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Forecasting Technological Needs and Prioritizing Factors for the Post-harvest Sector of Indian Fisheries

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Abstract

It is imperative to articulate technological needs of fish processing sector as future technologies for the domain of Indian seafood sector are expected to be different from what these are now. This calls for forecasting technological needs to fill the gaps in the present technological trends. Technology Forecasting is required for better planning and future preparedness, and may also give strategic advantage and global competitiveness in research and development. Non-thermal processing, active and intelligent packaging, development of high pressure and nuclear packaging technologies for food safety and security, biodegradable packaging and radiation preservatives emerged as frontier technological areas. The future researchable thrust areas in post-harvest fisheries *viz.*, in the area of processing, biochemistry and nutrition, seafood quality assurance, microbiology/biotechnology/molecular biology, fishery engineering & instrumentation and extension methodologies are detailed in this communication. Major factors that need attention for the development of fish processing sector for enhancing productivity are prioritized. Inadequate pre-project diagnosis of field problems and lack of proper feedback from the client and extension systems were reported as major constraints in research and development in the seafood sector.

Keywords: Technology forecasting, technological needs, fish processing, thrust areas

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Introduction

Fisheries sector is one of the fastest growing food sectors of India. The sector plays a pivotal role in the national economy, in view of its contribution to the food basket of the country, nutritional security, social objectives, sustainable large foreign exchange earnings, employment generation, besides stimulating subsidiary industries (Ayyappan & Biradar, 2004). The sector contributes 1.07% to the National GDP and 5.3% to agricultural GDP. Some of the issues in post harvest fisheries are unhygienic practices during handling and processing, inappropriate technologies in use, the need for more value added products and inadequate marketing facilities and information (FAO, 2000). There are also issues which need inter-disciplinary approach such as, post harvest losses, fisheries trade and quality control and fish quality and safety legislation (http://www.megapesca.com/issues.htm). In view of the points discussed, and in the context of dwindling resources, increasing globalization and emergence of new markets, the future of Indian seafood sector is bound to be affected, and is likely to be much different from what it is now. Upcoming technologies are expected to be different from what these are now which would require reconciliations of conflicting socio-economic and environmental objectives and trade-offs.

It is therefore imperative to articulate technological needs of different aspects of fish processing and contemplate how developments in science and policy can help address these needs. This calls for application of tools in the domain of fisheries from the field of Technology Forecasting (TF). TF is the qualitative and/or quantitative prediction at stated level of confidence of feasible and/or desirable characteristics of performance parameters of future

technologies, such as machines, procedures or techniques necessary for sustainable development with a specific time frame and specified level of support. TF is required for better planning and future preparedness, enlarging the choice of opportunities and setting priorities, assessing impact and chances, focusing selectively on economic, technological and social areas for further research and it may also give strategic advantage and global competitiveness in research and development.

Against this background, a workshop cum brainstorming on 'Forecasting Technological Needs for Fishing and Fish Processing Sectors in India' was organized to identify the future technological needs in the post-harvest sector of Indian fisheries. This paper presents the outcome of the technology forecasting exercise in terms of the frontier technological areas, future researchable thrust areas and the major factors that need attention for the development of fish processing sector.

Materials and Methods

In this study, questionnaire approach was used for forecasting technological needs in fish processing sector. Information from subject matter experts, who participated in the workshop (sample size of 51), was obtained for identification of specific technologies with greater utility in the years to come and for prioritizing factors affecting various aspects. As far as possible, the questions were made self explanatory, avoiding ambiguity, answers easy to select with sufficient space left for remarks. It was made simple but not compromising on the essentials for prioritizing factors / technological forecast of the events chosen. Each question focussed on one event only. Some questions were open-ended leaving space for the experts to pen down their ideas without influencing their thought process while some were having a list of possible options which they need to prioritize on a three point linguistic scale ranging from 'more important' (MI) to 'least important' (LI), the intermediate scale being 'important' (I), with few additional rows left blank for the experts to fill in factors left out, if any, in the list provided.

Data from 51 completely filled-in questionnaires obtained from subject matter experts were also analyzed for prioritizing factors that needed attention for the development of fish processing sector using linear combination scoring method. Each factor was scored by experts individually on a comparable three point linguistic scale, 'more important' through 'less important', and frequency counts were determined. Thereafter, weighted linear combination scores (weights being 1, 0.66 and 0.33 respectively for MI, I and LI) have been calculated using these individual counts separately for each factor.

Results and Discussion

On synthesizing the information provided by the respondents with regard to the emerging technologies in various areas of post-harvest sector, the frontier technological areas that emerged in fish processing sector domain were non-thermal processing technology, active and intelligent packaging, internationally-demanded value added products, development of high pressure and nuclear packaging technologies for food safety and security, high shelf life foods, convenient foods, biodegradable packaging materials, radiation preservation and non-thermal processing.

The future researchable thrust areas in post harvest sector that emerged were cold chain management strategies, development of greener technologies, development of ready reckoner for the detection of pathogenic organisms in fish and its products, development of spatial databases on fish processing technologies using GIS mapping, eco labelling/ fisheries certification, fingerprinting/pathogenomics of *Salmonella* and *Vibrio cholerae*, studies on socioeconomics, post harvest loss assessment, innovative communication tools for technology transfer, non-thermal processing, Public-Private Partnership (PPP) in technology development and transfer, development of simple and rapid methods for quality evaluation of fish and fish products, studies on technological adoption and impact, molecular methods for detection of seafood borne pathogens, nutrition labelling for fish and fishery products, pharma/ nutraceutical products from processing wastes, reverse transcriptase- PCR (RT-PCR) assay for the quantification of fish pathogens, development of cost-effective processing technologies, development of appropriate decision support systems for fisheries, smart/modern/green packaging, high value products and by-products, predictive modelling of seafood borne pathogens, seafood export related studies, development of fish processing equipments, novel genes and enzymes from marine bacteria, thermal processing, optimum resource use and zero waste generation fish processing units.

Table 1. Prioritization of major factors that need attention for the development of fish processing sector for enhancing productivity: scoring method

Prioritizing Factors	Frequency counts			Weighted Sum
	Less Important	Important	More Important	
Institutional and Policy				
Strengthening infrastructural facilities in fish landing centres/ fishing harbours	0	7	42	46.62
Organized marketing support	0	18	30	41.88
Timely availability of inputs/ resources/ raw materials	1	19	29	41.54
Pollution control	0	22	27	41.52
Effective institutional support	1	25	23	39.50
Integrated coastal zone management	4	18	26	37.88
Trade promotion	2	27	20	37.82
Safeguards from trade shocks	8	22	18	32.52
Favourable credit policy	4	32	10	31.12
Minimum support price	9	32	9	30.12
Stock certification and eco-labelling	9	23	15	30.18
Enhanced public investment	7	27	11	28.82
Subsidies	21	24	4	19.84
Technological				
Value addition	0	12	36	43.92
Eco-friendly technologies	1	16	33	43.56
Effective post harvest management	1	16	33	43.56
Diversification in fish processing	1	17	30	41.22
Development of location specific technologies	2	16	30	40.56
Better utilization of by-catches and low value fishes	2	20	27	40.20
Traceability	5	23	20	35.18
Promotion of Indigenous Technical Knowledge (ITK)	7	33	11	32.78
Extension				
Effective extension services by State fisheries/ ICAR institutes	0	23	28	43.18
Use of Information and Communication Technology (ICT)	1	20	29	42.20
Organizing regular awareness programmes to the stakeholders	3	21	26	39.86
Organizing regular/ adhoc training programmes to the stakeholders for HRD	4	28	18	36.48
Strengthening extension efforts and budget allocation	7	18	24	35.88
Socio-Economic				
Socio-economic issues affecting the coastal communities	1	20	27	40.20
Impact studies on consumer behaviour and marketing channels	2	20	26	39.20

Johnston et al. (2008) reported that the drivers for emerging technologies in food processing sector are environmental sustainability, improved understanding of dietary requirements and raw material availability. Akinneye et al., (2007) reported that the development of appropriate post harvest technologies that employed effective production, handling, harvesting, processing and storage, cannot be overemphasized especially in the age when aquacultural development is gathering momentum.

The major factors considered by the processors for adopting new technologies were cost and benefits. The acceptability of new innovations in small-scale fish processing operations were hinged on literacy level, cost of machineries, level of awareness on innovations, infrastructural facilities available such as electricity, source of water and accessible roads. Information on the availability of technologies to the fish processors were mainly obtained from neighbouring fish processors. In many cases, it has been left to the extension service to articulate the needs of fish processors. Priority should be given to the training on operational and maintenance skills necessary to sustain small scale fish processing, increase capacity and make available to processors regular supplies of the fish products, as required by larger buyers (Davies & Davies, 2009).

Major factors requiring immediate attention for the development of fish processing sector for enhancing productivity were prioritized by the scoring method (Table 1). It includes the institutional and policy issues such as strengthening infrastructural facilities in fish landing centres/ fishing harbours, organized marketing support, timely availability of inputs/ resources/ raw materials, and the technological issues such as value addition, effective post harvest management and diversification in fish processing. Since there is heavy demand for fish, there is an imperative need for improving the techniques for production, processing, product formulation, packaging, storage and transportation (Devadasan, 2004). Appropriate processing of fish enables maximum use of raw material and production of value added products which is obviously the basis of processing profitability (Al-Jufaili & Opara, 2006).

The major constraints in research and development for fisheries perceived by experts are given in Table 2. Poor targeting of research problems/less need based research, inadequate pre-project diagnosis of field problems and lack of proper feedback from the client and extension systems were reported as major constraints in research and development in the seafood sector.

With increasing importance and contribution of fisheries sector, there is a constant need for assessment and forecasting of future technological needs in order to have innovative policies, technologies and opportunities for holistic and sustainable development. There is a need to review current status of fisheries and fisheries science, and to look into the future challenges that may emerge in fisheries sector. For this, deliberations of short,

Table 2. Major constraints in research and development for fisheries

Issues	Less Important	Important	More Important	Weighted Sum
Poor targeting of research problems/ less need based research	2	20	27	40.20
Inadequate pre-project diagnosis of field problems	2	14	31	40.24
Lack of proper feedback from the client and extension systems	2	20	24	37.20
Administrative bottlenecks	8	20	21	34.20
Inadequate coordination between technocrats and administrators	7	22	20	34.52
Depleting scientific, technical and administrative manpower	12	19	18	30.54
Inadequate research infrastructure	10	19	18	30.54
IPR related issues	17	23	7	22.18

medium and long-term Indian fisheries prospects are required. Examination of plausible scenarios, covering various societal development choices, can hopefully turn around any negative trends besetting fisheries and rebuild the supporting ecosystems.

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