35. Disruptive extension for effective technology dissemination in Fisheries

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Food and nutritional security have now become a global concern with the increasing trend of population growth. Aquaculture is considered as a promising food production sector for providing high quality affordable protein food for sustaining the nutritionally secured livelihood of millions of rural populaces. Despite the significant contributions of the sunrise sector, global debates on fisheries issues and policies appear to be dominated by different degrees of concerns over environmental sustainability, overfishing and overcapacity in the fishing domain and in the post- harvest front, the processing industries face multifarious problems like complicated exporting procedures, high shipping costs, cut-throat competition in the industry, changing quality standards of importing countries, irregularity in supply of raw materials, hygiene problems and non-availability of quick transportation facilities from the fishing port to the processing units, etc. As a result of which trade-driven commercial fish farming is suffered that reduces the livelihood opportunities of small-scale dry fish processors, petty traders within the communities of poor fishermen.

Small-scale fisheries are normally characterized by low capital input activities, low capital intensive, lack of equipment and labor-intensive operations followed by traditional fishers. They also usually operate as semi-subsistence, family-based enterprises, where a share of the production is kept for self-consumption (Garcia *et al*., 2008). Traditional fishers dominate the marine sector and they are socially deprived, educationally weak with very high occupational rigidity. There is inequity in the distribution of yield and effort in marine fishing in case of traditional fishing communities. They are unorganized with least social security. The informal social security system in the form of sharing of earnings among the community prevailing in the traditional fishing is hardly seen in the mechanized fishing. There are also huge regional variations in productivity among them. Likewise, there are multitude of challenges associated with the socio-economic fabrics of the sector, which needs adequate attention from the social scientists to understand and put necessary effort to prove the sunrise sector as a potential driver of economic development. Technologies are the main drivers of growth. Hence, systematic technological interventions backed up by appropriate policy and institutional support are vital for making the aquaculture operations sustainable and economical. Generally, the technologies and trade interventions reinforce each other which can be characterized as skill-based, cost effective, capital intensive which can bring a change in the performance of the sector. Keeping eye upon this, following strategies have been suggested for an accelerated fishery development with

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focus on poverty alleviation of poor fishers:

- Commodity-centered approach
- System approach
- Prioritize technology on the basis of needs and problems at micro and macro levels
- Skill development/upgradation of the fishers
- Monitoring the technology demonstrations programs and assess the impacts.
- Innovate and strengthen institutions and policies
- Enhance investment and reorient policies to facilitate percolation of benefits to all sections of the society.
- Follow ecological principles
- Emphasize on domestic market demand and consumers' preferences
- Strengthen database and share it for a better planning and policy making in the sector.

Extension systems for sustainable development

Unlike India, the economy of developing and underdeveloped countries in sub Saharan Africa, Latin America, Asia inclusive of 22 Low Income Food Deficit Countries (LIFDCs) is predominantly agrarian economy, where agriculture inclusive of fisheries provides employment and livelihood to majority of the rural households, but the condition of both farmers/fishers and farming is in alarming state.

Hence, there is an urgent need to reform that agriculture allied sectors in holistic, scientific and systematic approach to meet the recent challenges due to climate change and global competitiveness so as to achieve sustainable production and growth under different agro-climatic conditions.

As per the report of world commission on Environment and Development (1987), sustainable development meets the needs of the present generation without compromising the ability of future generation to meet their requirements. The FAO committee on Fisheries (1991) defines sustainable development more elaborately as the management and conservation of national resource base and the orientation of technological and institutional intervention to ensure the attainment of human needs for present and future generation including fulfilment of social and economic demands and conserving the natural resource base. In response to that FAO developed a code of conduct for Responsible Fisheries (FAO,1995) that provides principles and guidelines for ensuring sustainable exploitation of marine resources. Sustainable fisheries can be possible through responsible fishery, which envisages rational fishery management that address a range of issues dealing with resource status, environmental health, post-harvest technology, trade and export, socio-economic benefits, legal and administrative support. Sustainable agricultural systems must be resource-conserving, socially supportive, commercially competitive, and environmentally sound. Hence, the agriculture research system must place emphasis on generation of resource conservation technology (RCT) along with strong forward-backward linkage between research-extension system. It involves design and management procedures that work with

natural processes to conserve all resources, promote ecosystem resilience and self-regulation, minimize waste and environmental damage, while maintaining or improving farm productivity and profitability (MacRae et al., 1990).

The role of extension in fisheries cannot be ignored. Strong extension system is the key to bring the desired changes to meet the present-day challenges related to sustainable fisheries. Basically, the end product of the fisheries extension system is to work with fisheries within an agro-climate and economic environment by providing suitable technologies to enrich knowledge and upgrade skills to improve better handling of natural fish resources and applying the cutting-edge technologies to achieve desired production level. Extension system plays a pivotal role in empowering fishers and other stakeholders to make fish farming more participatory, demand-driven, knowledge intensive and skill supportive for disseminating most appropriate technical, management and marketing skill to improve profitability in fisheries that can overcome the emerging challenges and concern, thus developing a synergistic pathway for enhancing productivity along with quality produce in order to sustain production base and ensure ecological and livelihood security. The extension system needs to disseminate a broad array of information starting from farm to fork in an integrated manner for safe delivery from field to the consumer considering all the aspects of conservation and production technologies, post-harvest management, processing and value addition. Such knowledge-based decision should be incorporated in reshaping of extension approaches. In present scenario, the extension system envisages a transformation from technology driven to market driven extension, where fishers would give emphasis on commercialization of fish and fish-based products, maintenance of quality, fulfilling consumers' demands, etc., in the program planning process for the effectiveness of any extension programme.

Further, with the advent of global competitiveness and market liberalization, our prevailing extension system has to be strengthened with innovative extension approaches to tackle the recent challenges in fisheries *viz.*, climate change, weather aberrations, dwindling resources and quality and safety of products; so that fishers can adjust their production portfolio keeping eye upon the emerging trends in food consumerism in domestic as well as global markets. Grooming fishers with proper information support for taking right decision related to fish production essentially requires a strong network of extension systems, supported with government initiatives and strong linkage among extension scientists and functionaries working for fishery sector development. This would ensure the livelihood security of millions of fisher communities by improving the quality production and creating better job opportunities, which intends to bring out planned changes to meet the needs of the present generation without compromising the future generation's requirements.

Innovative extension approaches for technology dissemination in fisheries

Earlier in developing countries, the extension personnel were involved in diffusion of farm technologies generated by public research organizations, mostly disseminated through appropriate mechanism, viz., On Farm Trials (OFT), frontline demonstrations (FLD), field visits, fishers' meetings, media use, etc. This process had the conceptual backup from the

'diffusion of innovation' model. But in the last two decades, the paradigm shifts in development pivots to the enhanced concern for future generations to meet their basic needs, accordingly the nature, design and integration of fisheries technologies are drawing attention of the extension professionals and practitioners across the globe. In India, different models for transfer of technology have been tested and some robust extension approaches have been validated. Furthermore, the frontline extension system of the country has been revisited and sharpened through fishers-oriented approaches for technology adaptation and dissemination. The extension system in India has been designed to move beyond technology and beyond commodity through reciprocal fishers-research-extension linkages. Fish farmers still suffer from lack of access to appropriate services like credit, inputs, market, extension, technologies etc. Keeping eye upon this, the World Development Report has focused on need to restructure and revamp agricultural extension system as a tool for realizing the growth potential of farm sector against the widening demand–supply pressures for ensuring sustainable fisheries, inclusive, pro-poor socio-economic development. Therefore, participatory technology development and participatory extension approaches emerged as a part of integration of the '*interdependence model*' and the '*innovation systems framework*' that offered more inclusive ways of involving the institution in technology generation, customization and diffusion. Extension approaches have to be redefined depending upon the components involved for sustainable growth and livelihood security of the farmers for which a conceptual framework has to be developed in response to recognizing and considering different livelihood assets viz., *human, social, physical, natural and financial resources*. Some of the following innovative extension approaches originating from multiple sources must be adopted on trial basis to make fisheries more lucrative and sustainable which can be replicated in the fishery sector interwoven with numerous challenges like increased production with sustained natural resources, growing market demand for processed products having entrepreneurial opportunities, protection and conservation of environment, and promoting international trade.

An analysis of national extension systems in the Asia and Pacific region by Qamar (2006) observes that agricultural extension is undergoing a major transformation as a result of failure of public extension systems perceived to be outdated in the context of globalization, decentralization, and information technology revolution. Extension systems in many developing countries are undergoing a paradigm shift to more fishers -oriented approaches based on rural innovation that emphasize the importance of interactive, integrated and multidisciplinary oriented mutual learning between formal and informal knowledge systems (Friederichsen, 2009).

a. Asset Based Community Development (ABCD) approach

As per the traditional approach to development, poor people see themselves as people with special needs that can only be met by outside supporting agencies. But Asset Based Community Development (ABCD) approach intends for the development of community based on the principle of identifying and mobilizing individual and community 'assets', rather than focusing on problems and needs. It is an extension approach in which a

community's micro-assets are linked with its macro environment. It believes that communities can initiate and sustain the process of growth and development themselves by recognizing and harnessing the existing, but often unrecognized assets, and thereby promoting local economic potential to drive its development process (Rans & Green, 2005). The approach is optimistic in nature, because the focus is on *'what is possessed by the community, rather than the problems of the community."*

The focal point in this approach is asset and not the need of the community. Assets of individuals, associations and institutions are identified after an extensive survey and assets are then matched with the need of the people to empower communities to control their futures and create tangible resources such as services, funds and infrastructures etc. *(Foot and Hopkins, 2010.* In fishery, ABCD approach gives greater emphasis on reducing the use of external inputs and on a high degree of social mobilization in which the assets of the poor (*social, physical, financial as well as human*) can be utilized to bring sustainable livelihoods in fisheries through number of different fishery related activities.

Five Key Assets in ABCD

As per ABCD approach there are 5 categories of asset inventories such as individuals, associations, institutions, physical assets and connections

1. **Individuals**: Every individual has got certain assets, gifts and qualities; such individual is at the center of ABCD approach.
2. **Associations**: Groups of people working with a common interest are critical to community mobilization.
3. **Institutions**: The assets of institutions help the community capture valuable resources and establish a sense of civic responsibility.
4. **Physical Assets**: Physical assets such as land, buildings, space, and funds are other assets that can be used.
5. **Connections:** These are the exchange between people sharing their assets by various methods.

b. Rural advisory services (RAS)

Rural Advisory Services (RAS) refer to all the different activities that provide the information and services needed and demanded by farmers and other actors in rural settings, to assist them in providing their livelihoods by developing their technical, organizational and management skills and practices (GFRAS, 2011; FAO, 2010). RAS designers and implementers must recognize the diversity of actors in extension and advisory fields (public, private, civil society); the need for extending support to farmers' producer organizations (FPO) and rural communities (beyond technology and information sharing) including advice related to farm, organizational and business management; and explaining the role of facilitation and brokerage in rural development and value chains. In the case of aquaculture, large-, medium- and small-scale fishers need different types of RAS support. The large aquaculture farms are mostly self-reliant and need only regulatory support, while medium-sized farms need mobilization and facilitation support in addition to regulatory support.

Small aquaculture farms need more education and input provision alongside facilitation (Kumaran, 2014). Timely sharing of research recommendations can address the problem of disseminating information to fishers. In this direction, innovative strategies are being formulated keeping the fishers' needs and capacities in mind to pass on appropriate technologies by combining Internet, telecommunications, video, and print technologies that may bridge the information gap and empower fishers to make better production and marketing decisions (McLaren et al. 2009).

In fishery sector, RAS helps in

- ⇨ Providing management and business development support appropriate to the scale, resources and capacities of each fisherman.
- ⇨ Better understanding markets (prices, products, seasonality, standards, value addition etc.) related to fish and fish products.
- ⇨ Linking fishers to other stakeholders involved in provision of varied support and services.
- ⇨ Creating platforms to facilitate interaction and sharing among the various stakeholders including FPOs to ensure coordinated support to fishers.
- ⇨ Exploiting information communication technologies (ICTs) to provide fishers with a range of information related to weather, prices, extension programmes and generic information regarding fisheries.
- ⇨ Facilitating the formation of FPOs and also collaborate with FPOs to strengthen the demand and supply side of RAS.
- ⇨ Promoting institutional and policy change to enable and support small-scale fishery.

RAS encourages the formation/ organisation of groups by involving individual fishers, who have little influence over the social, economic and political processes affecting them, but as a group/ organizations and networks they can deal with their specific challenges and make their voice heard. Such groupings can act as platforms to articulate concerns, exchange knowledge, influence policies and engage in collective action so that their agriculture remains sustainable and profitable. Effective formation of Rural Resource Centres (RRCs), Fishermen Cooperative Society, Farmers producers Organisations (FPOs) can be instrumental by galvanizing collective action in order to ensure better access to markets and to support innovation by their members in related activities (Sundaram, 2014).

c. Model Village System of Extension (MVSE) approach

MVSE is an integrated and holistic extension approach where *community participation* is prioritized for suitable technological interventions in the fisheries to bring all-round development in fisheries sector in terms of *socio-economic upliftment, technological empowerment, self-governance* thereby enhancing the futuristic knowledge base and skills through *participatory framework.* MVSE emphasizes on involvement of all stakeholders in the process to converge their activities with a stake in the food value chain *linking producer to consumer.* Nevertheless, MVSE is an action research taken up in fishers' farm based on the principle of leveraging the activities, investments and resources from outside agencies/

externally aided projects resulting higher productivity, ensuring food security and sustainable improvement in overall quality of life by promoting leadership, self-dependency of the community in food chain. Economically viable, ecologically compatible and socially acceptable suitable technologies are successfully intervened in a cluster approach through participatory mode by integrating the multi-disciplinary research. The cluster of villages is adopted as model village, the success of which is later replicated to other villages. The village is developed as a commodity village branding for a particular commodity in the market.

MVSE approach works on the following principles:

- Promotes self -governance among the fishers
- Skill improvement and leadership development among the fishing community.
- Establishing linkage through pluralistic convergence of various stakeholders associated in the sector.
- Encouraging the market opportunities through commodity-based village development (CBVD).

d. Farmers Field School (FFS) approach

The FFS extension approach is an alternative to the top down extension approach which was evolved as a method to solve complex field level issues in fisheries sectors. FFS aims to build fishers' capacity to analyze their production systems, identify problems, test possible solutions, and eventually encourage the participant member to adopt the practices most suitable to their farming systems (FAO, 2003 c). This is a learning-by-doing approach which emphasizes group observation, discussion, dissection, modification, and promotes field-based experimentation, analysis for collective decision making followed by actions. The FFS approach is an innovative, participatory and interactive learning approach that emphasizes problem solving and discovery-based learning. FFS also provides an opportunity to fishers to practice and evaluate sustainable resource use technologies, and adoption of new technologies by comparing with their conventional technologies developed in congruent with their own tradition, culture and resource use pattern. The goal of FFS approach is such that, after observing and comparing the results of field level experimentation fishers will eventually "own" and adopt improved practices by themselves side-lining the conventional ones without any external compulsion. Field day is being organized at the end of the season to give visibility to the entire activities to convince the non-adopters. Exchange visits with other FFS is also encouraged to learn by association and comparison A group of 20-25 fishers can form a Farm School under the guidance of a FFS facilitator. Extension workers, NGO workers, fishermen co-op members or previously trained fishers can become Farmer Field School (FFS) facilitators. The facilitators are trained by master trainers, who have expertise in the particular subject matter. FFS is a time bound activity usually covering one production cycle or a year.

It is also significant to note that irrespective of the merits of the technology, the acceptance to technologies is influenced by the extension method. Farmer Field School (FFS) model has been accepted as a good methodology because it is exclusively participatory. A special feature of this extension approach was that it reached poor and female-headed households

and lower-caste households much better than the regular extension services (Tiwari et al. 2010). FFS was also found to be effective in avoiding barriers like socio- economic constraints, infrastructure problem and incompatibility of technology for the adoption of sustainable fishery practices.

The basic component of FFS is setting up of a Participatory Comparative Experiment (PCE), commonly referred to as Participatory Technology Development (PTD), whereby the fishers put the FFS concept into practice under close monitoring and supervision by the FFS members. A PCE can be developed in the field of agriculture, livestock, fishery, forestry, agro-forestry, livelihood system and others.

Principles of Farmer Field School (FFS)are as follows: -

- Field is the learning place.
- Emphasizes hands on and discovery-based learning.
- Farmers become experts.
- Integrated and learner defined curriculum.
- Doing is better than learning/ seeing.
- Experiences are the start of all learning.
- Link to actual field situations and should be relevant to local needs and problems.
- Participatory monitoring and evaluation.
- Fishermen are decision makers.

e. Market Led Extension (MLE) approach

In order to make farming more enterprising, extension professionals need to be pro-active beyond the regular objective of maximizing the productivity of the fishers by transferring improved technologies rather fishers should be sensitized on various aspects of farming like culture, harvest, quality, processing and value addition, consumer's preference and market intelligence. This will help the fishing community to realize high returns for the produce, minimize the production costs, and improve the product value and marketability that may lead to realize the concept of doubling farmers' income (DFI). With the globalization of agriculture, emphasis on productivity and profitability to the farm enterprises has been increased and, therefore the demand- driven agriculture (and allied sectors) has led to the paradigm shift from production-led extension to market- led extension. There are many challenges in the agricultural marketing system, which can be resolved through the efforts of market- led extension models.

In this approach, fishers are viewed as 'Fish-entrepreneurs' who expects high returns 'Rupee to Rupee' from his produce by adopting a diverse basket of package of practices suitable to local situations/ farming systems with optimum cost benefit ratio (C:B ratio) ensuring maximum share of profit by exploring the market demand. Goal of market led extension is to facilitate fishers to get better price. Market led extension focuses on harnessing the ICT tools to access market intelligence including likely price trends, demand position, current prices, market practices, communication network, etc. besides production technologies.

For farmers, as the extension system is more credible source of farm technologies, the extension personnel ought to be knowledge- and skill-oriented in relation to production and marketing of agricultural goods. Thus, revamping the extension system will have a catalytic

role for ushering in farmer-led and market-led extension; which can subsequently alleviate poverty and ensure livelihood security. In the light of this, the challenge remains to motivate the extension personnel to learn the new knowledge and skills of marketing before assigning them marketing extension jobs to establish their credibility and facilitate significant profits for the fishing community. SWOT analysis of the market, Organization of Farmers' Interest Groups (FIGs), capacity development, establishing linkage and synergy, harnessing ICTs, digital marketing etc are the competencies required by the extension personnel in order to effectively implement market led extension.

f. Digital Extension approach

Extension reforms brought a transformation in fishery extension system through introduction of Information and Communication Technologies (ICTs). The ICT-enabled extension system referred to as Digital Extension has the potential for enabling the empowerment of fishing communities by improving their access to information and sharing knowledge with innovative e-agriculture initiatives (Saravanan, 2010a).

With the phenomenal growth in information and communication technology, use of IT application in agriculture will bring remarkable change in the attitude and knowledge level of user. Basic requirement is to provide most appropriate information in such a capsule that can be easily understood and used by them. This approach will strengthen the extension system for better dissemination of technology. As a case study the contribution of Digital Green, a NGO that uses an innovative digital platform for community engagement to improve lives of rural communities across South Asia and Sub-Saharan Africa is remarkable. Digital Green associate with local public, private and civil society organizations to share knowledge on improved farmers practices, livelihoods, health, and nutrition, using locally produced videos and human mediated dissemination. As per the study, the Digital Green project (participatory digital video for agricultural extension) increased the adoption of certain farm practices seven times higher compared to traditional extension services and the approach was found to be 10 times more cost-effective per dollar spent. Hence, along with ICT-based advisory services, input supply and technology testing need to be integrated for greater impact and content aggregation from different sources require to be sorted in granular format and customized in local language for rapid adoption of technologies (Balaji et al., 2007&Glendenning and Ficarelli, 2011).

The effectiveness of this innovative extension approach depends on capacity building, people's participation along with government initiative to provide strong infrastructure to be worked with the cutting-edge technologies. The farmer friendly technology dissemination process needs to be handled with careful planning by the incorporation of information communication technology. The use of ICT application can enhance opportunities to touch the remote farmers to live in close proximity of the scientific input. The computer based web portals namely aAQUA, KISSAN Kerala, TNAU AGRITECH Portal, AGRISNET, DACNET, e-Krishi, ASHA, India Development Gateway (InDG) portal, Rice Knowledge Management Portal (RKMP), Agropedia, KIRAN, AGMARKNET, ITC-e-Choupal, Indiancommodities.com, Mahindra Kisan Mitra, IFFCO Agri-Portal, Agrowatch Portal,

iKissan, etc. along with some mobile based Apps like mKRISHI® Fisheries, riceXpert, Pusa Krishi, Krishikosh, m4agriNEI CIFT Lab Test, CIFTraining etc. launched in India are some of the successful digital intervention for technology dissemination.

The use of internet, mobile and video- conferencing assists the IT enabled farmers to utilize the facilities for their favors for which the most suitable permanent infrastructure is the basic requirement. Strong linkages need to be established between direct ICT interventions and it should be part of the national level program on holistic agricultural development.

g. Disruptive Extension approach:

Recently, a new extension approach christened as 'disruptive extension' comes into limelight which is considered as an innovative extension approach that creates a new paradigm of extension that eventually disrupts an existing approach followed by extension professionals in the field of agriculture and allied sectors. It is an entrepreneurial oriented sustainable extension system that can able to transform every link in the food chain, from farm to fork. It is a cost-recovery extension approach the fulcrum of which lies between resource exploitation on one side and resource conservation on another side that influence the livelihood security and technology sustainability for small scale farm holders. It deals with the following principles:

- Importance of good governance in agriculture (and allied fields) that considers the resource rights of the farmers.
- Emphasis on growing interest among the stakeholders by explicit analysis of field level issues for technology adoption.
- Potential to resolve the social conflicts for equal access to community resources through Memorandum of Understanding (MOU).
- Based on cost recovery mechanism.
- Ensure commitment to optimum resource management and maximum economic benefit to improve food security.
- Provision of community based social insurance.
- Maintaining the sustenance of the technology supports through custom hiring approach.
- Focus on pluralistic convergence of different partners to build a network of linkage with various entities around the farm households.
- Encouraging the farmers-scientist interaction for technology development, assessment and application through Farmers' FIRST approach.

Global agriculture embraces diverse actors in its endeavour to feed about 10 billion people in the planet by the end of 2050. The small, marginal & landless farmers are extremely vital for food security due to shrinking of resource day by day. The contribution of women fishers also cannot be ignored particularly in on-farm operations, harvesting, post-harvest management, processing etc., especially in fishery and animal husbandry sector. Hence, in today's scenario innovation in agriculture extension is the key to address the growing challenges, which need to be validated, integrated and scaled up and further recommended for large scale implementation by the policy makers. The innovative extension approach should be based on capacity building, skill development, people's participation along with

government initiative to provide policy support to be worked with the cutting-edge technologies. Much effort has been initiated in going beyond the farm and the fishers and focus on beyond the technology to a wider innovation system.

References:

Aiyar, Swaminathan S and Rajghatt C 2006. Delhi. Special report on 'End of Poverty?' Sunday Times of India, p8.

Allison E., Delaporte, A., & Hellebrandt de Silva D.2012. Integrating fisheries management and aquaculture development with food security and livelihoods for the poor. Report submitted to the Rockefeller Foundation, School of International Development, University of East Anglia Norwich,124 p.

Allison EH (2011) Aquaculture, Fisheries, Poverty and Food Security. Working Paper 2011-65 (The WorldFish Center, Penang, Maylasia).

Allison, E.H. 2011. Aquaculture, fisheries, poverty and food security. Working Paper 2011-65, Penang: World Fish Center, 62 p.

Allison, E.H., Delaporte, A. & Hellebrandt de Silva, D. 2013. *Integrating fisheries management and aquaculture development with food security and livelihoods for the poor*. Report submitted to the Rockefeller Foundation, School of International Development, University of East Anglia Norwich, UK. 124 p.

Bailey, C., and S. Jentoft, 1990. Hard choices in fisheries development. Marine Policy, p333-344.

Ben Belton, Shakuntala Haraksingh Thilsted, 2014. Fisheries in transition: Food and nutrition security implications for the global South. Global Food Security, 3(2014), 59–66.

Béné *et al.* (2014) Béné, C, Arthur, R, Little, D C, Norbury, H, Leschen, W, Allison, E, Beveridge, M, Bush, S, Campling, L, Squires, D, Thilsted, S, Troell, M & Williams, M. 2015. How are fisheries, aquaculture, food security and development linked? Assessing evidence through a scoping review.

Beveridge, M C M, Thilsted, S H, Phillips, M J, Metian, M, Troell, M & Hall, S J. 2013. Meeting the food and nutrition needs of the poor: the role of fish and the opportunities and challenges emerging from the rise of aquaculture. *Journal of Fish Biology* 83, 1067-1084. doi:10.1111/jfb.12187.

Beverton, R.J.H., and S.J. Holt, 1957. On the Dynamics of Exploited Fish Populations. Fisheries Investigation (Min. Agric. Fish. Food UK) Series 2, No. 19, 533pp.

Caddy, J.F., and R.C. Griffiths, 1995. Living marine resources and their sustainable development. Some environmental and institutional perspectives. FAO Fisheries Technical Paper, Vol. 353, 174pp.

Dyck AJ, Sumaila UR (2010) Economic impact of ocean fish populations in the global fishery. J Bioeconomics 12:227–243.

FAO 1995. Code of Conduct for Responsible Fisheries. FAO: Rome. 41pp.

FAO. 2014a. The State of World Fisheries and Aquaculture 2014. Rome. 223 p.

FAO. 2014b. Securing sustainable small-scale fisheries: update on the development of the Voluntary Guidelines *for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines).* COFI/ 2014/3. (http://www.fao.org/cofi/23150-0423411126421a3feb059f7c1a6e5e92c.pdf

FAO/WorldFish/World Bank. 2008. Small-scale capture fisheries: a global overview with emphasis on developing countries. A Preliminary report of the Big Numbers Project. 64 p.

Fishing for a Future (2013a), Fishing for a Future. 2013a. *The Future of Demand*. FFAF Briefing Paper 5. Penang, Malaysia. WorldFish. pp. 12. http://www.fishingfuture.org/resources/05-the-future-of-demand/.

Fishing for a Future. 2013b. *Meeting Needs*. FFAF Briefing Paper 6. Penang, Malaysia. WorldFish. pp. 12. http://www.fishingfuture.org/resources/06-meeting-needs/. 25 FAO 2012. *The State of World Fisheries and Aquaculture 2010*. Rome, FAO.

Garcia, S., Allison, E.H, Andrew, N., Béné, C., Bianchi, G., de Graaf, G., Kalikoski, D., Mahon, R. & Orensanz, J.M. 2008. Towards integrated assessment and advice in small-scale fisheries: principles and processes. *FAO Fisheries and Aquaculture Technical Paper*. No.515. Rome, FAO. 84 p. (ftp://ftp.fao.org/docrep/fao/011/i0326e/i0326e.pdf).

Graham, M., 1935. Modern theory of exploiting a fishery and application to North Sea trawling. Journal du Conseil International pour l'Exploration de la Mer, 10, p264-274.

Gulland, J.A., 1983. Fish Stock Assessment. A Manual of Basic Methods. John Wiley & Sons: Chichester, UK.223 pp.

Hersoug, B., 1996. Social considerations in fisheries planning and management - real objectives or a defence of the status quo. p19-24. In Fisheries Management in Crisis, ed. by K. Crean and D. Symes. Fishing News Books: London, UK. 222pp.

HLPE, 2014. Sustainable fisheries and aquaculture for food security and nutrition. A report by the High-Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome 2014.

HLPE. 2014. *Food losses and waste in the context of sustainable food systems*. A report by the High Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.

http://www.fao.org/agriculture/ippm/programme/ffs-approach/en/

Kearney, J. 2010. Food consumption trends and drivers. *Philosophical Transactions of the Royal Society of London B* 365, 2793-2807.

Kent, G., 1987. Fish, Food and Hunger: The Potential of Fisheries for Alleviating Malnutrition. West View Press, Colorado, USA.

Kurien, J & López Riós, J. 2013. *Flavouring Fish into Food Security*. Report/Rapport: SF-FAO/2013/14. August/Aout 2013. FAO-SmartFish Programme of the Indian Ocean Commission,

Ebene, Mauritius.

Leroy, J.L.,Frongillo,E.A.,2007.Can interventions to promote animal production ameliorate under nutrition? J.Nutr.137,2311–2316.

McGoodwin, J.R. 2001. Understanding the cultures of fishing communities: a key to fisheries management and food security. *FAO Fisheries Technical Paper*. No. 401. Rome, FAO. 287 p.

Merino, G, Barange, M, Blanchard, J L, Harle, J, Holmes, R, Allen, I, Allison, E H, Badjeck, M C, Dulvy, N K & Holt, J. 2012. Can marine fisheries and aquaculture meet fish demand from a growing human population in a changing climate? *Global Environmental Change* 22,795-806.

Mruthyunjaya et.al., 2004. ICAR-ICLARM Project Report on Strategies and Options for Increasing and Sustaining Fisheries and Aquaculture Production to Benefit Poor Households in India, 2004. NCAP, New Delhi and WFC, Malaysia.

Pollnac, R.B, Pomeroy, R. & Harkes, I. 2001. Fishery policy and job satisfaction in three southeast Asian fisheries. *Ocean and Coastal Management*, 44(7-8): 531–544.

Pollnac, R.B. & Poggie, J.J. 2008. Happiness, well-being and psychocultural adaptation to the stresses associated with marine fishing. *Human Ecology Review*, 15(2): 194–200.

Richards, W.J. and J.A. Bohnsack, 1990. The Caribbean Sea. A large marine ecosystem in crisis. p44-53 In Large Marine Ecosystems. Patterns Processes and Yields, ed. by K. Sherman, L.M. Alexander, and B.D. Gold. American Association for the advancement of science: Washington, USA. 242 pp.

Robert Arthur, Chris Béné, William Leschen and David Little, 2013. Report on Fisheries and aquaculture and their potential roles in development: an assessment of the current evidence. Funded by the UK-Department for International Development, Research and Evidence Division.

Saravanan R and Devi I. 2008. E-ARIK. ICTS for promoting livelihood security among tribal farmers of North-East India. Compendium International seminar on strategies for improving livelihood security of rural poor. Sept 24-27, 2008 INSOEE, Nagpur, p94.

Sethi, Reena C. and Sharma Renu B.2011. Effective extension approaches for sustainable agricultural development. *International Journal of Farm Sciences* 2(1): 116-123, 2011

Singh B. 2008. 'Livelihood security need for cohesive strategy'. Compendium International Seminar on Strategies for Improving Livelihood Security of Rural Poor. Sept. 24-27, 2008 INSOEE, Nagpur, pp73-74.

Smith, C.L. & Clay, P.M. 2010. Measuring subjective and objective well-being: analyses from five marine commercial fisheries. *Human Organization*, 69(2): 158–168.

Sreekanth, G. B., Tincy Varghese, Mishal P., Sandeep K. P., Praveen, K. V., 2013. Food Security in India: *Is Aquaculture a Solution in the Offing?* International Journal of Science and Research (IJSR), Volume 4 Issue 3, March 2015, pp.553-560.

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? In R.P. Subasinghe, J.R. Arthur, D.M. Bartley, S.S. De Silva, M. Halwart, N. Hishamunda, C.V. Mohan & P. Sorgeloos, eds. Farming the Waters for People and Food. Proceedings of the Global Conference on Aquaculture 2010, Phuket, Thailand. 22–25 September 2010. pp. 705–717. FAO, Rome and NACA, Bangkok.

Susan Singh-Renton, 2016. Introduction to the Sustainable Development Concept in Fisheries

Symes, D., 1996. Fishing in troubled waters. p3-16. In Fisheries Management In Crisis, ed. by K. Crean and D. Symes. Fishing News Books: London, UK. 222pp.

Tacon, A G J & Metian, M. 2013. Fish matters: importance of aquatic foods in human nutrition and global food supply. *Reviews in Fish and Fisheries* 21, 22-38.

Tacon, A.G.J., Metian,M., 2013. Fish matters: Importance of aquatic foods in human nutrition and global food supply.Rev.Fish.Sci.21(1),22–38.

Thilsted, S.H., 2013.Fish diversity and fish consumption in Bangladesh. In:Fanzo,J., Hunter, D.,Borelli,T.,Mattei,F.(Eds.), Diversifying Food and Diets: Using Agricultural Biodiversity to Improve Nutrition and Health. Earthscan,London.

Waite, R, Beveridge, M C M, Brummett, R, Castine, S, Chaiyawannakarn, N, Kaushik, S, Mungkung, R, Nawapakpilai, S & Phillips, M. 2014. *Improving Productivity and Environmental Performance of Aquaculture*. Installment 5, Creating a Sustainable Food Future. Washington D C, World Resources Institute. pp. 60. http://bit.ly/1hinFaL.

Walsh B (July 7, 2011) The end of the line. Time, pp 28–36.

World Bank 2013. *Fish to 2030: Prospects for Fisheries and Aquaculture*. Washington, World Bank. pp. 102.

World Bank, 2006. Aquaculture: Changing the Face of the Waters: Meeting the Promise and Challenge of Sustainable Aquaculture. World Bank, Washington, DC.

World Bank, 2011, The Global Program on Fisheries Strategic Vision for Fisheries and Aquaculture, http://siteresources.worldbank.org/EXTARD/Resources/336681224775570533/2011StrategicVision.pdf .

World Bank/FAO/WorldFish. 2012. *Hidden harvest: the global contribution of capture fisheries*. World Bank Report No. 66469-GLB, Washington, DC. 69 p. www.fao.org/docrep/016/i2561e/i2561e01.pdf