Fishery Technology 50 (2013) : 331 - 336

Technology Evaluation Model for Rural Innovations – Case Study of Rubberwood Fishing Craft for the Small-scale Fisheries Sector

Nikita Gopal* and Leela Edwin
Central Institute of Fisheries Technology, P.O. Matsyapuri, Cochin - 682 029, India

Abstract

The use of rubberwood (*Hevea brasiliensis*) for fishing craft construction is an innovation introduced by the Central Institute of Fisheries Technology (CIFT), Cochin, Kerala, India. Technology evaluation is an integral part of any technology development to place the technology in its proper perspective. This paper presents a simple model of evaluating the technology by describing the Planning, Monitoring and Evaluation (PME) cycle and assessing impact through patent profiling, cost evaluation and looking at the social benefits. It has been observed that introduction of the technology has made available an alternative timber to the traditional boat building industry. Reduction in cost of construction to the tune of 28% and overall reduction of 35-40% in maintenance costs has been possible. FRP sheathed rubberwood fishing crafts are maintenance free. A patent profiling of the technology revealed that for use of rubberwood in traditional fisheries for canoe construction, there are no patents except for the ones filed by CIFT. Social benefits include availability of a cheap fishing craft for fishing operations which is the sole livelihood option of the traditional fishermen.

Keywords : Rubberwood, FRP, traditional fisheries, canoes, JEL Classifications O31 and O32

Received 12 January 2013; Revised 05 June 2013; Accepted 18 June 2013

* *E-mail: nikiajith@gmail.com*

Introduction

For developing countries and emerging economies, it is recognized that development depends on establishing and supporting R&D institutions that develop as well as share knowledge and output (Idris, 2003). While development of technology is an important aspect, technology evaluation forms another facet in the technology development-commercialization continuum. Technology evaluation is a process of assessing the potential value or use of a technology to stakeholders, sector or industry. The origin of technology evaluation can be traced to technology forecasting where future technological needs and trends are assessed. The necessity also arose due to increasing public interest or concern on negative effects of certain technologies. Systematic evaluation of the technology and possible impacts help in putting the technology in the right perspective. Public funded research organizations have to keep national needs also into consideration (Nelsen, 2007).

Fisheries has been an important contributor to our economy which has seen a 11 fold increase in fish production in just six decades, *viz.*, from 0.75 million t in 1950-51 to 8.3 million t in 2011-12 (Ayyappan, 2012). The sector also provides livelihood to about 14.5 million people, including a large population of traditional fishermen. Technological developments have played a major role in increasing production in the sector. However, problems of increasing pressure on the existing resources require a rethinking on the nature of technologies to be developed for the sector. Traditional fishermen are faced with increasing competition as well as escalation in costs of operation. Appropriate technology interventions and management measures are thus essential for the sustenance of this vulnerable sector in fisheries.

This paper attempts to evaluate two specific technologies developed by the Central Institute of Fisheries Technology (CIFT), Cochin, *viz.*, preservative treated and Fibreglass Reinforced Plastic (FRP) sheathed rubber wood (*Hevea brasiliensis*) craft for traditional fisheries. The process of technology development was explored and impact assessed with an aim to develop a generic technology evaluation model that can be applied to evaluate rural innovations.

Materials and Methods

Several methods of technology evaluation exist but they are generic in nature and need to be tailored to specific situations and technology profiles for evaluation. In developing the technology evaluation model, the factors integrated were the technology development process and the impact assessment. The Planning, Monitoring and Evaluation (PME) cycle was found most appropriate and was adapted with suitable modifications (Pefile, 2009) in this model. The major components of the PME cycle were diagnosis of the technology need, ex-ante evaluation, planning and implementation of the research or technology development process, ex-post evaluation, re-diagnosis for technology refinement, recommendations and impact assessment. The last aspect of impact assessment in the model was described through patent profiling, cost and social benefit evaluation. In rural technologies or innovations, the subject, context and scale are generally real time, as the case was in the technology that this paper deals in. The ex-post evaluation was carried out after it was introduced to the stakeholders for field trials. The subjects were thus the actual intended end-users of the technology. The context and scale are also real time. The factors considered were integrated to develop a simple model that can be used for evaluating rural technologies.

Results and Discussion

The model developed to evaluate the technology development process is represented in Fig. 1.

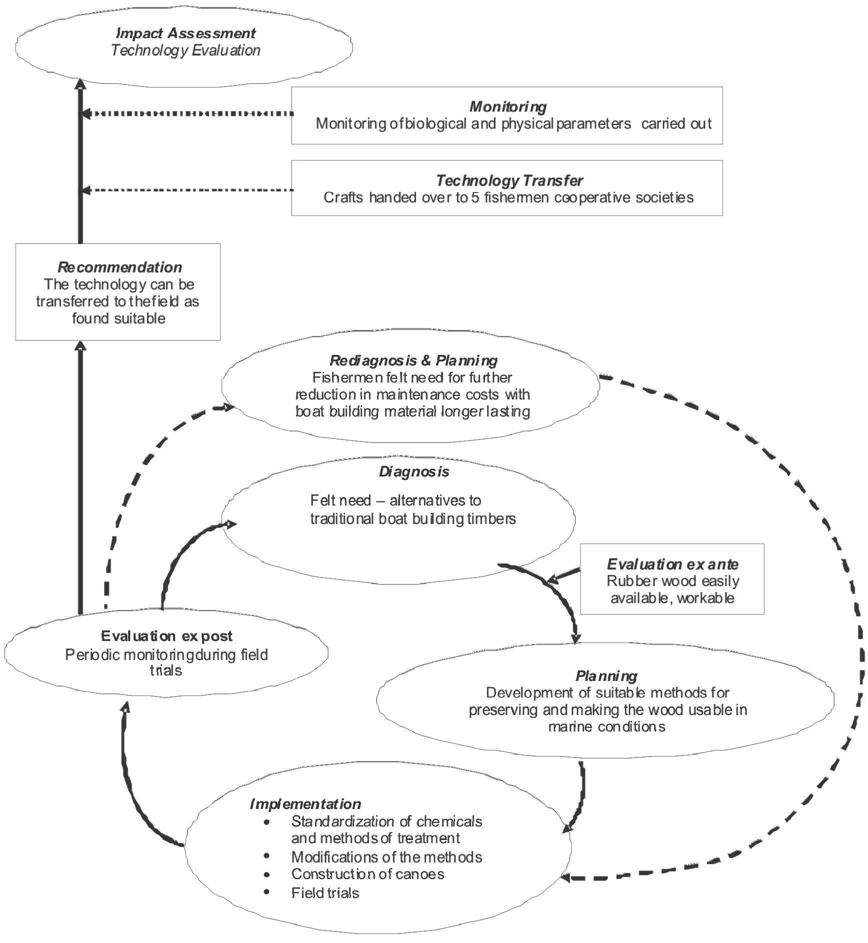

Fig. 1. Model for Technology Evaluation

In the first step of the PME cycle, the problem was diagnosed where the scarcity and high cost of conventional timbers was identified as one of the major problems faced by artisanal fishermen and the need for an inexpensive and easily available wood, which can give an economic and eco-friendly product, was felt. In the Ex-ante impact evaluation, a preliminary evaluation was done on the timbers and alternatives based on availability, workability and cost of the alternate material. Rubber wood was zeroed in as the candidate species, considering the factors listed above. This was followed by the Planning process which involved testing the rubber wood for resistance to biodegradability, finding appropriate chemical treatment for improving the durability of the wood and standardizing the treatment for arriving at suitable product for canoe construction. Studies at CIFT and elsewhere have indicated that natural durability of rubber wood to be very low such as 5-6 months in seawater (Edwin & Pillai, 2004). Hence, as a next step to prolong the life of the wood through chemical treatment, a dual preservative treatment with a water borne preservative followed by an oil borne treatment was adopted. The Implementation step followed where the field level issues were encountered and solutions developed. For instance there was practical difficulty in implementing the method of conducting the chemical treatment for wooden planks since pressure impregnation could not be done at the village boatyards. In its place, a simple immersion technique was demonstrated where a cement tank was constructed and preservative treatment was done through a combination treatment involving two stage immersion process. Using this technique, rubberwood was treated in a workshop of a village carpenter who was to construct the fishing canoe. Two fishing canoes were constructed and were handed over to selected beneficiaries belonging to fishermen cooperative societies (Table 1) who used them for regular fishing operations.

During Ex-post evaluation the canoes were checked periodically (once a month). Re-diagnosis and planning involved efforts to increase the durability of the rubberwood; and sheathing it with FRP was thought of as an alternative. It was assumed that the FRP sheathing made the canoe maintenance free for life. Using this technology, three canoes were constructed and handed over for field trails (Table 2).

The final Recommendation was that rubberwood could be used for constructing fishing canoes for the traditional sector after suitable chemical preservative treatment followed by FRP sheathing. The fishing canoes constructed and operated by the beneficiaries have shown satisfactory performance for the past 10 years.

Technology transfer which is an integral part of technology development process was also part of this project with the rubber growing areas of the country targeted, due to availability of the raw material in these areas, generating considerable

Table 1. List of beneficiaries to whom the technology (treated rubberwood canoes) was transferred for initial field trials

Name and location of Fishermen Cooperative Societies	Year	Type of Fishing
Chellanam Kandakkadavu Fishermen Welfare Development Cooperative Society, Chellanam, Kerala	2002	Gillnetting - Marine
Kumbalam Inland Fishermen Cooperative Society, Kumbalam, Ernakulam District, Kerala	2002	Gillnetting - Backwater

Table 2. List of beneficiaries to whom the FRP sheathed rubberwood canoes were transferred for field trials

Name and location of Fishermen Cooperative Societies	Year	Type of Fishing
Vechoor Lime Shell Cooperative Society, Kottayam, Kerala	2003	Clam collection
Aryad Lime Shell Cooperative Society, Alleppey, Kerala	2004	Clam collection
Thalassery Ulnadan Matsya Sahakarana Sanghom, Kannur, Kerala	2003	Gillnetting

interest among fishermen who saw an opportunity for getting less expensive and durable canoes, with maintenance free service life; while rubber farmers saw a chance in getting a better outlet for their less utilized rubberwood and environmentalists saw it as a significant innovation to save our forests. The technology was also transferred to two other states in the country viz., Tripura, which also is a rubber growing state and Arunachal Pradesh, where the same technology was utilized for construction of canoes with locally available low cost timbers.

Under Impact assessment, patent profiling, cost evaluation and social benefit evaluation were carried out as part of technology evaluation.

Patent profiling

Patent profiling helps to find out the originality of the idea, the extent of technology development elsewhere that are on similar lines and the suitability of technology to patenting. Patents are the right to appropriate returns from research (Reitzig, 2004). Though patents have been used to illustrate the value of a technology it has not been very useful because of the degree of variance of the economic importance and value derived from the patents themselves (Trajtenberg, 1990). Studies have however shown that more number of patent citations indicate greater economical worth of the patent (Harhoff et al., 1999). The social dimension is central in the discussion on patenting technologies that have evolved or have been developed in public funded organizations or institutions.

Free web based patent search engines such as e-space (http://www.epo.org/searching/free/espace.html.net), WIPO (http://www.wipo.int) and US patents (http://patft.uspto.gov/) were used for the patent search. Basically the search was done to examine the level of development of this particular technology and its applications in similar or diverse conditions. The patent search revealed that this technology has not been patented globally and there has been no world-wide patent applications for this specific technology. For use of FRP in boat building, patents have been granted for folding type mast for boat made of glass fiber reinforced plastics; fiber-reinforced plastic unitized boat hull frame; stem band construction for FRP small boat; FRP transom reinforcement; boat skin of mixed wood/polyurethane foam/glass fibre construction; glass fiber reinforced plastic cultivating boat. In general, the application of rubberwood for marine or aquatic purposes has not been patented.

Cost method of evaluation

The most commonly used method of evaluation and impact assessment is the cost method where the technology developed can be compared with an existing process/method/technology to assess the economic benefits accruing from the innovation. In this case, the technology was compared to a baseline technology taking the costs of construction of canoes made from conventional timbers like 'aini' (*Artocarplus hirsuta*) and 'sal' (*Shorea robusta*). Operational expenditure and returns of similar sized canoes were also collected from Chellanam region in Ernakulam district, Kerala state, which lies on the southwest coast of India which was one of the locations where the rubberwood canoes were introduced for field trials. Secondary data from the Chellanam-Kandakkadavu Fishermen Welfare Development Cooperative Society, for 5156 fishing trips made using traditional wooden canoes for the period 1999-2004 was used for comparative analysis. The hypothesized benefit of the introduced technology was that the use of a new, cheap and easily available alternate timber upgraded through chemical preservative treatment would in the long run replace the conventional timbers, which have become relatively costlier and scarce.

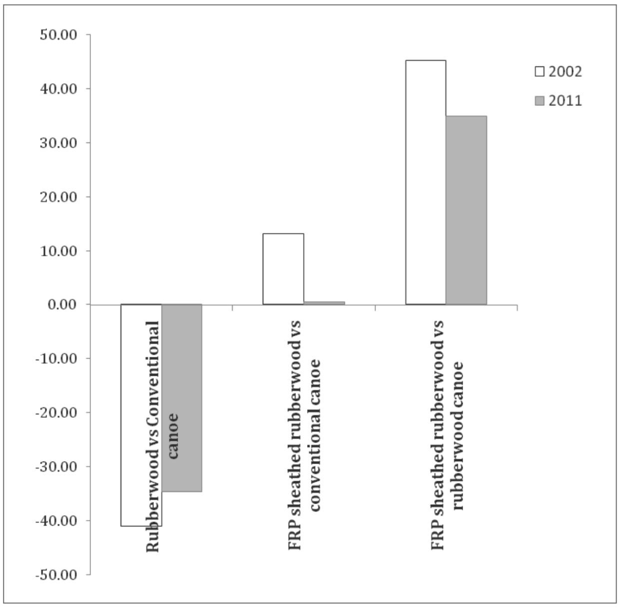

Fig. 2. Percentage difference in cost of construction of traditional canoes with different materials

Material used for construction of canoes of about 6 m L_{OA} was usually conventional timbers like 'aini' and 'sal'. The cost of 0.45 m^3 wood used for constructing traditional canoes was Rs. 9 750 in 2002 and Rs. 15 000 in 2011. The average cost of construction of these conventional canoes was Rs.13 550 and Rs. 27 000 at the time of construction (in 2002) and in 2011 respectively.

It has been observed that there was no marked change in either the area of operation or the type of fishing operations carried out by the end users of this technology, *viz.*, the traditional small scale fishermen. The major benefit accruing to them is in the form of potential reduction in costs in construction of treated rubberwood canoe over the conventional canoes. The reduction in costs was 40.96% in 2002 which has reduced but continued to be substantial in 2011 at 34.63% (Fig. 2). The FRP sheathing was definitely a costlier process with the cost of construction being 13.13% higher than unsheathed canoe during 2002, but with increased costs of conventional timber, the cost escalation has reduced to 0.57% in 2011. The FRP sheathed canoe was 45.21% and 34.87% costlier during 2002 and 2011 respectively, in comparison to treated rubberwood canoes.

Taking the difference in costs of construction of the three types of canoes, *viz.*, canoes made of conventional timber, preservative treated rubberwood and FRP sheathed rubber wood canoe, it was observed that the costs of construction was increasing at an annual growth rate of 11.02, 13 and 9.51% respectively. Taking these growth rates in to consideration, the projected cost of the three canoes would be Rs. 53 779, Rs. 38 936 and Rs. 50 300 respectively in the year 2020 (Table 3).

The major cost reduction is in maintenance costs. The cost of maintenance of conventional crafts included coating of animal or plant based resins, annually; and replacement of coir ropes and weathered planks. The average annual cost incurred for maintenance was approximately Rs. 4 000. The treated rubberwood canoes also need maintenance once a year but the cost incurred for two coats of preservative and labour was approximately Rs.1 000. The FRP sheathed canoes are practically maintenance free for its entire life span.

Table 3. Projected cost of rubberwood canoes

Items	Total cost (Rs)		
	2002	2011	2020 (projected)
Conventional canoe	13 550	27 000	53 779
Rubberwood canoe	8 000	17 650	38 936
FRP sheathed rubberwood canoe	14 600	27 100	50 300

Social benefits

The social impact of the technology on the stakeholders or end users of the intended technology was also assessed through interview method. Personal interviews were conducted with beneficiaries who had been using the treated rubber wood as well as FRP sheathed rubberwood canoes.

The reasonably priced fishing canoes have been found to be beneficial to the artisanal fishermen. There was an overall reduction in operational cost due to reduced maintenance. Maintenance-free FRP sheathed fishing craft has been in use by fishermen for the past 10 years. Regarding the rubberwood canoe, fishermen opined that it was lighter and more stable than the canoes made from traditional timbers. As it was lighter it was easily maneuverable by a single person. The canoe also was able to carry heavier loads of gear up to 8 kg while the traditional crafts could carry about 5 kg only. In general, beneficiaries were satisfied with the performance of the canoes.

A simple model for evaluation of technology was developed where the PME cycle was adapted for explaining the technology development process. In addition, profiling of patents and costs and benefit evaluation, including social benefits, completed the evaluation process. This model can be easily adapted for evaluation of similar technologies in fisheries or other traditional sectors.

References

Ayyappan, S. (2012) Indian fisheries on a fast track, The Economic Times, 28 September 2012, New Delhi http://www.icar.org.in/node/5112 (Accessed 28 September 2012)

Edwin, L. and Pillai, A.G.G.K. (2004) Resistance of preservative treated rubber wood (*Hevea brassiliensis*) to marine borers, Holz. Roh Werkes 62: 303-306

Harhoff, F.N., Scherer, F.M. and Katrin, V. (1999) Citation frequency and the value of patented inventions. Review Econ. Stat. 81 (3): 511-515

Idris, K. (2003) Intellectual Property – A Power Tool for Economic Growth – An overview, WIPO Publication No. 888.1, World Intellectual Property Organization (WIPO), Geneva, Switzerland

Nelsen, L. (2007) Evaluating inventions from research institutions. In: Intellectual Property Management in Health and Agricultural Innovation: A Handbook of Best Practices (Krattiger, A., Mahoney, R.T. and Nelsen L., Eds) MIHR: Oxford, U.K. and PIPRA: Davis, U.S.A. Available online at www.ipHandbook.org (Accessed 24 March 2011)

Pefile, S. (2009) Monitoring, evaluating, and assessing impact. In: Intellectual Property Management in Health and Agricultural Innovation: A Handbook of Best Practices (Krattiger A., Mahoney, R.T. and Nelsen L., Eds) MIHR: Oxford, U.K. and PIPRA: Davis, U.S.A. Available online at www.ipHandbook.org (Accessed 06 May 2012)

Reitzig, M. (2004) The private values of 'thickets' and 'fences': towards an updated picture of the use of patents across industries. Econ. Inno. New Technol. 13 (5): 457-476

Trajtenberg, M. (1990) Penny for your quotes: Patent citations and the value of innovations. RAND Jour. Econ. 21 (1): 172-187