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TECHNOLOGY INFORMATION FLOW IN COASTAL AQUACULTURE AND INTEGRATING INFORMATION CHANNELS FOR AN EFFECTIVE EXTENSION SERVICE

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1. Introduction

India is endowed with 1.2 million ha of brackishwater resource potential along the coastal lines. Since time immemorial the coastal families practiced the 'trap and rear' system of aquaculture as a livelihood activity. Due to the scientific advancements in breeding and development of hatchery technology for seed production,coupled with the promotional policies of the government, the present day commercial shrimp aquaculture came into operation. Coastal aquaculture in India is identical with shrimp farming till today. Shrimp farming has been a significant agro-based economic activity (Islam and Braden, 2006)and contributes significantly towards enhancing fish production, employment generation, economic advancement of aqua farmers, rural development and national economy to the tune of Rs.22,000 crores (MPEDA, 2015). Shrimp farming is being practised in different production systems,ranging from traditional to high-tech biofloc based intensive culture systems. Similarly, after the introduction of pacific white shrimp (*Penaeus vannamei*) in 2010 and its adaptability to low saline waters, it is being extensively farmed in low saline areas also.Shrimp farming is a high investment and technology intensive production systemand requires information pertaining to system specific production technology, sourcing quality inputs, services and market intelligence constantly at every stage of farming. Other than monoculture of shrimp, polyculture of finfishes and shellfishes is being practised in traditional "Bheries" of West Bengal and "Pokkali" fields of Kerala. The information requirements of traditional systems are different, mostly on species combination and integration with crops and livestock production systems.

Finfish farming, especially farming of seabass (*Lates calcarifer*), pearlspot (*Etroplus suratensis*) and milk fish (*Chanos chanos*) are being attempted on a limited scale, depending on the seed availability and market. Similarly, mudcrab fattening is also taken up as a livelihood activity, wherever seed material is available. Nevertheless, there is a scope for up-scaling of finfish and crab farming technology, with the intervention of nursery rearing phases. However, it requires capacity development, motivation, on-farm trials and field demonstrations. The information and skills required for addressing system specific issues are with research institutions which need to be linked or integrated for sharing and refinement. Aquafarmers require precise information in time because they need to adopt better management practices to provide most favourable pond environment for the delicate shrimp/fish being reared. Therefore, they should have access to quality information, inputs and service to take correct decisions. Further, aquafarmers need capacity enhancement in entrepreneurship skills to plan their farming schedules vis-a vis the market and input availability, source quality inputs and services, develop diagnostic and interventional capacities, be in constant touch with technical people, manage the farm without any production risks, learn from own experiences and of others, and devise suitable marketing strategy to secure reasonable profit. In a nutshell, they need quality information in time and skill development. Aquaculture extension agencies are expected to provide the critical access to the knowledge, information and technology that farmers require to improve their farm productivity and advance their economic status.

2. Fisheries Extension Service-the Present Scenario

Fisheries extension service aims to bring out desirable changes in the behavioral patterns of aquafarmers through conscious capacity building initiatives and facilitate them to access the required inputs and services to enhance their farm income which lead to their socio-economic prosperity. Effective extension services have contributed for the increased aquaculture production (Wang, 2001) in the South-East Asian countries and it could make the aquaculture sector contribute much more for the economic development of rural fish farmers (Tu and Giang, 2002; Brummett and Pouomogne, 2004; Maguswi *et al.*, 2004; Omoyeni and Yisa, 2005; Udo *et al.,* 2005). In any farm production milieu, the farmer is the pivot around whom the other inputs, services and market operate. The extension agent is the link pin expected to facilitate the farmers access to quality inputs, machinery, technical advice, institutional credit, better price and mobilise them for the collective compliance of better management practices. The Coastal Aquaculture Authority Act (2006), while articulating the importance of aquaculture extension, emphasized that extension function need to be strengthened to create awareness, improve the technical knowledge and skills of the aquafarmers, fisheries personnel, extension workers, aquaculturists and all those involved in planning and operation of sustainable aquaculture. Aquaculture extension services initially aimed at increasing aquaculture production through horizontal expansion and adoption of scientific production techniques. However, today it needs to additionally focus towards addressing issues of quality, market intelligence, food safety, traceability,

value addition, species diversification, poverty alleviation, livelihood security and so on as per the sector demands from time to time. Fisheries and aquaculture being the State subject, the states have the major responsibility in providing this key support. Moreover, there are other agencies that are also in the fore front in extending technical advisory services to the farmers. The streams which offer extension services in coastal aquaculture are presented in the Table 1.

3. Technology Information Flow in Coastal Aquaculture

The scenario of technology information flow in coastal aquaculture milieu can be ascertained by scanning the information source usage pattern of farmers, extension workers and research-extension linkage perception of the researchers.

The information sources of aqua farmers were studied based on a farm survey of a random sample of 1200 brackishwater aqua farmers from the coastal states of Andhra Pradesh, Tamil Nadu, Odhisa and Gujarat. About 80% of the samples were from Andhra Pradesh and Tamil Nadu and the remaining 20% were from Odhisa and Gujarat. The information seeking behaviour of extension workers was studied with a purposive sample of 60 extension personnel representing the states of Andhra Pradesh and Tamil Nadu. The linkage between extension workers and researchers was studied with a sample of 60 researchers from these two states. The primary data were collected mainly through personal interview using structured questionnaires. Focus group discussions were held with farmers as a group in each state to consolidate and triangulate the results.

4. Information Sources of Aquafarmers

The information sources consulted by the aqua farming community depicted in Fig.1 shows that 90% of aquafarmersdepended on private extension sources (input companies and aqua-consultants) for information. Aqua feed companies who dominated the input supplies have employed subject matter personnel to approach farmers to market their product. They visited their client farmers at least once a week and provided technical counselling on the farming practices. They were accessible for any problem at any time through mobile phones. Similarly, independent aqua-professionals who are qualified fisheries/ biology graduates, having rich experience in the field and earned the trust of the farmers were the potential private extension service providers. Most of them were fisheries graduates or post graduates in Zoology/Marine Biology/Aquaculture and few of them even doctorate holders. They operated as full time farm consultants, some were having own farms and some of them provided analytical services like testing of soil and water, and supply of seed and other inputs, in addition to farm consultancy. Though profit making was underlined in their services, these consultants work for the sustainability and continued farming by their client farmers which are indispensable for their survival. Due to these reasons the private extension personnel were perceived as a key source of information for the farmers. Fellow farmers were the sources of information for triangulation and

Table 1. Aquaculture extension service providers and their services

Streams	Activities and services offered	Perception of the end users
A. Public Funded Services (MoA, DoF, MPEDA,FC & RI, ICAR) • Coastal Aquaculture Authority • Departments of Fisheriesof States/UTs • ICAR Research Institutes • KVKs • SAUs/Fisheries Colleges& Research Institutions • MPEDA-NaCSA	• Information on registered hatcheries and status of broodstock import • Usage of drugs in aquaculture • Policies/Guidelines/ regulations • Capacity building • Diagnostic/technical service • Technology validation • Technology up scaling • Mobilising farmers • Traceability/food safety • Printed materials invernacular languages • Programmes through Radio and TV • ICT aided information delivery	• Poor access • Frequency of contact is occasional to rare • Information provided is general in nature • Mostly confined to implementing regulations • Mostly welfare activities • Insufficient manpower and budget • Less effective
B. Private Services (Input companies, Aqua Consultants) • Professional Aqua Consultants/Firms • Para Consultants/ Farm Technicians • Inputs Dealers (Hatchery, Feed, etc.)	• Inputs- seed, feed, etc. • Technical advice • Market intelligence • Technology upscaling	• 24 x 7 Easy access • Farm specific reliable information • Personal face to face contact young and energetic • Updated • Efficient • Profit motive
C. Third Party Services • Progressive farmers/ • Farmergroups/ Associations • Corporate groups like AISHA • Pressure groups - Society of Aquaculture Professionals	• Collective compliance of BMPs • Common crop calendar • Sourcing of quality inputs • Sharing of information • Technology advancement	• Most preferred • Limited information • 24 x 7 Easy access • Personal face to face contact • Cross checking the information obtained.

sharing for 60% of respondents. About 24% respondents reported public extension agencies, the Department of Fisheries (DoF) and Marine Products Export Development Authority (MPEDA) as the information sources. Aquaculture consultants were the next important source of information for about one fourth of the respondents (24%). Mass Media and research Institutions were the information sources respectively for 18% and 8% of farmers.

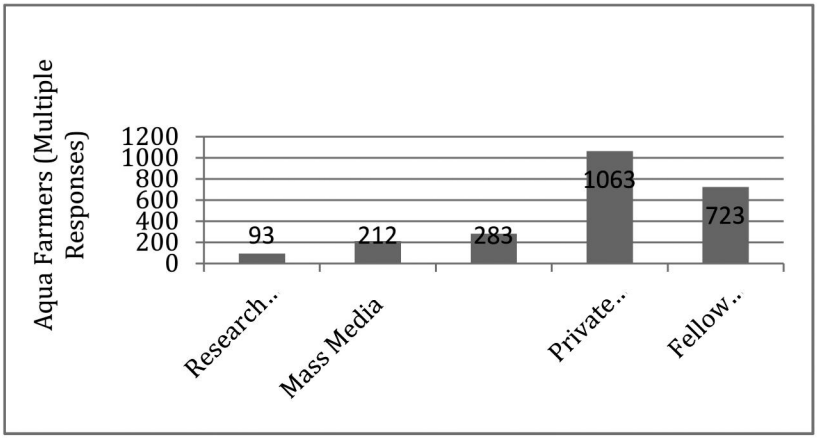

Fig. 1. Information Sources of Aqua Farmers (N=1200)

Farmers perceived that the private extension service providers are better than others (Kumaran *et al.*, 2012) and recognized them as the real extension service providers (Table 2), though they pay for their services directly in case of consultants and indirectly to aqua business companies. This may be due to the fact that in high value species like shrimp aquaculture, farmers needed advise on daily basis from the extension agent which was impossible for DoF to do in the present scenario; hence farmers depend on the inputs from dealers and technical consultants who were easily accessible. However, farmers approached the DoF for getting government license and subsidy benefits.

5. Knowledge Sources of Fishery Extension Personnel

Knowledge sources of the state fishery extension personnel are presented in Fig. 2. Their information seeking level was limited to the tune of less than 50%. Hardly fifty percent of the respondents had approached them for information sources to update regularly. It was found in discussions with extension personnel that they were not conversant with the latest scientific advancements in aquaculture. Technical manuals and reports of fishery research and development institutions were the main information source for 45% of them. Fishery institutions publish technical reports, posters, bulletins, manuals and as part of their human resource development efforts they supplied them to the DoF for wider distribution to the end users. Around 40% of the extension personnel informed that their respective department training institutions were their information source. The DoF have their staff

training institutes for providing induction and in-service training to their field personnel. It was expressed that the opportunity for training was given once in a few years and the content of the training was also mostly obsolete. About one third of the respondents expressed that Fisheries College (35%) and MPEDA (30%) were the other important sources of information.

Table 2. Perception of farmers on extension services (Kumaran *et al.*, 2012)

S.No	Attributes	Public Extension	Private Extension
1.	Accessibility	Difficult	Easy and Any time
2.	Frequency of contact	Occasional	At least Weekly once
3.	Timeliness	Not in time	Timely
4.	Practical relevance of the advise	Not so relevant	Practical field specific
5.	Topics of discussion	Registration of farms, regulations, awareness creation on banned antibiotics	All aspects of farming including inputs, services and market intelligence and arrangement (seed to shrimp)
6.	Follow up	Rarely	Regularly
7.	Extension approach	Mass and group contact	Individual face to face contact
8.	Perceived subject matter skill	Poor, not updating	Very good andupdating regularly
9.	Personality	Dull and skeptical	Young andenergetic
10.	Effectiveness	Needs improvement	Effective

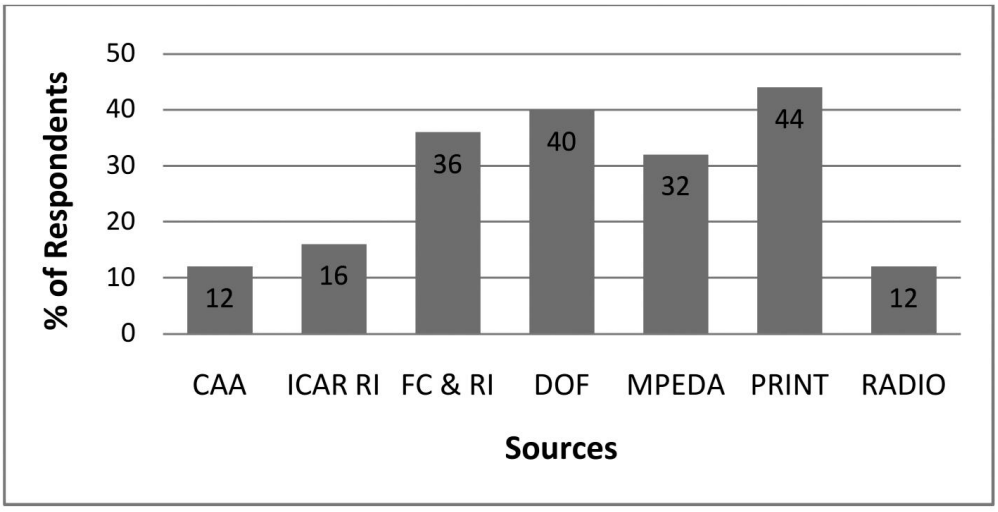

Fig. 2. Knowledge sources of fishery extension personnel

6. Research-Extension Linkage in the Aquaculture Sector as Perceived by the Researchers

Research and extension agencies should have regular consultation and linkage with each other to facilitate need based technology development, communication of technological information and obtaining feedback on the field requirements. It may be noticed from Fig.3 that the researchers had limited contact and linkage with extension agencies. Less than 50% of the researchers expressed having consultations with the personnel of extension agencies. There was no established mechanism or institutional arrangement like pre-seasonal and post-seasonal conferences to ensure periodic consultations as existed in agriculture (Kumar, 1996; Krishna, 2000; Kumaran *et. al.,* 2004). It was informed that 48% and 40% of the researchers respectively had linkage with DoF and MPEDA. However, the frequency of their contact was mostly occasional in the form of attending meetings where both researchers and extension people participate. The research institutions offered training courses for the extension personnel and representatives from DoF and MPEDA participated in such programmes. Research institutions had regular linkage with departments by participating in the meetings organised by each other and shared technical information. However, in general, the linkage between the research institutions and other stakeholders was mostly occasional.

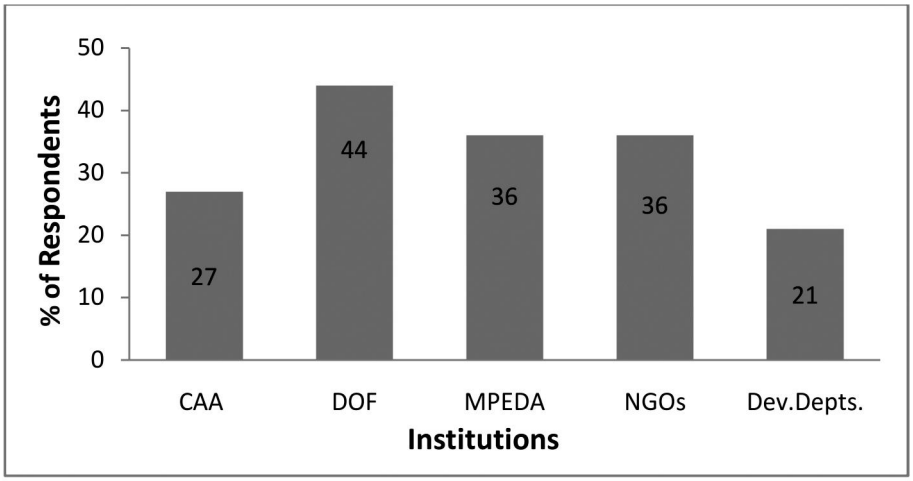

Fig. 3. Research-Extension Linkage in aquaculture as perceived by the researchers

The following linkages are vital for the sustainable development of coastal aquaculture sector.

- Linkage between the central research institutions and state level research stations for the development of location specific farm technologies.
- Linkage between the researchers and farmers group/farm innovators to make the research programmes need based as well as for the validation of research findings from farmers' ponds for assessment and refinement.

- Linkage between the researchers and fishery extension personnel for capacity development, wider dissemination of technology to end users and feedback.

However, experience indicates that the above mentioned linkages hardly exist in the fisheries sector. The minimum existing linkages were also 'consultative' in nature and not 'collaborative' as desired.

7. Organizational Appraisal of DoFs

Even though fisheries extension services are planned both at the central and state levels, the states have the major responsibility in undertaking extension activities and providing technical guidance to farmers, fisheries being the state subject.A multidimensional perspective based organizational appraisalof the DoFs taking into account the organizational climate, human resources and extension orientation shows that there are significant gaps between existing organizational capacity vis-a-vis preferred/expected organizational capacity (Table 3). The analysis show that the organizational set up, reachability, climate, linkage with research and development departments, key performance areas, manpower at various levels, capacity development mechanisms, extension approaches and strategies and budget provisions need total overhaul. It was observed that welfare measures and implementation schemes consumed their time and the main function of providing technical services to farmers was neglected. The existing manpower of extension officers was in-sufficient to plan, execute and reach the clientele. The opportunity for capacity enhancement is insufficient. The extension education function was totally lacking. Above all, the budget allocation for extension is grossly neglible. The following are general impressions about the fisheries extension system and its service.

i. There is no organized effort at the national/state level to improve the fisheries extension service.Unlike in agriculture where the department has the primary role of extension and mobilizing support services for the farmers, fisheries sector is yet to start a dedicated and organised extension service.
ii. There is no linkage mechanism between the research and extension sub-systems for capacity development, information delivery and to obtain feedback from the field.
iii. There is no uniform organizational structure in the DoFs of maritime states.
iv. There is no budget for fisheries extension as such.
v. Inadequate skilled manpower at various levels.
vi. Lack of extension orientation in the DoFs and officials are not trained in extension concepts, methods.
vii. DoFs are not fully tuned towards extension service per se and concentration mostly on welfare measures.
viii. Lack of opportunity for knowledge and skill updation.
ix. Mismatch of trained personnel with their work.
x. Lack of infrastructure, material and aids for extension education.

Table 3. Organizational appraisal of Fisheries Departments

Sl. No.	Organizational Attribute	Mean Score		Recommendation
		Existing	Optimum	
1	**Organizational climate and reachability** (Organizational policies, practices andprocedures, organizational reach, delegation of authority, existing infrastructure at various levels (Physical, equipments, transport, etc.) and linkage with research and development departments)	8	12	Revamp with structural and functional reorientation
2	**Human resource appraisal** (% of time spent on key performance areas, manpower availability (top, middle, field level and ministerial staff), opportunity for capacity building and skill appraisal)	14	20	Pragmatic coverage, manpower planning, recruitadditional manpower and capacity enhancement
3	**Extension service appraisal** (Technology communication and feedback,ideal extension worker: service area,extension approach followed,extension methodology, frequency of contact with clients, communication skills of FEOs,use of mass media and ICT by FDOs (Print, radio, TV, electronic, internet) Budget for extension work).	14	21	Reorientation with appropriate approach and system-fit extension strategies supported by skill development, materials, mobility and budget.

The nature of linkage between the information holders and information seekers and information flow in coastal aquaculture sector is given in Fig.4. It shows that the linkage triangle comprising of private extension, farmer and third party extension is much stronger than the public extension, farmer and research and training trio.The reasons for the scenario are explained in the earlier sections.

Private extension agencies continue to play a decisive role in technical counselling because the inputs like seed, feed, probiotics, etc. continue to be in their ambit and under severe market competition, technical support being a part of their marketing strategy. Farmers mostly listen to them even paying an additional price because of other associated benefits. Fisheries extension has been neglected in national planning and establishment of fish farmer development agencies (FFDA/BFDA) as a scheme for both the freshwater and brackishwater aquaculture was the major measure undertaken so far on the fisheries extension front. However, studies indicated that BFDAs are no longer functional in most

of the maritime states and FFDA trainings were not effective in terms of content and capacity building. Therefore, the state departments need revamping with structural modifications and functional re-orientations. However, this may not happen in the foreseeable future, considering the importance given to fisheries development by the states. But, considering the different strata of farming population, nature of farming systems, levels of operation andother realities,thestate owned extension service need to be strengthened to ensure regulated, guided and sustainable aquaculture development in the country. However, the state owned DoF alone may not cater to the on and off-farm information and skill requirements of the high value farming like brackishwater aquaculture which demands advanced technical guidance. Hence, an integrated approach is the need of the hour.

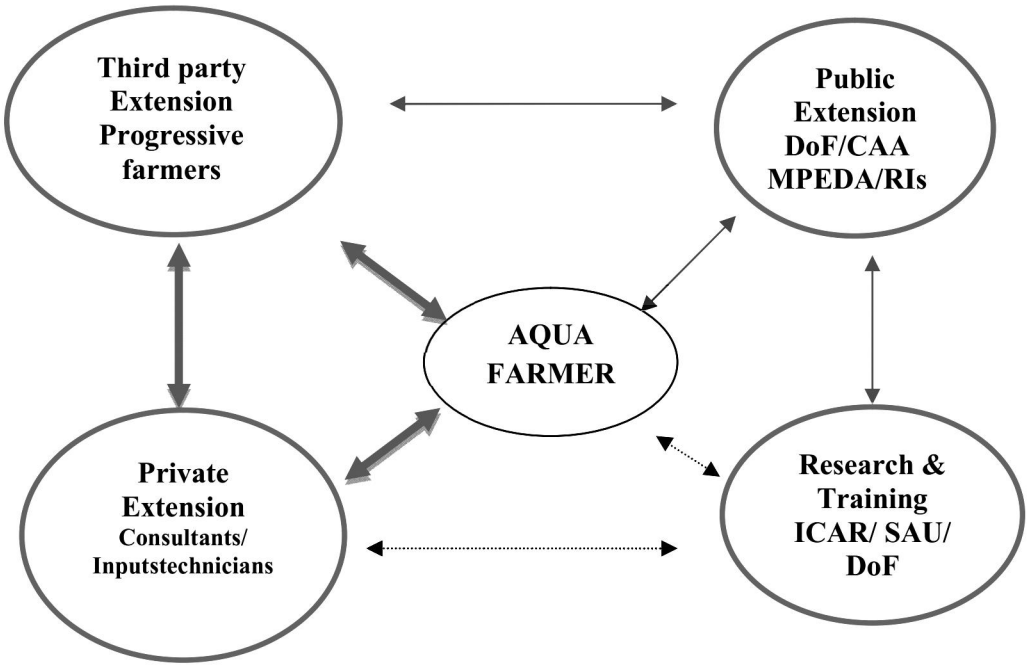

Fig. 4. Technology information flow in coastal aquaculture

Moreover, extension services of the public extension agencies are stifled due to inadequate infrastructure, manpower and budget. The private extension services are not free but paid through their product's price by their clients. On the other hand, the services of the DoF are free service by the government. Every end user is inclusive and equally treated under public extension services and the non-clients were exclusive and competitor in private extension services. While the private services mostly aim for marketing their products aided by technical counselling, the public agencies mainly strove for sustainability, diversification, expansion of area and production, capacity development assisted by subsidies and welfare measures.Hence,strengthening the DOF with structural modifications and functional specialisations, manpower planning, recruitment, capacity development, extension

service orientation and adequate budget provision for extension is the need of the hour. Even then, public extension may not be in a position to serve all the segment of the farmers. In this scenario, a principle of extension pluralism through accommodation and collaboration with private extension as 'partners of extension' could be a right option rather than trying to eliminate or run a parallel regime. However, in the proposed public-private extension partnership, the private extension should be regulated through registration/ certification and their service and competencies must be under constant monitoring and regulation by the government.

8. ICT Tools for Technology Transfer and Bridging Linkage

In the absence of a vibrant research-extension linkage for a two way communication and capacity building, it is important to look for an alternative strategy to forge this link and in the era of information revolution, Information Communication Technology (ICT) aided tools could offer a solution to address this gap and capacity strengthening (ADB, 2003; Richardson, 2003). The success stories of several ICT based knowledge management initiatives in Indian agriculture and allied sector, like the Agri-India knowledge portal by ICAR, Village Knowledge Centres of MSSRF, e-Sagu Aqua, e-Choupal of Indian Tobacco Company, Kisan Kendras of Rallies, Kisan Bharath Kendras of United Phosphorus Limited, Kisan Call Centres (KCC), AGRISNET, AGMARKNET, e-velanmei, AGRITECH portal and e-Velanmaiof TNAU, e-Arik of North- East states and e-linkage projects of Krishi Vigyan Kendras (KVKs) have proved that ICT aided tools could create an impact in information dissemination. ICT aided projects like'Phone-in' Programme (PiP), farmer-friendly touch screen information kiosks, expert systems, information dissemination through mobile phones, e-extension modules, e-publications, short video-films, decision support systems, information dissemination through FM radios, social network media-face book and mobile apps have shown success in a limited scale and space. However, scaling up of delivery still remains at the experimental stage (Heeks and Molla, 2009). Real time macro level ICT projects aiming to offer the information and services mostly needed by the farmers like access to market information, land records and services, accounting and farm management information, management of pests and diseases, are extremely limited (Meera *et al.*, 2004). Poor, marginalised, illiterate farmers, females, and marginal areas are excluded in ICT programmes. Agricultural extension projectstaff has inadequate training and farmers have very little faith in the ICT project personnel and their commitment to achieve the goals of the projects (Meera*et al.*, 2004). Moreover, lack of knowledge of best practices in IT usage as well as IT-related skill deficiencies in the workforce will also constrain the benefits from ICT (Kaushik and Singh, 2004).Application of appropriate ICT tools for a specific target of audience considering their access and comprehension is very important. ICT medium suitable for communication between research and extension may not be fit for the farmers. Therefore, the ICT medium should be receiver oriented and hence selection of right channelis crucial. Application of ICT for extension service requires periodical capacity enhancement of the extension personnelon the subject matter they

deal, a dedicated subject matter specialists (SMS) team at the district/regional level, capacity to select and use right ICT tools for an appropriate subject, necessary infrastructure like network, hard ware and software and adequate budget.Therefore, it is perceived that ICT per se may not replace the existing system, but it can enhance the efficiency of the system and facilitate the linkage between technology development, dissemination, adoption on the one hand and inputs and market on the other.

9. Integrating Information Channels for an Effective Extension Service

From the aspects discussed above, it is true that none of the information source could exclusively or independently cater the information and skill requirements of different segments of aquaculture systems and different strata of farmers in the aquaculture sector. Therefore, the better approach is collaboration/partnership between the institutions/agencies and integration of information channels by the institutions as given in Fig.5.The national and state research institutions are the sources of technology, guidelines for regulations and provider of standard operating protocols for seed production, farming and diagnostic services. It is the responsibility of the state research institutions to develop or modify system specific technology, guidelines and farming protocols suiting to their state or region. While the national institutions publish technical bulletins, special publications, technology packages, expert systems on different farming packages, website, knowledge portals, hands-on trainings for master trainers and development of TV and radio script modules, the state research institutions may develop the above information in vernacular languages with suitable modifications fitting to their states.The information and materials can go from the research institutions to the DoFs and in turn it could reach the farmers. The private extension agents are periodically trained by their companies. Aqua consultants mostly get updated from internet, peers and fiends in various institutions. Awareness related information can be disseminated through mass media, group e-mail and group messages through mobile phones. However, group meetings and hands-on training are the best channels for skill development.

10. Partnership with Private Extension

Aqua inputs companies and aqua consultants'qualified people, have a good hold on farmers because of their local presence and relatively long association.Aquaconsultants are highly qualified and possess rich experience with strong field presence. The research institutions could collaborate with themin conducting on-farm trials for technology validation, technology transfer, joint monitoring of water bodies, disease surveillance in aquaculture farms at different regions,collection of data from the farmersand conduct of farmer field schools to develop the diagnostic and interventional capacity of aqua farmers. They need only recognition in terms of joint publications and sharing of knowledge. Similarly, collaboration with aqua feed companies who have a considerable presence in a region can help the research institutions,for example,in field monitoring for disease surveillance by helping in

collection of water and animal samples from their client farms. The research and extension institutions can convey messages to the farmers through them. The arrangement ICAR-CIBA had with Water Base Feed Companyin 2012-13 for collection of samples for screening Early Mortality Syndrome (EMS) disease is worth mentioning. Otherwise, it would be difficult and expensive for the remotely located institution to reach enough number of farmers. Similar kind of public-private partnership models existed in agricultural advisory services in India (Rasheed, 2003; MANAGE, 2003) and globally(Rivera and Zijp, 2002; Neuchâtel group, 2006). In such circumstances, the state can take on the role of a facilitator for many other actors involved in farm advisory services (Gautam, 2000; McMillan *et al.*, 2001).

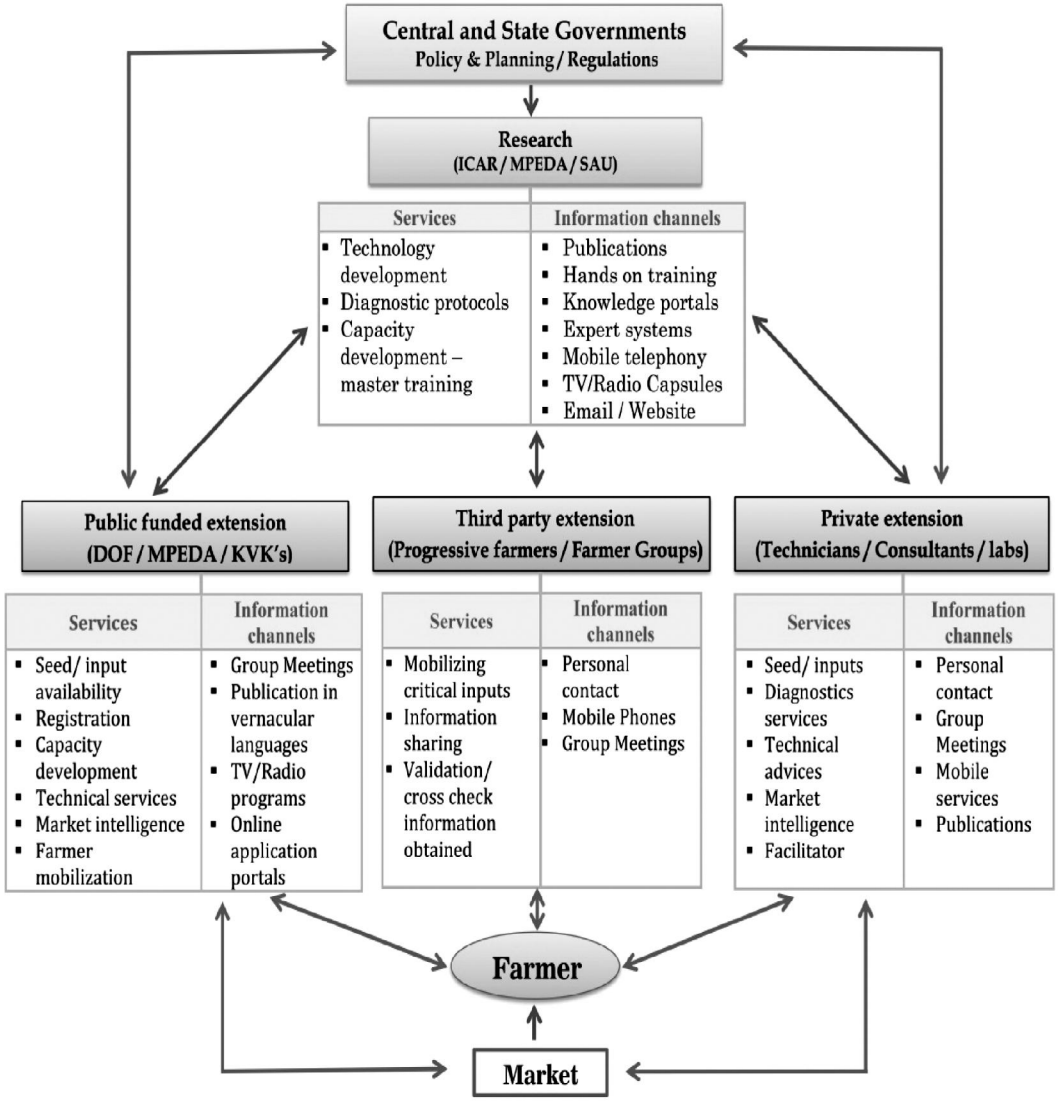

Fig. 5. Integrating information channels for effective aquaculture extension service

11. Strengthening the Public Extension Organization (DoF)

Strengthening the public extension system (DoFs) with structural and functional modifications is need of the hour. A strong public funded extension system is essential to cater to the diverse farming systems, resource poor farmers and ensure sustainable natural resource management. Further, a strong DoF alone could create an enabling environment for other extension service providers to contribute for sustainability. It has been amply proved that investments in aquaculture extension and policy support had contributed to the rapid development of aquaculture in Asia (Rabanal, 1995; Potipitak, 1996; Karim, 1997;World Bank, 1998; NACA/FAO, 2000) and in China which contribute around 70% of Asian aquaculture production.It is estimated that at least 15% of the annual aquaculture production growth is directly attributed to the aquaculture extension services (Wang, 2001; Gupta, 2009).

11.1. *Institutionalizing research-extension linkage mechanism*

Linkage between research, extension and user systems is very important for demand-based technology development, transfer and feedback. However, it is highly informal and ineffective in the fisheries sector. Therefore, an institutional mechanism to facilitate the linkage between research and extension systems for sharing of knowledge and experience needs to be established at the state level. This would ensure regular exchange of information between research and extension, help in updating the fishery extension personnel and contribute to need-based technology development, transfer and communication of field feedback.

11.2. *Integrating ICT for extension*

ICT has the potential to enhance the efficiency of institutions. Development of a knowledge portal for brackishwater aquaculture incorporating the interactive modules on different systems of farming, domains for researchers, extension personnel, farmers, inputs and dealers, with the provision for loading information and experiences by the end user which can be vetted by the web master might contribute immensely for information dissemination. This portal can link inputs and producers and market. Expert systems on shrimp, finfish and crab farming with digital calculators for feed calculation, water quality analyses, short movies on seed selection, nursery rearing, disease diagnosis, etc. will act as capacity building modules and provide a platform for linkage between research, extension, farmers, inputs and market.

11.3. *Mobile telephony*

Mobile phones are the most important medium through which short messages on farming, inputs and market related information can be communicated to the farming community as well as to extension workers rapidly, at low cost.Presently, social media like *WhatsAPP,*

Facebook are very popular in sharing information and data among all the sections of the society. Therefore, development of MobileApps, Facebook groups linking different stakeholders (farmers, input producers, market) would aid in information sharing and informed decision making.

11.4. *Harnessing television and radio*

Research institutions may prepare tailor made audio-video capsules in vernacular languages on various aspects of shrimp, finfish and crab farming in different delivery modes and the extension department may disseminate them through popular TV and FM radio channels.

12. Conclusion

Aquaculture at present is more like business farming, rather than a traditional system of subsistence farming and the farmer requires a variety of information to plan, farm and market his shrimp/fish/crab. He should be supported with the required knowledge and skill and need to be facilitated to access quality inputs, technology and market. The technology information flow shows that private extension is dominant, but has its own agendas. Public extension system is not equipped to cater the requirements of the end users. It is learnt that none of the extension system can exclusively or independently cater the information and skill requirements of different segments of aquaculture systems and different strata of farmers. Therefore, the pragmatic approach is collaboration/partnership between the institutions/agencies and integration of information channels. Conventional as well as recent media of communications need to be optimally blended to achieve the goal of information dissemination and capacity building for the sustainable development of coastal aquaculture.

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