Fishery Technology
2009, Vol. 46(2) pp : 185 - 192

Technology Development Efficiency and Socio Personal Characteristics of Researchers in Marine Fisheries

J. Charles Jeeva, J. Vasanthakumar*, S. Balasubramaniam and V. Geethalakshmi
Central Institute of Fisheries Technology,
Matsyapuri P.O., Cochin - 682 029, Kerala, India.

This paper deals with the assessment of the technology development efficiency among the researchers in marine fisheries and identification of the influencing socio-personal characteristics. The study was conducted among 72 researchers of two premier fisheries research Institutions. The results revealed that the technology development efficiency index was 88.51 ± 10.01. Among the 15 variables studied, the variables viz., communication behaviour, extent of linkages with extension and clientele systems, time utilization in research, participation in professional bodies, in-service training undergone, job satisfaction, job performance and technologies generated had positive and highly significant relationship with the technology development efficiency. The R^2 value indicated that all the variables taken together served as cause for explaining 57.60 % of variation in the efficiency level in the technology development process. The present results establish that the technology development process is efficient in marine fisheries.

Key words: **Research system, technology development process, client orientation, attitude, time utilization, linkages, job satisfaction, job performance.**

In planned fisheries development, a large number of scientists, technocrats and other categories of personnel are involved in research, education, technology transfer and administration. Fisheries research is conducted by eight ICAR Research Institutes, twelve Fisheries Colleges under Agricultural and allied Universities, and also by several other Universities in India. Over the years, they have developed several technologies for wider adoption. Inspite of considerable interactions in research and technology transfer, technological gaps exist due to various factors including lack of efficiency of technology development and transfer processes, the resource poor nature of clients, imbalances in social development, vagaries of weather on water bodies and dynamic market conditions.

Several conferences and seminars dealt with various issues in fisheries, and problems often reported are technological gaps and priorities given in the research and extension systems. Swaminathan (1979) has pointed out that the ultimate objective of research in agriculture is to develop technologies that are suitable to users. The achievements in the research institutes should reach the farmer to get the maximum returns from the investments in research. The technological findings of different disciplines of agricultural, animal and fishery sciences are available in the form of research reports, project files, research articles, research notes etc (Sabarathnam, 1987). These findings must reach the clients if the purpose of the research is to be served.

* Department of Agricultural Extension, Faculty of Agriculture, Annamalai University, Annamalai Nagar - 608 002, Tamil Nadu, India

In this context, it is of utmost importance to study the research outputs from various fisheries research institutions. Many research studies have revealed that only thirty percent of the farmers have utilized the technologies generated by the research system. Hence, there lies a great gap in the technology generation and adoption. It is essential that there should be efficient technology development, technology transfer and technology adoption among clientele systems. The technology development process is a complex phenomenon involving various steps, identifying the problem from different sources, considering multiple factors in prioritizing the thrust areas, following different approaches, and expecting different outcomes. In this context, this study was taken up with the objectives to assess the technology development efficiency among the researchers in marine fisheries and to identify the related socio-personal characteristics.

Materials and Methods

The study involved the researchers of two premier fisheries research Institutions in Ernakulam district, Kerala state, India. Both the Institutes are actively involved in research, extension and education in the field of marine fisheries. As the number of research personnel is limited, all the researchers in the two Institutes, available at the time of investigation were considered for the study, and the questionnaires developed for the study were personally handed over to them. The responses were received in time from 72 researchers from both the Institutes. Data were collected by using structured and pre-tested questionnaires developed for the purpose.

The efficiency of the technology development process was operationalized as the extent of adoption of the identified activities and other associated factors in the process of evolving the technologies, with specific clients or potential end users in view. Based on the review of literature, discussion with experts and relevancy rating from judges, 48 items were identified under five sub heads viz., steps in the technology development process, sources of the research idea, factors considered in prioritizing the thrust areas, approaches followed and expected outcome of the technology development process. The researchers were asked to indicate their response to each of the activity, i.e., the extent of adoption of the listed 48 items in their technology development process, on a two-point continuum viz., 'Adopted' and 'Not Adopted' with the scores of two and one respectively. The total score of an individual respondent was obtained by adding up the scores secured by him/ her for all the 48 items.

The Technology Development Efficiency Index (TDEI) was calculated by using the formula;

$$\text{TDEI} = \text{Actual score obtained} \times 100 / \text{Maximum score possible}$$

Based on the index values obtained, the respondents were categorized into low, medium and high categories using cumulative frequency distribution. Item-wise frequencies and percentages were also worked out to have an in-depth understanding about the technology development process.

The independent variables viz., age, educational qualification, professional experience, annual income, time utilization pattern, participation in professional bodies, communication behaviour, in-service training undergone, extent of linkages with extension and clientele groups, job performance, technologies generated and research articles/ extension literature published were measured through indices developed for this study. The variables, rural/ urban background and job satisfaction were measured through scoring patterns followed in earlier studies (Balasubramaniam, 1988). Attitude towards participatory technology development was measured through an attitude scale constructed for this study, using the method suggested by Likert (1932). Using Statistical Packages for Social Sciences (SPSS), the statistical tools viz., frequencies and percentage analysis, cumulative frequency distribution, simple correlation coefficient and multiple regression analysis were employed for analyzing the data of this study.

Results and Discussion

The frequency distributions of researchers according to their socio-personal characteristics studied are given in Table 1. The majority of the researchers were middle-aged (52.78%), had Ph.D as educational qualification (70.83%), urban background (61.11%) and medium level of professional experience (37.50%). Time utilization was reported on activities such as, basic research (15.82%), applied research (51.39%), analytical work (6.97%), consultancy services (3.24%), extension/ training (7.94%), teaching (7.84%), administration (4.25%) and other activities

Table 1. Distribution of researchers according to their socio-personal characteristics (n=72)

Sl. No.	Variables	Frequency	Percentage
1.	Age (Years)		
	a) Young (Upto 35 years)	5	6.94
	b) Middle (36-45 years)	38	52.78
	c) Old (Above 45 years)	29	40.28
2.	Educational qualification (Scores)		
	a) Ph.D	51	70.83
	b) Post Graduate	21	29.17
3.	Rural-Urban background (Scores)		
	a) Rural	28	38.89
	b) Urban	44	61.11
4.	Professional experience (Years)		
	a) Low (12.67 and below)	24	33.33
	b) Medium (12.68 to 24.34)	27	37.50
	c) High (24.35 and above)	21	29.17
5.	Annual income (Rupees '000)		
	a) Low (379 and below)	38	52.78
	b) Medium (380 to 539)	24	33.33
	c) High (540 and above)	10	13.89
6.	Total time utilization for research (%)		
	a) Low (53.33 and below)	19	26.39
	b) Medium (53.34 to 76.66)	29	40.28
	c) High (76.67 and above)	24	33.33
7.	Participation in professional bodies (scores)		
	a) Low (1.67 and below)	28	38.89
	b) Medium (1.68 to 3.34)	38	52.78
	c) High (3.35 and above)	6	8.33
8.	Communication behaviour (%)		
	a) Low (22.67 and below)	17	23.61
	b) Medium (22.68 to 30.34)	36	50.00
	c) High (30.35 and above)	19	26.39
9.	In-service training undergone (Scores)		
	a) Low (3.33 and below)	60	83.33
	b) Medium (3.34 to 6.66)	10	13.89
	c) High (6.67 and above)	2	2.78
10.	Extent of linkage (%)		
	a) Weak (9.67 and below)	18	25.00
	b) Moderate (9.68 to 14.34)	41	56.94
	c) Strong (14.35 and above)	13	18.06
11.	Job satisfaction (%)		
	a) Low (21.33 and below)	14	19.44
	b) Medium (21.34 to 25.66)	15	20.83
	c) High (25.67 and above)	43	59.73
12.	Job performance (%)		
	a) Poor (35 and below)	8	11.11
	b) Average (36 to 40)	26	36.11
	c) Good (41 and above)	38	52.78
13.	Technologies generated (Scores)		
	a) Low (1.1 and below)	9	12.50
	b) Medium (1.2 to 8.65)	55	76.39
	c) High (8.66 and above)	8	11.11
14.	Research articles/ extension literature published (Scores)		
	a) Low (17.22 and below)	10	13.89
	b) Medium (17.23 to 67.39)	48	66.67
	c) High (67.40 and above)	14	19.44
15.	Attitude towards participatory technology development process (Scores)		
	a) Unfavourable (26.67 and below)	10	13.89
	b) Neutral (26.68 to 33.34)	43	59.72
	c) Favourable (33.35 and above)	19	26.39

(2.57%), which included guidance of research scholars, institute building activities, etc. They had medium scores on participation in professional bodies (52.78%), communication behaviour (50.00%), linkages with extension and clientele groups (56.94%), number of technologies generated (76.39%) and number of research articles/extension literature published (66.67%). Majority (83.33%) of them had low level of exposure to in-service training programmes. Benor *et al* (1984) emphasized the importance of training for upgrading skills and professional competency. More than half of them had high levels of job satisfaction (59.73%) and job performance (52.78%). Majority of the researchers had neutral attitude (59.72%) towards participatory technology development, followed by favourable attitude (26.39%) and unfavourable attitude (13.89%).

The distribution of respondents according to the technology development efficiency index scores is given in Table 2. The overall technology development efficiency index was 88.51±10.01 and majority of the respondents (73.61%) belonged to high category, followed by medium (22.22%) and low (4.17%) in their distribution based on technology development efficiency index scores. Though the categorization showed an encouraging result, there is scope for further improvement. For widespread acceptance of technologies generated, the technology development process should be client oriented.

Table 2. Distribution of respondents according to the Technology Development Efficiency Index (n=72)

Sl. No.	Category	Frequency	Percentage
1.	Low (64 % and below)	3	4.17
2.	Medium (65% to 80%)	16	22.22
3.	High (81% and above)	53	73.61
	Total	72	100.00
	Mean = 88.51 ± 10.01		

Hence a stronger emphasis should be placed upon ensuring that research conducted by the organization is matched with corresponding community impacts.

The item-wise analysis in Table 3 showed that the extent of adoption of the defined steps in the technology development process was more than 80 percent for all steps except for the three steps viz., multi-location testing, assessing the perceived attributes of innovations and technology assessment and refinement. This needs the attention of research managers so as to ensure that these steps are strictly followed in the technology generation process. Conducting on-field adaptive testing in various locations away from the research institutions, assessing the perceived attributes of innovations such as relative advantage, compatibility, complexity, trialability and observability and refining the technologies based on such assessments would result in generating need-based technologies.

The prime sources of the research ideas were literature-based or review of secondary data (94.44%), followed by colleagues (92.36%), personal inclination (90.97%), success or failure of prior works (90.97%) and Information Technology (IT) based resources (90.28%). Problem identification is the crucial activity in the technology generation process. The preceding results indicated that the priority sources of the research problems were literature-based or personal inclination of the researchers. The important sources vital for developing client-oriented technologies, such as the feedback from the clientele and extension personnel, and the indigenous technical knowledge (ITK) of the clientele, have been given least priorities. These sources can ensure co-operation from the end-users in developing need-based or location-specific technologies to suit the skill, labour, capital and other resources of the client system.

Table 3. Technology Development Efficiency Index: Extent of adoption of activities in the technology development process and other related factors

Sl. No	Activities	Adoption Index	Adopted Freq.	Adopted %	Not Adopted Freq.	Not Adopted %
A. Steps in the technology development process						
1.	Survey of the existing knowledge, attitude, practices and resources of the client system	84.03	49	68.06	23	31.94
2.	Acquiring background information and insight into the research problem	95.83	66	91.67	6	8.33
3.	Prioritizing the research problem	93.75	63	87.50	9	12.50
4.	Formulation of objectives and hypotheses	94.44	64	88.89	8	11.11
5.	Choosing the appropriate research strategy	96.53	67	93.06	5	6.94
6.	Preparing the plan of action	95.83	66	91.67	6	8.33
7.	Designing tools and instruments	93.06	62	86.11	10	13.89
8.	Detailing interdisciplinary approaches, wherever necessary	87.50	54	75.00	18	25.00
9.	Demarcating field and lab experiments	91.67	60	83.33	12	16.67
10.	Preparing project proposal in the prescribed proforma	95.83	66	91.67	6	8.33
11.	Development of infrastructure and procuring inputs	95.14	65	90.28	7	9.72
12.	Conducting research	97.92	69	95.83	3	4.17
13.	Analysis and interpretation of data	97.22	68	94.44	4	5.56
14.	Verification of findings	92.36	61	84.72	11	15.28
15.	Multi-location testing	72.92	33	45.83	39	54.17
16.	Assessing the perceived attributes of innovations (relative advantage, compatibility, complexity, trialability and observability)	75.69	37	51.39	35	48.61
17.	Technology assessment and refinement	79.86	43	59.72	29	40.28
18.	Release of technology	84.72	50	69.44	22	30.56
B. Source of the Research idea						
1.	Literature-based/ review of secondary data	94.44	64	88.89	8	11.11
2.	Indigenous Technical Knowledge of the client system	79.86	43	59.72	29	40.28
3.	Informal and formal surveys	88.19	55	76.39	17	23.61
4.	Identification of policy issues	86.81	53	73.61	19	26.39
5.	Feedback from the extension worker	77.78	40	55.56	32	44.44
6.	Feedback from the clientele group	86.11	52	72.22	20	27.78
7.	Colleagues	92.36	61	84.72	11	15.28
8.	Personal inclination	90.97	59	81.94	13	18.06
9.	IT based resources	90.28	58	80.56	14	19.44
10.	Success/ failure of prior works	90.97	59	81.94	13	18.06
C. Factors considered in prioritizing thrust areas						
1.	Organizational goals	96.53	67	93.06	5	6.94
2.	Government policies	90.97	59	81.94	13	18.06
3.	Likely impact of technology- socio-cultural, economical, technical and environmental	90.28	58	80.56	14	19.44
4.	Urgency/ timeliness of the problem	91.67	60	83.33	12	16.67
5.	Resources available	95.83	66	91.67	6	8.33
6.	Practical applications of the innovations	96.53	67	93.06	5	6.94
7.	Felt needs of the clients	89.58	57	79.17	15	20.83
D. Approaches followed in the technology development process						
1.	Systems approach covering research, extension, client and support systems	86.81	53	73.61	19	26.39
2.	Need-based, demand-driven and bottom-up approach	91.67	60	83.33	12	16.67
3.	Participatory approach- encouraging the participation of clients in the various stages of technology development process	68.75	27	37.50	45	62.50
4.	SWOT approach- recognizing the Strengths, Weaknesses, Opportunities and Threats in the research, extension, clientele and support systems	78.47	41	56.94	31	43.06
5.	Ensuring that the gain from the adoption of the innovation adequately compensates the additional expenditure of money, time, labour etc. that its adoption may involve	70.14	29	40.28	43	59.72
E. Expected outcome of the technology development process						
1.	Innovations, for a specific practical situation (Reducing the cost of production, improving productivity, employment opportunities, income generation etc.)	83.33	48	66.67	24	33.33
2.	Filling the gap in earlier research	92.36	61	84.72	11	15.28
3.	Solving location-specific problems	90.28	58	80.56	14	19.44
4.	Explaining certain un-explained phenomenon	79.17	42	58.33	30	41.67
5.	Data use	89.58	57	79.17	15	20.83
6.	Hypothesis testing-expectations about the results of an action	84.03	49	68.06	23	31.94
7.	Producing certain desired changes in the environment	84.03	49	68.06	23	31.94
8.	Scientific development	96.53	67	93.06	5	6.94
	Technology Development Efficiency Index		**Mean = 88.51 (SD = 10.01)**			

The results indicated that the organizational goals were the major factors in prioritization of thrust areas. Though every research institute has its own mandate, flexibility should be there to work on need-based problems. Researchers should have the autonomy to work on issues of their choice. The technologies evolved might be having varied attributes such as, profitability, initial investment, complexity, local compatibility, direct and indirect impact, availability of inputs and other relative advantages of adoption, and need to be adapted to suit the resource base of clients. These determinants have to be given due importance by the research system in the process of technology generation. The organizational goals or the mandate of the research system might also have reflected in the expected outcome of the technology development process. However, enough care has to be taken on the practical applications of the innovations such as, reducing the operational expenditure, increasing the production, reducing the drudgery in works, better utilizing the resources, income generation, and ultimately, the better livelihood for the clientele. In addition to the organizational goals, the autonomy for the researchers to work on these issues will improve the success rate of developed technologies.

Simple correlation coefficients were calculated to assess the existence of any relationship between the socio-personal variables and Technology Development Efficiency Index. In order to find out the relative importance of various characteristics influencing the Technology Development Efficiency Index, the data were subjected to multiple regression analysis. The results are given in Table 4.

Table 4. Correlation and Regression Analyses between the Socio-Personal Variables and Technology Development Efficiency Index (n=72)

Sl. No.	Variables	Correlation coefficients (r)	Regression coefficients (b)	SE of 'b'	't'
1.	Age	-0.020	-0.750	0.542	-1.509
2.	Educational qualification	0.126	0.014	2.823	0.106
3.	Rural/ urban background	0.164	0.198	2.375	1.636
4.	Professional experience	0.027	0.620	0.533	1.210
5.	Annual income	0.095	0.356	0.019	1.541
6.	Time utilization in research	0.142*	0.083	0.067	0.681*
7.	Participation in professional bodies	0.295*	0.131	1.189	1.006
8.	Communication behaviour	0.330**	0.212	0.256	1.476
9.	In-service training undergone	0.250*	0.079	0.757	0.542
10.	Extent of linkage with extension and clientele groups	0.315**	0.051	0.435	0.378
11.	Job satisfaction	0.244*	0.286	0.315	2.146*
12.	Job performance - self appraisal	0.049*	0.143	0.324	1.125*
13.	Technologies generated	0.250*	-0.014	0.403	-0.087
14.	Research articles/ extension literature published	0.093	-0.061	0.063	-0.366
15.	Attitude towards participatory technology development process	0.176	0.064	0.275	0.532

(** Significant at 1% level; * Significant at 5% level; R^2 = 0.576; F= 1.882*)

Among the 15 variables studied, the variables viz., age, educational qualification, rural/ urban background, professional experience, annual income, number of research articles published and attitude towards participatory technology development did not show any relationship with the efficiency of technology development process. The variables, communication behaviour and extent of linkages with extension and clientele groups showed positive and highly significant relationship ($p<0.01$) and the variables viz., time utilization in research, participation in professional bodies, in-service training undergone, job satisfaction, job performance and technologies generated showed positive and significant relationship ($p < 0.05$). A perusal of the regression coefficients revealed that, out of the 15 variables, only three variables viz., time utilization in research, job satisfaction and job performance had contributed significantly towards the efficiency in technology development process. The R^2 value indicated that, all the variables taken together served as cause for explaining 57.60% variation in the efficiency level. The significant 'F' value revealed the overall significance of the regression at five percent level of probability.

The major constraints in the technology development process as perceived by the respondents were administrative bottlenecks (58.33%), lack of adequate research and technical staff (54.17%), lack of proper feedback from the clients and extension personnel (45.83%), lack of periodical training of researchers (41.67%), lack of autonomy (25.00%), non availability of time (25.00%), inadequacy of financial resources (25.00%), lack of infrastructural facilities (22.22%), lack of conducive working climate (15.28%), lack of transport facilities (15.28%), increase in stress (15.28%), lack of support from colleagues and subordinates (11.11%), etc.

Technology refinement based on feedback from extension personnel and clients, socio-economic viability reports for the technologies evolved, operational research with active involvement of stakeholders, adequate manpower and infrastructural facilities, collaborative effort of research, extension and client system in evolving the technologies, multidisciplinary approach, need-based research, field trials before release of technologies, autonomy for researchers, adequate support from administration and training of the researchers on specialized subjects were reported as suggestions to improve the efficiency of technology development process.

The present results establish that the technology development process is efficient in marine fisheries. Hence, the assumption that the technology development process is not efficient in marine fisheries is baseless, and the gaps in adoption of fishery technologies might be possibly due to other factors such as, the diversified socio-economic characteristics, informational and knowledge barriers among the client system, the bottlenecks in technology transfer efforts, varied attributes of technologies such as profitability, initial investment, complexity, local compatibility, availability of inputs, etc. The study also helped to identify the essential elements, constraints and suggestions to augment the technology development efficiency in marine fisheries. The results of the study on the influence of various characteristics of researchers on the technology development process could be appropriately manipulated in the future research management and organizational strategies to improve the efficiency of the process. A technology is said to be successful, only when majority of the clientele groups implements it without any inhibition and gets satisfied with the result. However, all research innovations cannot be adopted in the field, as they have varied attributes. Hence, location-specific technology generation and target-based technology transfer efforts have to be followed for wider adoption and popularization. Paradigm shifts in technology development process such as the shift from mono-disciplinary to multi disciplinary, supply-driven to demand-driven, general to location-specific etc. are the need of the hour.

The authors express their sincere thanks to Director, CIFT, Cochin for granting permission to publish this paper. Thanks are also due to the respondents of this study for their kind cooperation extended during the research investigation.

References

Balasubramaniam, S. (1988) Analysis of Technology Transfer Effectiveness in Inland Fish Farming. Ph.D. Thesis, TNAU, Coimbatore, India

Benor, D., Harrison, J.Q. and Baxter, M. (1984) Agricultural Extension- The Training and Visit System, the World Bank, Washington D.C., USA.

Likert, R. (1932) A Technique for the Measurement of Attitude, *Arch. Psychology*, No. 140

Sabarathnam, V.E. (1987) A Study on the Process of Development and Dissemination of Dry land Agricultural Technology. Ph.D. Thesis, Andhra Pradesh Agricultural University, Hyderabad, India.

Swaminathan, M.S. (1979) New Technology-Problems and Potentialities in Agricultural Development in India (Shah, C.H. and Vakil, C.N., Eds), Orient Longman Ltd., Bombay, p. 457.