Designing the research in development initiatives to test this hypothesis requires a solid understanding of each CRP country's social, cultural and economic contexts and of the variations across them. This paper provides an initial input into developing this knowledge, based on a review of literature on agriculture, aquaculture and gender relations within the five focal countries. Before delving into the findings of the literature review, the paper first justifies the expectation that successfully achieving lasting wellbeing improvements for poor women and men dependent on AAS rests in part on advances in gender equity, and in light of this justification, presents the AAS CRP's conceptual framework for gender and social analysis.

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This publication should be cited as: WorldFish. (2013). 2012 Publications Catalog. WorldFish, Penang, Malaysia. Catalog: 2013-18.

Design & Layout : Bold Inspiration Sdn Bhd

Photo credits : Cover: Simon Heck, Back Cover: Finn Thilsted

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