Chapter 2

Innovative Extension Approaches for Sustainable Fisheries

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Importance of global fisheries

Global fisheries have made rapid strides in recent years by establishing its strong hold over increasing food supply, generating job opportunities, raising nutritional level and earning foreign exchanges. These accomplishmentshave become more important when considered in the context of recent challenges in food production, nutritional security, social changes and growing climatic hazards. Fish and fishery products are the most traded food commodities in the world accounting for 1% of world merchandise tradein value terms representing more than 9% of total agricultural exports all over world (FAO, 2014). About 38% of the global fish production enters international trade in various forms and shapesaccounting for export earning of nearly US$148.1billion with a record import at US$140.6 billionduring 2014. The value of the global fish trade exceeds the value of international trade in all other animal proteins combined. Mostly the developing countries that account for over 60% of global fish catch, which is continued to expand at an average annual rate of 8.8%(FAO, 2009 & 2012),play a major role in the global trade of fish and fish products; about 50% of all fishery exports in value terms and more than 60% in quantity terms are supplied by them (World Bank 2011). At the same time, demand for fish products are likely to rise as a result of rising populations that are expected to reach 9.3 billion by 2050. Furthermore, developing countries now display a positive trade balance due to their increasing involvement in global fisheries trade.Developing country like Indiamay have higher proportion of population growth but it's impressive economic growth over the past two decades has resulted in steady increase in per capita income in real terms that in turn increases the purchasing power of people resulting in increasing demand for food to feed & ensure nutritional security of the population. As a result of which it brought inconsistency in fish consumption pattern across the coastal, marine and hill region.

It is estimated that fish production generally contributes 0.5 – 2.5 % of GDP globally (Allison 2011). In spite of that globally an estimated more than 1.3 billion people are in extreme poverty (2016), 795 million people (2015-16) are estimated to be chronically hungry and an estimated one third of children in the developing world under five years of age are stunted (Conway 2012). Fish is considered as the most affordable and frequently consumed animal-source food in low income food deficit countries in sub-Saharan Africa, Latin America and Asia (World Bank,2006) , which is an important source of a wide range of intrinsic micronutrients, minerals and fatty acids. It accounts for about 17 % of most affordable, easily digestible, high-quality animal protein and 6.7 % of all protein, all essential amino acids, essential fats (e.g. omega-3 fatty acids), vitamins and

mineralsthus contributing to a great extent to food and nutrition security in many Asian and African countries where large numbers of people are still under starvation and under nourished (Kent,1987). Besides small-sized fish species are excellent source of many essential minerals such as iodine, selenium, zinc, iron, calcium, phosphorus, potassium, and vitamins such as A, D and B. About 150 g of fish provides about 50–60 % of daily protein requirements for an adult. On an average, fish provides about 20–30 kilocalories per person per day. In addition, dietary diversity of the region is mainly influenced by different quantitative and qualitative attributes viz., income, price, preference, market, type and quality of products, cultural traditions, beliefs as well as various geographical, environmental, social and economic factors that influences the fish consumption pattern.

Despite the important contributions by the sunrise sector, global debates on fisheries issues and policies appear to be dominated by concerns over environmental sustainability, overfishing and overcapacity. In this context, it is alarming to note that the sector did not receive adequate attention from the social scientists to understand its various socio-economic dynamics to prove the sunrise sector fisheries as a potential driver of local and national economic development.

Major concerns in fisheries

Food security has become the prime concern with the increasing trend of population growth in a country. Over the last fifty years, the food grain production in India has increased considerably, but the advantage of this increase in foodgrain production has not beenreflected in the percapita availability of food grains. As per estimate, the human population and food grain production in India was grown up by 2.09% and 2.36%, respectively from 1961 to 2011, whereas the annual per capita availability of food grains was come down from 171.1 kg in 1961 to a level of 169 kg in 2011 showing a decreasing trend of 1.17 %. In case of fish, Asia accounts for almost two-thirds of global fish consumption i.e. 21.4 kg per capita in 2011 – a level similar to Europe (22.0 kg/cap/yr) and North America (21.7 kg/cap/yr), and close to the levels of Oceania (25.1 kg/cap/yr). Africa, Latin America and Near-East have lowest per-capita consumption (10.4, 9.9 and 9.3 kg/cap/yr in 2011, respectively). Although annual per capita apparent consumption of fish products has grown steadily in developing regions (from 5.2 kg in 1961 to 17.9 kg in 2011) and in LIFDCs (4.4 kg in 1961 to 8.6 kg in 2011), it is still considerably lower than in developed regions (from 17.1 kg in 1961 to 23.0 kg in 2011). It is clearly evident that rising population is nullifying the effect of growth in food grain production, keeping aside several other factors which determine the access to food grains.In this context, increasing fish production to meet the challenges of nutritional security has drawn the attention of the planners and policy makers. In this context, aquaculture is considered as a promising food production sector for high quality protein food and providing livelihood to the rural populace. Hence, it is essential to make it more efficient and cost-effective. However, there is multitude of challenges associated with the growth of this industry.

The fishery sector is a major foreign exchange earner for any developing countries. In India, its foreign exchange earnings were estimated to increase by 16 to 20 per cent by 2005 and 26 to 42 per cent by 2015. In view of higher production in fisheries, producers may lose from price fall in the domestic market; where prices were estimated to

fall by 15 to 20 per cent by 2005 and 27 to 54 per cent by 2015. Nearly 85 per cent of the export benefits are projected from shrimp export alone. Because of its potential and rich source of animal protein, fish demand has been rising in both the developed and developing world at more than 2.5 percent per year (Peterson and Fronc, 2007) and demand levels were raised in proportion to increase in income in highly populated countries like China and India, (Garcia and Rosenberg, 2010).In spite of the phenomenal success of the sector, still there are concerns for the economic and nutritional conditions of fisher folk in addition to some important concerns in the context of rising environmental hazards, depressing prices world over, emerging new economic order following establishment of WTO, IPR & SPS issues, compliance of several multilateral agreements, etc.

In the post- harvest front, the processing industries used to face the problems of 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 reduce the livelihood opportunities of small scale dry fish processors, petty traders within the communities and poor fishermen.

Environmental degradation poses a challenge to the phenomenal success of the fishery sector in promoting food security and adversely creates impact on nutritional rights and livelihood of the fishermen communities for whom fish and fishery products are critical to health and wellbeing. As per directives of international conventions like Kyoto Declaration and Code of Conduct of Responsible Fisheries, this trade-driven, resource depletion sector can be sustained through by-catch reduction and ban on juvenile fishing. The benefit of this may be accrued through policy level intervention by institutions within the legal framework.

Small-scale fisheries are normally characterized by low capital input activities, low capital investments and lack of equipment, 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. They are unorganized with least social security benefits. The informal social security system in the form of sharing of earnings for the community and social organizations prevailing in the traditional fishing is absent in the mechanized fishing. There are also huge regional variations in productivity.

Technologies are the main drivers of growth. Hence, systematic technological interventions backed by adequate 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. Following strategies have been suggested for an accelerated fishery development with 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
- Innovate and strengthen institutions and policies
- Upgrade the skills of the fishers
- 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
- Monitoring the technology demonstrations programs and assess the impacts.
- Strengthen database and share it for a better planning and policy making inthe 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 sector provides employment and livelihood to majority of the rural households, but the condition of both farmers and farming is in alarming state.

Agriculture stands on the very complex interaction between biological, climatic and geographical factors in addition to human activities. The information under such a complicated system is unpredictable, unstable, subjective, site specific and reliant on empirical decision given the inherent variability of biological phenomena. In spite of nation's priorities and developmental strategies for reducing poverty, hunger and ensuring quality of life to its people, we are still lagging behind in human development index as expected. People particularly small, marginal and landless farm households are still far from the reach of good education, nutrient nourished diet, better health care facilities and modern age amenities.

Hence, there is an urgent need to reform agriculture inholistic, scientific and systems approach to meet the present day challenges in agriculture due to climate change and global competitiveness so as to achieve sustainable agriculture production and growth under different agro-climatic conditions.

In agricultural parlance, sustainability means maintaining the crop productivity without enhancing input levels. Sustainable agriculture is a form of agriculture aimed at meeting the needs of the present generation without endangering the resource base of the future generations. According to the concept laid by the Technical Advisory Committee (TAC) of the Consultative Group on International Agricultural Research (CGIAR)

“Sustainable agriculture is the successful management of resources for agriculture to satisfy the changing human needs, while maintaining or enhancing the quality of environment, and conserving natural resources”. 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 required technology along with strong linkage between research-extension system and vice versa. It involves design and management procedures that work with natural processes to conserve all resources, promote agro-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 agricultural system cannot be ignored. Strong extension system is the key to the desired change to meet the present day challenges in agriculture. Basically the end product of the extension system is to work with farmers within a climate and economic environment by providing suitable technologies to widen their horizon, enriching knowledge and upgrade skills to improve better handling of natural farm resources and applying scientific production technologies to achieve desired production level. Extension system plays a pivotal role in empowering farmers and other partners to make it more farmers’ participatory, demand-driven, knowledge oriented and skill supportive for disseminating most appropriate technical, management and marketing skill to improve profitability in agriculture 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 ecological and livelihood security. The extension system needs to disseminate a broad array of information starting from seed to seed, field to fork in an integrated manner for safe delivery from field to the consumer concerning 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 farmers would give emphasis on commercialization of high value products, maintenance of quality control, fulfilling market demands, cost effectiveness etc. thus economic indicators become theme to the program planning process for the effectiveness of any programme.

With the advent of global competitiveness and market liberalization, our prevailing extension system has to be strengthened with innovative extension approaches to tacklethe recent challenges in agriculture viz., climate change and weather aberrations, dwindling resources and population stress, so that farmers can adjust their production portfolio keeping eye upon the emerging trends in food consumerism in domestic as well as global markets. Grooming farmers with information supportfor taking right decision to improve their production in agriculture and allied fieldsessentially requires a strong network of extension systems, along with government initiatives and strong linkage among extension scientists and functionaries working for agricultural development. This would ensure the livelihood security of millions of farmers by improvingthe quality

production and creating of better job opportunities in rural areas,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

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, farmers' 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 of agricultural technology design and integration is drawing attention of the extension professionals and practitioners across the globe. In India, different models for transfer of farm technology have been tested and also robust extension education approaches have been validated. Furthermore, the frontline extension system of the country has been sharpened through more farmer-centric approaches for technology adaptation and dissemination. The extension system in India has been designed to move beyond technology and beyond commodity through ensured reciprocal farmer-research-extension linkages. Farm producers located at far-off and those unreached still suffer from lack of access to appropriate services like credit, inputs, market, extension, technologies etc. Keeping eye upon this, the World Development Report had focused on need to restructure and revamp agricultural extension system as a pivot for realizing the growth potential of farm sector against the widening demand–supply pressures for ensuring sustainable, inclusive, and pro-poor agricultural and economic development. Therefore, farmer's participatory technology development and client's participatory extension approaches emerged as a part of integration ofthe 'interdependence model' and the 'innovation systems framework' that offered more inclusive ways of involving the institution in technology generation, diffusion and use of new knowledge. 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 approachesoriginating from multiple sources must be adopted on trial basis to make agriculture more profitable to provide food, nutrition and livelihood security to farmers, which can be replicated in the fishery sector interwoven with numerous issues including increased production with sustained natural resources, growing market demand for processed products having entrepreneurial opportunities, protection and conservation of environment, and even 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 farmer-oriented

approaches to 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) approachintends 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 agriculture, 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 through variety of different agricultural and non-agricultural 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 farmers need different types of RAS support. The large 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 farmers. In this direction, innovative strategies are being formulated keeping the farmers' 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 farmers 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, 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 family farmers, 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 was prioritized for suitable technological interventions in the farmers' field to bring all round development in agriculture and allied sectors in the community in terms of socio-economic upliftment, technological empowerment, self-governancethereby

enhancing the futuristic knowledge base and skills through participatory framework. MVSE emphasized oninvolvement 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 farmers' field 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 were successfully intervened in farmers' field in a cluster adopted as model village through participatory mode by integrating the multi-disciplinary research which was later replicated to other villages. The village was 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 farmers
- Skill improvement and leadership development among the community members.
- Establishing linkage through pluralistic convergence of different stakeholders associated in the sector.
- Encouraging the market opportunities through commodity based village development.

d**. Farmers Field School (FFS) approach**

This extension approach is an alternative to the top down extension approach which was evolved as a method to solve complex field level issues in agriculture and allied sectors. The FFS approach is an innovative, participatory and interactive learning approach that emphasizes problem solving and discovery based learning. FFS also provides an opportunity for farmers to practice and evaluate sustainable land use technologies, and introduce new technologies by comparing with their conventional technologies developed in congruent with their own tradition, culture and resource use pattern.FFS, considered as a farmer-to-farmer extension approach, aims to build farmers' capacity to analyze their production systems, identify problems, test possible solutions, and eventually encourage the participants 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 goal of the approach is such that, after observing and comparing the results of field level experimentation farmers will eventually "own" and adopt improved practices by themselves 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 farmers can form a farm school under the guidance of a FFS facilitator. Extension workers, NGO workers, farmer organization staff or previously trained farmers can become Farmer Field School 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, farmers' acceptance to them is influenced by the extension method. Farmer Field School (FFS) model has been accepted as a good methodology because it is exclusively participatory. A comparison was made between a 6-year participatory seed selection and multiplication project in Nepal and a 3-year seed distribution relief program in Zimbabwe. The study revealed that the project in Nepal was successful in its scaling up and continuity as the new varieties of crops increased yields by about 45% and improved stability in household food access. In contrast, only 12% of the beneficiaries in Zimbabwe decided to reuse and plant the open pollinated maize varieties the following year because the new varieties were not properly appreciated by the farmers because they had not received sufficient information and training on seed selection (Ministry of Foreign Affairs of the Netherlands, Policy and Operations Evaluation Department 2011).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). Other barriers to the adoption of sustainable agriculture practices include social barriers, infrastructure, and incompatibility of technology.

The basic component of FFS is setting up of a Participatory Comparative Experiment (PCE), commonly referred to as Participatory Technology Development (PTD), whereby the farmers 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, livelihoodsystem 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.
- Farmers are decisionmakers.

e. Market led extension approach

In order to make agriculture more enterprising, extension professionals need to be pro-active beyond the regular objective of maximizing the productivity of the farmers/producers by transferring improved technologies rather farmers should be sensitized on various aspects of produce like quality, consumer's preference, market intelligence, processing and value addition and other marketing information.This will help the farming 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.With the globalization of agriculture, emphasis on productivity and profitability to the farm enterprises 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 farmer/producer is viewed as an 'Agripreneur' who expects high returns 'Rupee to Rupee' from his produce by adopting a diverse baskets 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 farmers to get. 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 farming 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 agricultural extension system through introduction of Information and Communication Technologies (ICTs). The ICT-enabled extension systemreferred to as Digital Extension has the potential for enabling theempowerment of farming communitiesby improving their access to information and sharing knowledgewith 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 acase 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 agricultural 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 agriculture 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 likemKRISHI® Fisheries, riceXpert, Pusa Krishi, Krishikosh, m4agriNEI 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 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 farmers 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 on capacity building, people's participation along with government initiative to provide strong infrastructure to be worked with the modern age technologies. Much effort has been initiated in going beyond the farm and the farmer, and focus on beyond a technology to the 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.

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.

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

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).

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.

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.

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