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Socioeconomic Aspects of Transfer of Technology in Coastal Agroecosystems

C. V. SAIRAM and S. ARULRAJ

Central Plantation Crops Research Institute
Kasaragod, Kerala - 671 124

Agricultural technologies are developed with huge investments and based on strenuous research efforts of the scientific community. Unless the fruits of these efforts are reaching the farmers at appropriate time, the ultimate objective of performing agricultural research will not be met with. Coastal agroecosystem with varied resource potential needs to have long term vision oriented strategies for technology development and dissemination. The major aspects of them includes a) the aim of the applied research is expected to be oriented towards the major problems faced by the farmers, b) the technology development process needs to include the farmers at all the stages of development. After they are being developed, their testing and integration with the farming system needs to be done effectively, c) there are multiple ways and means for technology dissemination and diffusion. The mass media and farmers themselves could strengthen its role in these processes. To conclude, technology transfer in agriculture is a continuous process and the same needs to keep pace with the other scientific development.

*(**Key words** : Technology transfer, Socioeconomic issues, Technology evolution, Participatory approach, Technology testing & integration, Technology diffusion)*

Coastal agroecosystem with its wide variability in different components of production systems plays a prominent role in Indian agriculture. This agroecosystem extends to nine states viz., Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Orissa and West Bengal and Union Territory of Pondicherry, besides islands of Lakshadweep and Andaman and Nicobar Islands. The sustained development of the system is more important as it produces wide range of annuals, biennials, perennials, animals and fishery based products. One of the characteristic features of this production system is the predominance of small and marginal farmers with an average land holding size of less than 0.02 ha in states like Kerala to about 1.5 ha in states like Andhra Pradesh. The ecosystem is blessed with high rainfall zones in the West Coast and irrigated farming in the East Coast. Consequently, this zone falls under the medium to high productive zones for various crops. Though crop husbandry predominates the agrarian scenario in general, fisheries and animal husbandry are effectively integrated with it. This system is also prone to high degree of natural disasters like cyclones in the East Coast. The socio-economic profile of coastal agroecosystems has wide degree of variations with increasing level of urban population. The paradigm shift of the agricultural labour from farming to non-farming is another characteristic feature of the coastal agroecosystem. In the background this paper discusses the socioeconomic aspects of transfer of technology in coastal agroecosystem.

Technology spread among resource-poor farmers

During the past fifty years, agricultural development policies have been remarkably successful by emphasizing external inputs as the means to increase production. This has led to growth in the consumption of pesticides, inorganic fertilizers, animal feed stuffs and tractors and other machineries. Consequently, we have achieved outstanding agricultural progress in the recent years. However, there has been little effect of green revolution technologies in most of the holdings of the resource-poor farmers. New technologies rarely spread beyond the large/resourceful farmers and the aggregate impact remains small. But it is the declared intention of the Government in our country to increase production from these holdings as well, both to improve the standard of living of these hitherto neglected sector of farmers and also to make a greater contribution to our country's increasing needs. Where extension does reach them, the approach has been to attempt the transfer of technologies proven to work on research stations rather than on farmers' fields. Consequently, new technologies rarely spread beyond the large farmers and the aggregate impact remains small. This lack of progress by resource-poor farmers is a feature of agricultural development in many countries and it

has been argued that it is largely due to its inappropriateness of the transfer of technology (TOT) approach used in many research and development programmes.

Technology evolution

Indian agriculture predominated by small and marginal farmers, faces stupendious challenges in the present century. The challenges to be faced in the agricultural sector of the country are more daunting to the National Agricultural Research System (NARS), which has to be revitalized and integrated for the solution of location-specific problems of increasing and sustaining the productivity of the natural resource base. This would demand a relook into the present strategy being followed by the NARS of the country.

Indian Council of Agricultural Research (ICAR) is the apex body of India's agricultural research programmes including its allied disciplines such as horticulture, animal husbandry, agricultural engineering, fisheries, forestry etc. ICAR takes the major policy decisions on agriculture and its allied disciplines and also implement various research programmes mainly based on commodity lines. At present, agriculture remains as a "State Subject" in Indian administration procedure and the respective state governments' deals this subject with the help of the State Agricultural Universities and the State Department of Agriculture and allied disciplines. There are also other institutions such as National Bank for Agriculture and Rural Development (NABARD), needs to get themselves actively involve in the developmental aspects of agriculture.

Agricultural research, organized traditionally along disciplinary or commodity lines and without adequate involvement of the clients lacked the farming system perspective as they are mostly conducted in research stations under conditions that are not representative of farmers' fields. They often focus on increasing the productivity of the farms by generating new technologies without a proper understanding of the existing farming systems, resulting in low adoption rate of the evolved technologies.

Agricultural researchers, having a good idea of the constraints pertaining to their field of specialization use them for research problem definition. By this, they often fail to observe that any change caused by the introduction of a new technology will not only affect the component being studied, but the entire farming system within which the component is embedded. Agricultural research in India often aims to increase the productivity of crops without paying much attention to the economic viability of those technologies under farmer's field condition. In contrast, farmers are more interested in raising profits, which need not be necessarily through increase in productivity. Hence for better adoption of research results by the farmers, in addition to productivity, more attention is required on the socioeconomic aspects of the evolved technologies. The first step for this is to perform a SWOT analysis about the evolved technologies. This could be well understood through SWOT anaiysis of the system.

Strengths, Weakness, Opportunities and Threats of coconut sector in India

Strengths

- ❖ Coconut has wider adaptability to ecosystems
- ❖ Established management practices for sustained yield levels are available
- ❖ Time tested and proven technologies for adoption at farmers' level with scope for inter/multi/mixed crops
- ❖ Innumerable products/byproducts of high economic value
- ❖ High employment opportunities for women, deprived and youth
- ❖ High potential for export of products and earnings in international markets
- ❖ Health promoting food products and eco-friendly non-food items
- ❖ Great stake for agro-industries and community development

Weakness

- System dynamics in coconut-based farming is a long run process
- The research results and their benefits cannot be realized in short run as in the case of annual crops
- Diseconomies in scale of production and marketing at farm level
- The agronomic and plant protection practices for the crop demands special type of skilled labour
- Mechanization is not possible to the desired level due to predominance of marginal farms
- Predominance of rainfed farming in major growing areas like Kerala
- Lack of organized marketing based on cooperative norms
- Insufficiency in agro-based industries
- Unexploited potential of human resources for small/medium scale industries.

Opportunities

- Evaluation of the largest number of germplasm for a given purpose/utilization
- Enhancement of knowledge through intensive training programmes
- Greater scope for adoption of technologies with refinement
- Involvement of community level approach for augmenting farm income
- Potential source for women empowerment through self-help groups
- Restructuring the market base linkages with agro-corporations/industries
- Excellent scope for product diversification and addition of high value to products

Threats

- Decline in farm income imposed due to various factors - market price, infestation by pests/ diseases, adverse weather
- Neglect of the garden leading to poor yield levels
- Increase in unemployment of youth and women
- Non-competitiveness at global level
- Decline in general price level for coconut products at international level

Considering the above facts, perspective planning of research and development including the transfer of technology needs to reorient their mandate. Based on socioeconomic aspects, the major characteristic features in coastal agriculture as a whole could be explained as :

- Predominance of small and marginal farmers, who in general are risk averters in nature but face high degree of production and price risks
- Farming systems approach – better resource use efficiency
- Low marketable surplus
- Market reforms involving farmers
- On-farm processing
- Categorization of technologies
- Prioritization of technologies
- Identification of problems
- Striking the crux among the problems

A farming system is a complex, interrelated matrix of soils, plants, animals, power, implements, labour, capital and other inputs controlled in part by farming families and influenced to varying degrees by political, economic, institutional and social forces that operate at many levels. The combined effect of these factors is often location-specific and there are many reasons behind their internal relations. In short, farming system is a highly heterogeneous and complex phenomenon.

Small and marginal farmers, who are more risk-averse than large farmers, are expected to adopt higher degree of farm diversification or intensification for protection against production and economic risks. This means that these farmers can make use of the production complementarities to reap the benefits of synergism through appropriate choice of crop combinations or other economic activities. This would help them to achieve maximum resource use efficiency through i) intensive use of land, ii) optimum use of time, iii) benefits from additional enterprises, iv) reuse of farm wastes and byproducts, v) rational use of farm family labour, and vi) integration of farm and non farm activities. While evolving technology and disseminating them, the researchers need to consider the following.

Transfer of technology

a) *Aim of applied research*

Research refers to science and it seeks new knowledge by abstracting the models with multiple assumptions. New knowledge, of itself, has no value to farmers, until it is put into a technology. Farmers cannot use science. They need technology.

Applied research like agricultural research, adopts various principles and theories of science in genetics and plant breeding, crop management, plant physiology, biochemistry, entomology, pathology, engineering, etc. to achieve their respective mandates, which are often centered on increasing the production by achieving higher productivity. To meet these goals, researchers of individual disciplines apply various scientific theories in their experiments and try to prove or disprove their hypotheses. But, this process may lead to evolution of a technology keeping other factors as constant. The same technology when is being exposed to the real world conditions under farmer's conditions, may or may not be successful depending on the relevance of the assumptions made at the time of technology evolution. In nut shell, applied research efforts need to give more stress not only on the scientific theory, but also the end point of application of these theories should lead to evolving a new technology.

A new technology in any branch of agricultural science is warranted provided the existing technology has become invalid due to system dynamics of one or more factors of the production

system, as well as the clients loses their credibility on its technical feasibility and economic viability. The existing technology can also be replaced, if the new technology shifts the production function to an elevated level by realizing better input-output coefficients.

b) *Participatory technology development*

Technology generation is a process, which integrates knowledge, technology, and other traditional values like folk wisdom into a form which serves to meet the objectives even in uncontrolled conditions for wider range of end users. The role of technology generation is to produce new technology alternatives.

Social scientists perceive that while researchers aim for increase in productivity, farmers who are undertaking the farming as a livelihood aim for maximizing their profitability. Hence the process of technology development and its dissemination needs to begin after thoroughly understanding the existing farming system considering its agroclimatic, edaphic, biotic, abiotic and socioeconomic conditions and also the pros and cons of the existing technology, which may need an alternative.

The linear model of technology development, which assumes that research, first generates knowledge, which is then transferred by extension and finally utilized by farmers is more successful in western countries, wherein the research situations are comparatively similar to that of the experimental stations. However in reality, there are many differences between the Research Station and the farmer's fields (Table 1).

Table 1. *Major differences between the environment of the research station and farmers fields*

Particulars	Research Station	Farmers field
Experimental results	Often evolved under homogeneous conditions	Heterogeneity is the rule
Farming environment	Ideal conditions prevail	Heterogeneous
Factors of production	Controlled	Subject to time, production and price risks
Land	Usually large and in general land is not a major constraint for conducting the experiments	In India more than 80 percent of the farmers are small and marginal and are having land area of less than one hectare
Source of investment	Based on budget allocation from the sponsoring organization	Mainly from farm business income
Capital	Often unlimited	Often limited in case of small and medium farms and adequate in case of medium and large farms
Irrigation facilities	Not a serious constraint	Serious constraint during summer months
Infra-structure	Often well developed	Often limited in case of small and medium farms and adequate to unlimited in case of medium and large farms
Labour	Permanent labour and casual labour available in time	Mostly dependent on hired and family labour
Marketing	Bulk and generally on contract basis	Often staggered and less marketed surplus and mostly to village traders
Effect of production and price risks	Less impact	More impact
Concept of resource recycling	Often in theory	Often put into practice
Support from institutional agencies	Not required	Often needed
Socioeconomic factors	Often have less impact	Often have more impact

The present mode of technology development in India is a unidirectional flow of knowledge from National Agricultural Research System (NARS) to subject matter specialists, to extension workers, to contact farmers and from them to follower farmers. The linear model does not include farmers as an essential component in technology development process, but make them as passive receptors and users. In this situation, if the new technologies are appropriate and fit in a particular farmer's conditions or needs, then they stand a good chance of being adopted. But if they do not fit and if farmers are unable to make changes, then they have only one choice. They have to adapt to the technology or reject it entirely.

The alternative to overcome the present malady is to seek and encourage the involvement of farmers in adapting technologies to their conditions. This constitutes a radical reversal of the normal mode of research and technology generation, because it requires interactive participation between professionals and farmers. Participatory Technology Development (PTD) is a process in which the knowledge and research capacities of farmers are joined with those of scientific institutions, while at the same time strengthening local capacities to experiment and innovate. Farmers are encouraged to generate and evaluate indigenous technologies and to choose and adapt external ones on the basis of their own knowledge and value systems.

Though PTD has its own limitations based on group behavior and individual farmer's perception of the problem, his attitude, level of knowledge and resource environment etc., at present social scientists consider this as one among the best tools for problem identification and technology transfer. A sincere involvement of the end users would always help to undertake mid term review in the technology generation process, which would ultimately end in better rate of adoption. In this process, there is ample scope for evolving alternative technologies or other options for a particular technology.

c) *Technology testing and adaptation*

Research results based on field experiments in the research institutes, need not suit to the needs of the farmers or some refinement on these findings would enhance the adoption rate of the recommended technologies. The reasons are obvious since there are many differences in the place where the technologies have originated from the place where they are going to be adopted. Hence for realizing better rate of adoption of the technologies, the researchers should understand these differences and needs to refine and assess their technology.

Technology testing and adaptation can be performed through assessment and refinement, which paves way for achieving effective operational linkages between scientific institutions and the farmers for technology integration and optimization. This would meet the growing demands of different production systems to increase productivity, augment income and improve the quality of life of rural people.

Technology transfer, to be effective, must be preceded and succeeded by technology assessment. How reliable is the assessment can be judged by the effectiveness of transfer of a given technology. Technology assessment and transfer are complementary to each other. Technology transfer must be based on needs and capabilities of agroecological settings, resources endowments, agro-production distribution systems and farm household. The ultimate aim of researchers, extension personnel and developmental agencies is to empower the farmer with the appropriate knowledge, technique and skills so as to enhance the capability to judiciously exploit the natural resources and family labour for sustainable agriculture and rural development. Further, the feedback received from the past extension programmes was inadequate to reset the research and transfer of technology agenda on a large scale.

d) *Technology integration*

Technology integration fits a new technology into current farming systems. It has three dimensions:

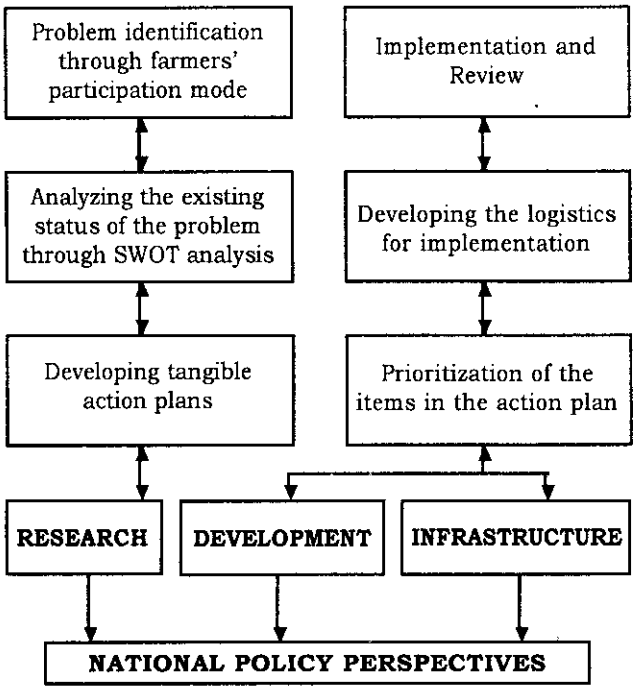
a. One pertains directly to the system of production. Integration is facilitated by knowledge of the farmer client and is also facilitated by research on related problems and by extension instruction to farmers on its use. As with testing, integration is essential. The farmer must do it. If he has to do it without research and extension help, it will be inefficient and slow.

b. A second dimension is integration with the market, both input and product. Much agricultural technology is embodied in a commodity. If that commodity is not available and cannot be made available, a new technology cannot be adapted, no matter what its merit. Integration involves market action to make inputs available or research-extension activity adapted to the lack of input. On the product side, if there is inadequate market, farmers cannot integrate the technology into their systems of production.

c. The third dimension is integration with national policies. National policy often works through product and input markets and sets conditions the farmer must adapt to. These conditions affect the ways he can deal with new technology. If policies are not adequate and cannot be changed, the conditions they create must be adapted to.

To be more precise, technology integration is the process of synergizing the technology with the farming system, infrastructural facilities and with the national policy perspectives. The success of the technology mainly depends on this stage. In this process, effective coordination is needed among the research institutes, development departments and the farmers. Technology integration need not to be restricted to the national or state levels, but to be expanded upto a minimum of districts. The steps involved in this process may be explained as in the flow chart

FLOW CHART ON TECHNOLOGY DEVELOPMENT PROCESS



e) *Technology dissemination*

This process involves informing farmers about a new technology and helping them to integrate them into their farming systems. The extension demonstration is one of the most effective ways of doing dissemination. It may not be as much a 'demonstration' as it is a means by which the farmer's own experimental process is facilitated. Farmers will not adopt a practice until they have either experimented with it in their own system or have seen it perform in a system almost like theirs. The demonstration facilitates this process and is literally an 'on-farm trial'. As technology becomes more complex, more assistance is needed from extension to help farmers fit it into there systems. The role of mass media is vital in this process. With the advancement in the field of Information Technology, diffusion process has become easy and economical.

f) *Technology diffusion*

Technology diffusion and adoption are primarily centered on the farmer. Farmers themselves, through their kinship groups and other social systems, constitute a powerful force for technology diffusion. Extension is most effective when it takes advantage of and encourages the farmer dynamics.