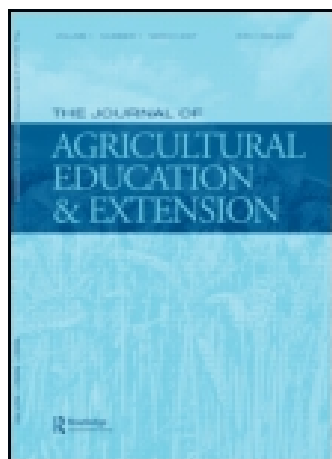


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Extension Approach for an Effective Fisheries and Aquaculture Extension Service in India

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ABSTRACT Purpose: *Public-funded fisheries extension services have been blamed as poor and responsible for the slow pace of aquaculture development in India. The present investigation aimed to find concrete interventions to streamline the extension service by understanding the research-extension-farmer linkage indirectly in terms of information sources of aqua farmers and fishery extension officers and assessing the existing organizational, manpower and extension capabilities of Departments of Fisheries of sample states.*

Design/methodology/approach: *A random sample of 1008 brackishwater aqua farmers, a purposive random sample of 60 extension personnel and 45 researchers were interviewed to collect primary data for the study. A multidimensional Organizational Analysis Index was developed specifically for the study. The Wilcoxon paired rank test was employed to analyze and compare the perceptions of the fishery extension personnel.*

Findings: *The study revealed that 90% of aqua farmers depend on private extension sources for information; information-seeking by the extension personnel was less than 50%; and less than 50% of the researchers expressed having had consultations with the extension agencies. Results indicated that the respondents differ significantly over the existing and ideal organizational, manpower and extension attributes of the fisheries departments. An extension approach to evolve a National Fisheries and Aquaculture Extension Service (NFAES) to strengthen fisheries departments with structural and functional realignments and partnership with farm leaders and fisheries professionals is suggested in order to streamline the fisheries and aquaculture extension service in India.*

Practical implications: *The findings of the study may enlighten the fisheries development planners and provide indications to initiate attempts to streamline the fisheries extension departments for an effective extension service in India.*

Originality/value: *The study was originally conducted by the authors. Nothing similar has been previously published or is currently under consideration for publication by another journal.*

KEY WORDS: Fisheries and aquaculture, Extension service, Organizational analysis, Extension approach

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Introduction

Farm extension services play an essential role in agrarian development (Birner et al., 2006; Anderson, 2007). This renewed interest in farm extension is linked to the rediscovery of the role that the farm sector can play in reducing persistent rural poverty (World Bank, 2007). Aquaculture of shell fishes and fin fishes is recognized as an important means for rural development, food and nutritional security for the rural folk (Ayyappan and Diwan, 2007). Worldwide, the aquaculture sector has grown at an average rate of 8.8% per year since 1970, compared with only 1.2% for capture fisheries and 2.8% for terrestrial farmed meat production systems over the same period (FAO, 2007). India ranks third in total fish production in the world and second in the aquaculture production (FAO, 2007; Eknath et al., 2009). Fisheries and aquaculture are the sources of livelihood for over 14 million Indian people and also contribute to foreign exchange earnings considerably, constituting about 1% of the total gross domestic product (GDP) and 5.3% of the GDP from the agriculture sector of the country (DAHDF, 2007).

Aquaculture includes the growing of fishes both in freshwater (normal water) and in brackishwater (salinity up to 35 ppt): named respectively freshwater and brackishwater aquaculture. The area where the confluence of freshwater and seawater takes place is called brackish or estuarine. Brackishwater has more salinity than freshwater, but not as much as seawater. Technically, brackishwater contains salinity ranging between 0.5 ppt and 30 ppt (Venkatesan and Kathirvel, 2010). Indian brackishwater aquaculture is synonymous with farming of a single shrimp species: tiger shrimp (*Penaeus monodon*). Initially, the corporate sector ventured into shrimp farming; however, the outbreak of deadly viral diseases in the mid-1990s and continued crop failures led to the corporate sector withdrawing from shrimp farming. Today the cultivable 0.14 million hectares of brackishwater are mostly owned and operated by small-scale farmers with a farm size of two hectares or less (Yadava, 2002; MPEDA, 2006). Brackishwater aquaculture farms are located side-by-side along the brackishwater creeks, which are the common water source. Because of this dependency and because water is the primary medium through which viral pathogens spread (Corsin et al., 2001), one farmer's mismanagement would harm all the farms in the cluster. To prevent this, shrimp farmers are organized into groups to carry out farming practices in a synchronized manner in many places. But ownership and management remain individual. The shrimps produced are mostly exported.

Aquaculture in India has demonstrated a six and a half fold growth in the last two decades (MPEDA, 2006). Nevertheless, hardly 13% of the potential brackishwater resources alone have been utilized so far, indicating enough scope for both horizontal and vertical expansion. In any farm production milieu the farmer is the nucleus around which the other inputs, services and market operate. The farm extension agency is the lynchpin in this loop, which is expected to facilitate the farmers' to access quality inputs, machinery, technical advice, institutional credit and better prices, and to mobilize them for a collective compliance of better farm management practices. Fisheries and aquaculture being the provincial subject, the states have the major responsibility in providing this key support. The Coastal Aquaculture Authority Act (2005) of India (regulator of aquaculture development) emphasized that 'extension function need to be strengthened to improve the technical knowledge

and skill of extension personnel, farmers and all those involved for planning and operation of sustainable aquaculture' (CAA, 2006: 221).

Effective extension services have contributed to increased aquaculture production (Wang, 2001) and could enable the aquaculture sector to contribute much more for the economic development of rural fish farmers (Tu and Giang, 2002; Brummett and Pouomogne, 2004; Maguswi et al., 2004; Udo et al., 2005; Omoyeni and Yisa, 2005). In India, though both the central and state governments formulate policy guidelines, the states have the major role in executing the extension programs at field levels through their respective Departments of Fisheries (DoFs). The Union government also provides financial support through its schemes to provide technical, financial and extension support to aqua farmers. However, the measures undertaken so far on the extension service front by the government agencies are inadequate (Kumar, 1996; Kumaran et al., 2004, 2007). However, in the South East Asian countries the state-sponsored fisheries extension services are the major players among fisheries extension services (Rabanal, 1995; Rajbanshi, 1995; Potipitak, 1996; Naoyuki, 2000; Hishamunda and Subasinghe, 2003; Brummett and Pouomogne, 2004).

Aquaculture is always consumer driven and the extension services need to focus their efforts beyond technology dissemination to adoption of food safety practices, value addition, environment safety and social responsibility issues, such as the import market and consumer demand. However, studies have reported that the DoFs are not adequately equipped with manpower, extension infrastructure, budgetary allocation and technical content as there are no proper linkages between the state fisheries departments and research institutions (Kumar, 1996; Kumaran et al., 2004; Kumar and Ananthan, 2009). In this context, it is imperative to assess the research-extension-farmer linkage in terms of information sources of aqua farmers, knowledge sources of fishery extension officers and linkages between researchers and extension agencies and the existing organizational, manpower and extension capabilities of DOFs from the fishery extension personnel's perspective, so that appropriate interventions can be suggested to streamline the aquaculture extension service.

Objectives

- (1) To assess the information sources of aqua farmers
- (2) To assess the knowledge sources of fishery extension officers
- (3) To assess the research-extension linkage in the aquaculture sector as perceived by the researchers
- (4) To assess the organizational, manpower and extension capabilities of the DoFs from the fishery extension personnel's perspective
- (5) To suggest a pragmatic extension approach and strategy for an effective aquaculture extension service

Methodology

This study was undertaken in two leading aquaculture states in India, Andhra Pradesh (AP) and Tamil Nadu (TN) along the east coast of the country. The extension officers working in the DoF need to look after both types of aquaculture under this jurisdiction; hence, the extension officers included in the study represent both freshwater and brackishwater areas. The farmer respondents selected are from brackishwater aquaculture only. The reason for confining the farmer respondents to the brackishwater area alone was due to the fact that brackishwater aquaculture is a high-value, risk-intensive farming and demands more technical knowledge and support from the extension personnel. The respondents of the study, sample size and sampling procedure adopted are given in Table 1. Primary data for the study were collected from the respective respondents using a well-structured and pre-tested questionnaire.

The methodology adopted to collect the primary data from the respondents is described below.

Information Sources of Aqua Farmers

For the present investigation the information sources of farmers includes: the information source(s), frequency of consultation, triangulation of the information, level of satisfaction and extent of sharing the information with fellow farmers. The scoring pattern followed was: information source (one score for each information source consulted), frequency of consultation (frequent (2), occasional (1) and never (0)), triangulation (yes (1) and No (0)), level of satisfaction (satisfied (1) and not satisfied (0)) and extent of sharing (Yes (1) and No (0); fully shared (1) and partially shared (0)). The scores for these four aspects were added to achieve an individual's information-seeking score.

Table 1. Respondents of the study.

Respondents	Tamil Nadu	Andhra Pradesh	Sampling procedure
Aqua farmers (n = 1008)	402	606	Proportionate random sampling
Fishery Extension Officers (n = 60)	30	30	Random sampling
Researchers (n = 45)	30	15	Random sampling

Knowledge Sources of Fishery Extension Officers (FEO)

The knowledge-seeking behavior of the FEO was operationalized as the extent to which the knowledge sources were consulted, frequency of consultation and respondent's level of satisfaction with the content. The scoring pattern followed viz., knowledge source (one score for each source used), frequency of consultation (frequent (2), occasional (1) and never (0)) and level of satisfaction (satisfied (1) and not satisfied (0)). Scores for the three aspects were added to achieve an individual's knowledge-seeking score.

Linkage Between Research and Extension as Perceived by the Researchers

Extent of linkage between the fisheries research and extension agencies was studied by measuring the extent of contact between the fishery researchers and the extension agencies. It was measured through a summated rating procedure developed for the study which included linkage with an agency (one score for every linkage institution), frequency of contact (frequent (2), occasional (1) and rare (1)) and perceived satisfaction of the respondent (satisfactory (1) and not satisfactory (0)).

Organizational Analysis of DoFs

The DoFs need to be appraised using a multidimensional perspective because of their multiple and conflicting goals, constituents and time frames that influence their performance. Hence, a multidimensional Organizational Analysis Index (OAI) was developed and employed to collect data. The OAI is a multidimensional index designed to elicit the perception of the FEO on the extension organizational attributes. It is a dichotomous *Existing vs Ideal* format index consisting of 20 attributes grouped under three sections, namely, organizational, manpower and extension, having 5, 7 and 8 dimensions respectively. It was prepared based on a consultation of relevant literature and broad discussions with extension researchers and senior extension officials. It was also content validated by a team of extension researchers and extension personnel. All the dimensions have a three-point continuum pertinent to the attribute (like 'most conducive' to 'un-conductive') which were scored 3, 2 and 1 from right to left on the ideal side and vice versa on the existing side. The scores of all 20 variables on the existing and ideal sides were added separately to achieve the existing and ideal OAI scores of an individual. Likewise, an OAI for every respondent was calculated as a ratio of the actual to the maximum score possible for a respondent multiplied by 100.

Statistical Analysis

The Statistical Package for Social Sciences (SPSS version 14.0) was used to analyze the data collected and to draw inferences. Since the same group of respondents was asked to give their perceptions on both existing and expected conditions the non-parametric statistic-Wilcoxon paired rank test was employed to analyze and compare the perceptions of the fishery extension personnel.

Results and Discussions

Information Sources of Aqua Farmers

The information sources consulted by the aqua farming community are depicted in Figure 1. The findings revealed that 90% of aqua farmers depend on private extension sources (inputs companies and aqua consultants) for information. Fellow farmers were the sources of information triangulation and sharing for 68% of respondents. About 24% respondents reported public extension agencies, the DoF and Marine Products Export Development Authority (MPEDA) as the information sources. Mass media and research institutions were the information sources respectively for 18% and 8% of farmers.

Aqua feed companies, who dominated the inputs supplied, have employed subject-matter personnel to approach farmers to market their products. They visited their client farmers at least once a week and provided technical counseling on farming practices. Necessary information was written by them in the daily routine register kept at the farm and this was followed fully. They were accessed for any problem at any time by mobile phones. These companies organized farmers' meetings at farm clusters at the beginning of culture operations and educated the farmers on the management practices to be followed using appropriate extension audio-visuals and extension literature. This formed the basis for farmers to begin culture operations. Further, farmers were taken on field tours to various shrimp farming areas and provided with an opportunity to interact with shrimp farmers from other places within and outside the country. Successful farmers were even given awards and used them as a medium for convincing other farmers. Though profit-making was their main objective they contributed to the dissemination of technical information across their operational areas. Further, the majority of the farmers acquired feed and other inputs on a credit basis from local feed dealers, which was then repaid after the

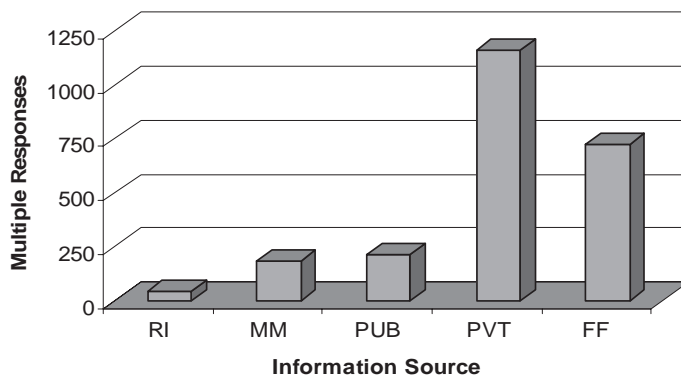


Figure 1. Information sources of aqua farmers.

Notes: RI: Research Institutions (fisheries colleges and research institutes); MM: Mass Media (TV, printed publications, internet); PUB: Public Extension (DOF and MPEDA); PVT: Private Extension (feed company technicians and consultants); FF: Fellow Farmers (progressive farm leaders and fellow farmers).

harvest with interest. Instances of 'buy back' arrangements were also found among the farmers and input traders in both the states.

Aquaculture consultants were the next important source of information for about a quarter of the respondents (24%). Independent aqua professionals who were qualified fisheries/biology graduates, having rich experience in the field and having earned the trust of the farmers were potential private extension service providers. Most of them were fisheries graduates or post graduates in zoology, marine biology and aquaculture, and a few of them were even doctorate holders. They operated as full-time farm consultants, some had their own farms and some of them provided analytical service testing of soil, water, seed and other inputs—in addition to farm consultancy. The majority of them had worked more than five years on a farm or in an input company before they became independent consultants and most of them had more than 5–10 years of consultancy experience. These consultants visited each of their client farms more frequently, monitored the pond conditions and advised the farmers on day-to-day operations in writing and their advice was adopted. In addition, these consultants facilitated their client farmers to access quality inputs, services and proper market. They created awareness among their client farms on the adoption of better management practices including farm-level bio-security measures to prevent the entry and spread of diseases in the shrimp farming clusters. Their consultancy was for the whole crop, from pond preparation to marketing of shrimps, and their consultancy was paid for mostly after harvest depending on the volume of production and market price. Though profit-making was underlined in their services, these consultants worked for the sustainability and continued farming of their client farmers, which is indispensable for their survival. Due to these reasons the private extension personnel were perceived as a key source of information for the farmers of both the states.

Fellow farmers (peers) were the next important information provider and a source of information processing and triangulation for 71% of the farmers. Homophilous nature, familiarity and credibility factors strongly facilitated the information exchange among themselves. Farm literature in the form of manuals, booklets, journals, etc. supplied by the public and private extension agencies were an important information source for the farmers. The MPEDA—a central government agency—promoted brackishwater aquaculture in the country with an aim to increase fish production for export, operated several subsidy oriented programs and organized awareness campaigns against the use of antibiotics and other banned chemicals in shrimp culture to ensure high quality standards of farmed shrimp. It also promoted collective farming at cluster level with proper farm practices to ensure disease-free shrimp culture. Further, to avail institutional credit from nationalized banks, the aqua projects of farmers/entrepreneurs need to be recommended by the MPEDA. The Department of Fisheries (DoF), the main extension service provider of the state, played a major role in facilitating farmers to obtain licenses/registration from the Coastal Aquaculture Authority (CAA). Aqua farmers shared and triangulated their experiences and information gathered from other sources with their peers. Further, farmers perceived that the private extension service providers were preferred, as reported by Kumaran et al. (2007) (Table 2), and recognized them as the real extension service providers though they pay for their services directly in the case of consultants and indirectly in the case of aqua business companies. This may be due to the fact that in high-value species like shrimp aquaculture farmers need advice on a

Table 2. Perception of farmers on public and private extension services.

S. No.	Attributes	Public extension	Private extension
1.	Accessibility	Difficult	Easy and anytime
2.	Frequency of contact	Occasional	At least once a week
3.	Timeliness	Not in time	Timely
4.	Practical relevance of the advice	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 and updating regularly
9.	Personality	Dull and skeptical	Young and energetic
10.	Effectiveness	Needs improvement	Effective

Source: Kumaran et al., 2007.

daily basis from extension agents which was impossible with the DoF in the present scenario, so farmers depended on the inputs dealers and technical consultants who were more easily accessible. However, Farmers approached the DoF for obtaining government licenses and subsidy benefits.

Knowledge Sources of Fishery Extension Personnel

The knowledge sources of the fishery extension personnel are presented in Figure 2, which shows that their information-seeking was limited to less than 50%. Hardly 50%

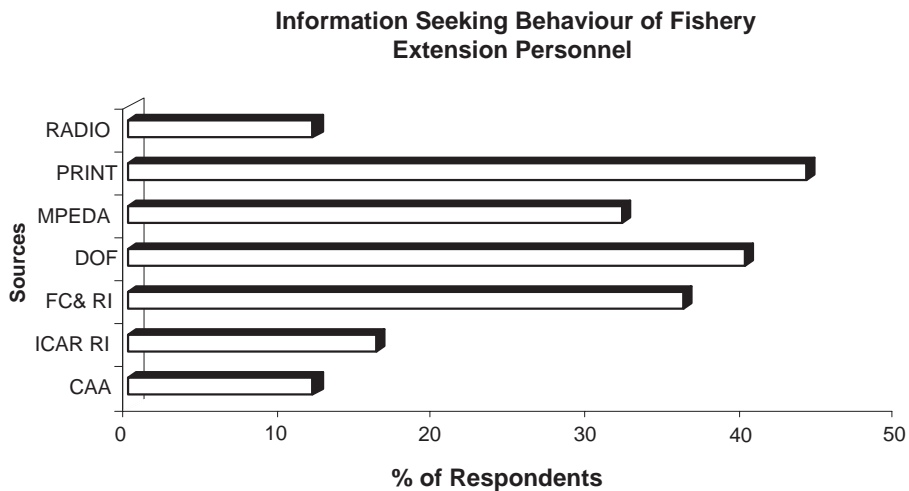


Figure 2. Information-seeking behavior of fishery extension personnel.

of the respondents had approached information sources to update them regularly. It was found in discussions with the respondents that they were not conversant with the latest scientific advancements and other developments in aquaculture. Technical manuals and reports of fishery research and development institutions were the main information source for 45% of fishery extension personnel. Fishery institutions publish technical reports, posters, bulletins, manuals and part of their human resource development efforts supplied them to the DoFs for wider distribution to the end users. Around 40% of the extension personnel in both states indicated that their respective department training institutions were their information source. The DOFs in both states had their staff training institutes for providing induction and in-service training to their field personnel. However, it was expressed that the opportunity for training was given once every few years and that the content of the training was also mostly obsolete.

About one third of the respondents expressed that fisheries colleges (35%) and MPEDA (30%) were the other important sources. This may be because of the respondents' personal rapport and interaction with these institutions. Further, MPEDA, being the promoter of aquaculture, offered several subsidy-oriented schemes and the DOF was an official member for identifying beneficiaries in such committees. The extension officers attended such meetings on behalf of their superiors and interacted with MPEDA officials and exchanged field-level information between them. Further, credit institutions who were offering credit assistance to aqua farmers on the basis of the projects scrutinized by the MPEDA and DoF also had an interaction through that. It was also opined that the information exchanged in such meetings was extremely useful and the linkage with the development institutions needs to be strengthened. Research institutes of Indian Council of Agricultural Research (ICAR), the CAA and printed publications were their other information sources. However, the frequency of consultations with these sources was mostly occasional. Some respondents had attended training programs conducted by the research institutions and felt satisfied with the content. The CAA, which frames guidelines to regulate aquaculture through the DoFs, was also a natural information source for the respondents.

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 needs-based technology development, communication of technological information and for obtaining feedback on field requirements. The CAA is the nodal institution for regulating the development of costal aquaculture through its guidelines. The DoF, MPEDA, development departments and non-governmental organizations (NGOs) working in the aquaculture field have an extension function. Figure 3 shows that the researchers had limited contact and linkage with extension agencies. Less than 50% of the respondents expressed having consultations with the extension agencies. There was no established mechanism or institutional arrangement to ensure their periodic consultation as existed in agriculture (Kumar, 1996; Krishna, 2000; Kumaran et al., 2004). The figure shows that 48%, 40% and 38 % of the researchers respectively had linkages with DoF, MPEDA and NGOs. However, the frequency of their contact was mostly occasional

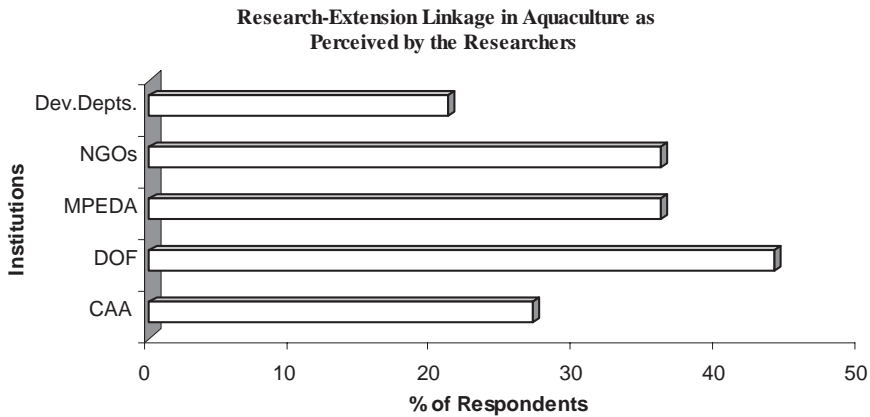


Figure 3. Research-extension linkage in aquaculture as perceived by the researchers.

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 programs. Further, research institutions also involved NGOs in transferring their technology to the Self Help Groups and other special categories of end users. Research institutions had regular linkages with CAA by participating in the meetings organized by each other and shared technical information. In addition to the above, they had rapport with development departments for sharing information and involved each other in their development programs. However, in general, the linkage between the research institutions and other stakeholders was mostly occasional. The respondents felt that a formal linkage mechanism needs to be evolved to ensure proper collaboration between the research and extension agencies at regular intervals for technology validation, transfer and obtaining field feedback.

DoF Organizational Analysis—The Organizational Climate

Organizational analysis of the DoF comprising the organization, human resources and extension orientation dimensions was carried out to elicit the perceptions of the respondents on these aspects and the responses are discussed here. As shown in Table 3, that the majority of the respondents (62%) perceived that the existing organizational policies, practices and procedures of the DoF were conducive for undertaking the programs of the departments. However, 85% of the respondents expected to have a favorable organizational climate, which is essential to perform effectively. It is understood from the responses that the existing organizational practices and procedures of DoFs need to be fine-tuned to carry out their extension programs effectively. About 52% and 41% of the respondents felt that the departments had their presence only up to mandal/taluk (sub-divisional) levels. It was recognized in the discussions that the DoF had offices only at the district level, and in many instances two to three districts were looked after by a single office. Hence, the majority (69%) of respondents felt that DoF should have a presence up to village level to visit, understand, plan and work with farmers and to know their requirements better. As

Table 3. Organizational diagnosis of DoF (values as percentage of responses).
A. Organizational appraisal (values as percentage of respondents)

	Existing		Attributes	Expected		
1. Unconductive	Conductive	Most conductive	Organizational climate (your perception of organizational policies, practices and procedures)	Most Favorable	Favorable	Manage with existing
29	62	9		43	42	15
2. Mandal level	Panchayat level	Village level	DoF organizational reach	Village level	Panchayat level	Mandal level
52	7	41		69	12	19
3. No delegation	Planned delegation	Fully delegated	Delegation of authority to subordinate	Full delegation	Planned delegation	No delegation
32	60	8		21	72	7
4. Does not exist	Exists, but insufficient	Existing, sufficient	Existing infrastructure at various levels (physical, equipment, transport, etc.)	Needs extensive investment	Only some additions	No further additions required
30	65	5		64	30	6
5. Does not exist	To some extent	Exists	DoF linkage with other departments	Need more stronger linkage	Manageable with the existing	Not needed
7	68	25		77	23	0.00
B. Human resource analysis (values as percentage of respondents)						
	Existing		Attributes	Expected		
1. Administration// welfare	Research	Extension	% of time spent on key performance areas* (for example: 50%, 25% & 25%)	Extension	Research	Administration/ welfare
78	39	82		76	56	58
2. Not sufficient	Manageable	Sufficient	Sufficiency of manpowerA. Extension officers	Need lot more manpower	Some additional requirement	Additional manpower not required
85	15	0.00		58	40	2

(continues)

Table 3 (Continued)

	Existing		Attributes	Expected		
3. Not sufficient	Manageable	Sufficient	B. Extension workers	Need lot more manpower	Some additional requirement	Additional manpower not required
92	3	5		54	46	0.00
4. Not sufficient	Manageable	Sufficient	C. Administrative staff	Need lot more manpower	Some additional requirement	Additional manpower not required
45	40	15		23	54	23
5. Others	General science	Fisheries science	Educational qualifications required for FEOs*	Fisheries and aquaculture	Marine biology/zoology	Others
26	55	53		94	50	5
6. Once in 1–2 years	Once in few months	Need based	Opportunity for capacity-building as per your requirements	Need based	Once in few months	Once in 1–2 years
32	15	53		54	14	32
7. Negative	Routine	Positive	Career prospects of FEOs (motivation, performance appraisal and counseling)	Positive	Routine	Negative
25	72	3		73	27	0.00
C. Extension (values as percentage of respondents)						
	Existing		Attributes	Expected		
1. Rare	Occasional and general	Regular and focused	Two way communication with research (technology communication and feedback)	Regular and focused	Occasional and general	Rare
51	45	4		86	7	7
2. Per Taluk level	Mandal level	Panchayat level	Ideal extension worker: service area (ratio to farmers)	Extension worker in each creek	Per 100 ha or 100 farmers	2–3 farmers clubs
21	51	28		19	50.00	31

(continues)

Table 3 (*Continued*)

	Existing		Attributes	Expected		
3. Adhoc	Conventional	Participatory	Extension approach mostly followed	Participatory	Conventional	Ad hoc
34	57	9		83	27	0.00
4. Mass contact	Group contact	Individual contact	Extension methodology mostly used (indicate proportion)*	Individual contact	Group contact	Mass contact
46	78	46		55	75	29
5. Occasional	Once a month	Once a week	Frequency of contact with clients	Once a week	Once a month	Occasional
53	30	17		64	36	0.00
6. Poor	Average	Good	Existing communication skills of FEOs	Manageable	Training needed	Not needed
16	64	20		23	77	0.00
7. Not used	Used to some extent	Extensively used	Use of mass media and ICT by FDOs (print, radio, TV, electronic, internet)	Need extensive usage	Need to some extent	Not needed
50	47	3		80	20	0.00
8. Not sufficient	Manageable	Adequate	Budget for extension work	Need separate higher budget for extension	Required some additional budget	Manageable with the existing
94	4	0.00		83	17	0.00

Notes: *multiple responses.

far as delegation of authority is concerned, about 60% of respondents felt that planned and needs-based delegation existed at present in the DoF. However, the respondents felt that the authority to decide according to the situation on the ground was not delegated to them. Hence, most of the respondents favored needs-based delegation of authority to the subordinates.

Sixty-five percent of respondents perceived that the required infrastructure (physical, equipment, transport, etc.) existed at various levels but was insufficient to carry out extension work effectively. Hence, 64% of the respondents felt that extensive investments need to be made in creating or upgrading the infrastructure facilities. The majority of the (68%) respondents perceived that the DoF had linkage with other departments to some extent. However, the majority of them (77%) felt that the DoFs should have a stronger linkage with research and development departments to strengthen their role as an extension organization. It was apparently clear from the discussions that though the DoFs and research institutes 'consulted' each other, they did not 'work together' due to lack of institutional mechanisms to facilitate the interactions between them.

Human Resource Appraisal

Extension service is the primary activity of the DoF and it has the mandate to provide technical and other assistance to the farming community. The majority (82%) of the extension workers expressed that they were spending hardly 50% of their time on extension activities. Similarly, around 78% of respondents felt that administrative and welfare works consumed 50% of their time. However, they (76%) felt that they should spend 50% of their time on extension work and 25% of their time on on-farm research. Further, more than half (56%) of them expressed that they preferred to spend 50% of their time on on-farm research by conducting trials to validate the technologies at field level for refinement and to communicate the short comings, if any, back to the research. This shows the existing role ambiguity in the DoFs.

The majority (85% and 92%) of the respondents respectively felt that the existing manpower of fishery extension officers and field-level extension workers was insufficient to conduct extension education programs for farmers and to visit the large number of farmers located in distant locations under their jurisdiction. Hence, the respondents (58% and 54%) felt that DoFs needed a lot more additional extension officers and field-level assistant workers to strengthen the fisheries extension service. Further, the respondents were of the view that extension personnel had to spend much of their time on routine administrative work. Therefore, about 54% of the respondents expressed that extension personnel need to be relieved from administrative work by recruiting additional administrative staff.

It was noted from the data that about 50% the existing FEOs were from fisheries and general biological science backgrounds. However, most of the respondents (94%) felt that fisheries departments should recruit only professional fisheries and aquaculture graduates as fishery extension officials or workers. However, about 50% of the respondents opined that marine biology was also to be considered as an education qualification for FEOs. It was opined that the DoFs should recruit only professional fisheries graduates (B.FSc) as fishery extension officers in order to improve the effectiveness of the fisheries extension services, as is the case in agriculture and

veterinary departments, where professional (B.Sc. Agri. and B.VSc.) graduates have alone been considered eligible for recruitment as agricultural officers and veterinary assistant surgeons respectively.

About half of the respondents (53%) expressed that a needs-based opportunity was given for capacity-building as per their requirements, although the frequency was once in 2–3 years. Moreover, the respondents felt that an ideal extension organization should provide an opportunity for capacity enhancement whenever the need arises. Fifty percent of the respondents expected opportunities for capacity-building at least once a year to update the knowledge and skill of the extension officers and the workers. Learning should be continuous to perform effectively and it should be built into the system for periodic updating of the knowledge and skill of the extension personnel. About three quarters of the respondents (73%) suggested that employee-friendly career prospects should be evolved in the DoF. They felt that career prospects in the form of incentives, promotions and performance appraisal were gloomy in the DoFs and expressed that the departments should have positive employee-friendly career prospects to motivate the officials. Promotions should not be linked to vacancies and a career path with promotion possibilities every 8–10 years needs to be evolved. Participatory performance appraisal procedures need to be introduced to motivate and guide the extension officials and workers.

Extension Approach and Methodology

Two-way links with research institutions for technology communication, training and feedback are essential for the DoFs to be an interface between technology development and adoption. However, half (51%) of surveyed extension personnel felt that the existing two-way communication with research was a rare phenomenon and that the existing limited linkage was also not focused. Hence, the respondents (86%) felt that the DoFs should have regular and focused interaction with research institutions for capacity-building, technology evaluation, providing feedback from the field about performances of innovations at regular intervals. About 51% of respondents felt that an ideal extension worker service area ratio would be one extension worker per 1000 ha or 1000 farmers. The majority (57%) of respondents felt that the extension personnel of DoF mostly followed conventional extension approaches, where the needs and wisdom of farmers were ignored and they were considered to be passive receivers of the given services. About 34% of respondents felt that the DoFs followed ad hoc extension approaches in the field situations. However, the majority of them (83%) expressed that the DoFs should adopt participatory extension approaches in planning and execution of extension programs at field level by collaborating with other extension service agencies and the farming community in the preparation of local extension plans and their execution.

The majority of respondents (78%) were of the opinion that they followed group contact extension methods to contact their clients. Moreover, three quarters of them (75%) felt that group contact would be an ideal extension method for their extension work. Further, about 84% of the respondents felt that individual contact could be the ideal extension methodology for highly technical matters. Since the majority of the FEOs hailed from general science backgrounds they lacked orientation to extension concepts. It has been demonstrated that an ideal extension methodology should

include all three (individual, group and mass) contact methods in proper proportion according to the nature of the message and clients. A general thumb rule of 25%:50%:25% of individual, group and mass contact methods are to be adopted to reach the clients. About half (53%) of the respondents revealed that they could contact their clients at occasional intervals. About one third (30%) of respondents revealed that they contacted their clients once in a month. However, the majority of them (64%) felt that they should meet their clients at least once a week to provide technical guidance to the farmers and to understand the field problems.

The majority (64%) of respondents expressed that the field-level extension personnel of DoFs had limited communication skills due to their inadequate extension orientation and subject-matter knowledge. Hence, 77% of them felt that the fishery extension personnel of the DoFs needed training in interpersonal communication skills. Fifty percent of respondents indicated that mass media and Information Communication Technology (ICT) channels of communication (print, radio, TV, electronic mail and internet) were not used by them in their extension activities. But, 80% of respondents felt that mass communication channels needed to be extensively used to communicate to the farmers and to obtain feedback from the field. Most of the respondents (94%) of both states felt that the budget available for extension work was not at all sufficient and hence the majority (83%) of them expressed that the DoFs needed separate higher budgetary allocations for extension work.

The perceptions of the respondents about their organizational attributes, as presented in Table 4, show that there is a significant difference between the perceived ideal and the existing organizational conditions. The ideal organizational conditions would certainly improve the efficiency and effectiveness of an organization. The Wilcoxon signed rank tests confirmed that the perceptions of the respondents differ significantly ($p < 0.01$) pertaining to the existing and ideal organizational dimensions. It indicates that the organizational climate of the DoFs needs improvement to become an ideal organization. This shows that respondents expect an ideal organizational, manpower and extension preparedness to improve their DoFs performances.

With Fisheries being the state subject, like agriculture, the extension function lies with the DoFs of respective states. There was no uniform organizational setup that

Table 4. Respondents' mean score of organizational attributes.

Sl. no.	Organizational attribute	Mean score		Minimum score possible	Remarks
		AUDIT	IDEAL		
1	Organizational appraisal	8.8	11.77	5	Revamp
2	Human resource appraisal	14.71	19.91	7	Recruit
3	Extension service appraisal	14.29	21.31	8	Reorient
Grand mean		37.8	52.99	20.00	Revamp, recruit and reorient

Notes: Wilcoxon signed ranks test score of significance between the perceived existing and ideal organizational attributes: 0.0023371; **Significant at the 1% level of probability.

existed in all nine of the major maritime states of the country. The main activity of the fisheries departments was the welfare of fisher folk, not the extension education/service. Hence, the department was oriented towards welfare measures only. As far as aquaculture was concerned all backward and forward services and inputs (inputs, technical service, process and market) were carried out by private players. The departments did not reach the grassroots level and sometimes three or four districts were looked after by a single office. Further, the majority of the personnel working in the DoFs were from general biology/zoology or from other subjects and they lacked extension subject orientation. Since most of their time was spent on welfare and administrative matters over the years, they neither had the time nor the inclination for an extension service. DoFs were constrained with poor infrastructure, manpower, extension subject orientation, extension material and audio-visual aids and most importantly lack of a budget for an extension service. There was no meaningful linkage between the research and extension institutions. The Fisheries Colleges and Research Institutes (FCRI) of the state agriculture universities were supposed to be the major research support for DoFs though ICAR institutes work for the wider national mandate. For the FCRI, being an educational institution, manpower development was their top priority and the research component was invisible. Hence, there was no linkage, that is, flow of technical information and field problems, between them, other than that some officers on both sides were members of some of the committees of respective agencies. There is no established mechanism to facilitate the two-way flow of information from research to extension and vice versa at present.

*Co-existence of Public Extension and Regulated Private Extension Service—
The Suggested Extension Approach*

The results of the study have revealed in unequivocal terms that farmers rely on private extension service providers (inputs companies, aqua consultants and progressive farmers) for their technical information. Further, independent aqua consultants and progressive farmers were seen to be working for the welfare of the farmers because consultants' survival is dependent on the success of farmers and the progressive farmers advocated for the sustainability of farming in their neighborhoods. On the other side, the fishery extension officers were neither given the opportunity to update their knowledge nor were they inclined to do so. The linkage between the research and extension agencies was mostly of a 'contextual and contact only' nature, not 'regular and collaborative'. Further, the extension organization was also constrained in terms of manpower, extension orientation and budget to provide an effective extension service. In spite of that, considering the different strata of farming population, nature of farming systems, levels of operation and other realities the respondents—aqua farmers, fishery extension officers and researchers—felt that state-owned extension services 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 requirements of high-value farming like brackishwater aquaculture which demands advanced technical guidance. Hence, viewing the pros and cons of the existing scenario, the study has suggested a 'co-existence of public and public-regulated private extension services' as a

pragmatic extension approach and a strategy of public-private partnership in extension service provision with the following requirements.

- To streamline the public extension service and to facilitate partnerships, the evolution of a National Fisheries and Aquaculture Extension Service (NFAES) to strengthen the public extension system (DoFs) with structural and functional modifications is needed. A strong public funded extension service is essential to cater to the diverse 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 to sustainability. It has been amply proved that investments in aquaculture extension and policy support have contributed to the rapid development of aquaculture in Asia (World Bank, 1998; NACA/FAO, 2000; Rabanal, 1995; Potipitak, 1996; and Karim, 1997) and in China, which contributes 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; and Gupta, 2009).
- An institutional mechanism which facilitates the linkage between research and extension systems 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 needs-based technology development, transfer and communication of field feedback.
- Public-funded extension alone may not be able to cater to the specific requirements of a diverse sector-specific people; hence, the immediate extension strategy would be that the public research and extension system should make use of the service-minded farm opinion leaders and aqua professionals for field extension services. The current efforts of the Government of India to improve the extension services also include encouraging Public Private Partnership (PPP) in various modes/forms which can provide a synergistic approach to extension efforts (DOE, 2006). Farmer-to-farmer communication has been found to be very effective in disseminating fisheries information (Turongruang and Demaine, 2002; Tu and Giang, 2002; Muok et al., 2005; Fernando et al., 2005; Kris et al., 2007; Kumaran, 2006, 2007). Professional aqua consultants have excellent networks with farmers through their regular contacts and services. They could be involved in technology validation and extension work on a trial basis. The national draft extension policy also stated that para-technicians in farm extension should be encouraged for organizing demand-driven production systems, enabling them to serve not only the farmers but the entire country better, thereby strengthening the extension system (Government of India, 2000; Sekara, 2001; Signorini, 2001; Tiedao et al., 2001; MANAGE, 2003; Nancy, 2004).

Conclusion

Aquaculture extension services are expected to facilitate the farming community to access backward and forward inputs and services, educate the farmers on better farm

management practices, food safety guidelines and enforce regulatory guidelines for the planned aquaculture growth. However, insufficient extension service orientation, inadequate manpower and lack of budgetary provisions for extension work have hampered the public extension agency in providing the expected service. Lack of research-extension linkage mechanisms have further aggravated capacity enhancement and information dissemination. Moreover, inputs and services are mostly in the hands of private companies and individuals. Being a high-investment and risk-intensive enterprise aquaculture farmers have to depend on inputs dealing people who provide them with technical advice on-site. Nevertheless, a public extension service is essential to help the resource poor farmers and regulate the sector as per the guidelines. Hence, a sector-specific better-fit extension approach of 'co-existence of public funded and government regulated private extension services' with a national mission to strengthen the public funded extension systems at the country level is needed. The suggested approach could facilitate strong research and extension linkage and build partnerships with service-oriented private people like the farm opinion leaders, farmers' groups and fisheries professionals in the field, to streamline the fisheries and aquaculture extension service in India.

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