CHAPTER VI

Conclusions

Conventionally technology development was seen as a linear process. According to the linear model, technology developed by scientists (the invention stage) is marketed (the diffusion stage) to the adopters. Gallon, however, views technology development as a non-linear process. He argues that scientists/technologists right at the time of invention construct a social reality where technologies are developed and a future scenario in which the technology is employed. Gallon develops a perspective in which technology development is caused by actor-networks and leads to constitution of actor-networks. An actor network is composed of a series of heterogeneous elements, animate and inanimate, that have been linked to one another for a certain period of time (Cowan, 261-281, 1989).

The present study on technology development in oil palm cultivation was based on Gallon's actor-network perspective.

The objectives of the study were to study the network relations among various human and non-human actors that were involved in oil palm cultivation and their influence on the participation of adopters of the technology. Oil palm cultivation was introduced through Oil Palm Demonstration Project (OPDP) in three states in the coon-
try, viz., Maharashtra, Karnataka and Andhra Pradesh. The OPDP in Andhra Pradesh was chosen for this study. The three districts involved in the state viz., East Godavari, West Godavari and Krishna were covered by the study.

Among a total of 665 adopters of oil palm technology a sample of 166 were drawn for the present study whose network relations and participation levels were analysed. Empirical evidence in the present study suggests the non-linear nature of technology development in oil palm cultivation. However, the present study finds it difficult to assume homogeneity among the human elements as suggested by Callon. Perhaps this is due to the differences between the contexts which will be explained later.

The agricultural scientists imported oil palm seeds specifically keeping in view the edible oil shortage in the country and the poor nutritional conditions of middle and lower class consumers. The technologists constructed future scenario of a society where farmers would benefit economically and thus increase their surplus by cultivating a very high yielding oil palm and consumers would get an oil with reasonably low cholesterol content at an affordable price which augments quality of life.

Callon applied actor-network theory to study industrial technologies. He studied the development of electric car (VEL) in France in 1970s and the debate that surrounded it among the engineers, which involved building of sociological theories along with technological elements. The present study extends Callon’s model to understand dynamics of an agricultural technology development. It
was found that the non-linear nature of technology development was particularly relevant in the case of agricultural technologies. As an agricultural technology is aimed at the production of food products which meet one of the basic needs of the people, it is all the more necessary for the technologists to perceive the needs of the people and the probable success of the technology in meeting those needs before developing technologies.

As discussed in earlier chapters, the technologists in the OPDP constructed a scenario of an Indian rural society right in the beginning of the project and chose only those as the beneficiaries of the project who had risk-bearing capacity (medium and big farmers). Though some small farmers were also chosen as a part of the policy, this study recorded high performance among the medium and big farmers.

Higher participation levels were also found among those belonging to higher castes and classes owning substantial landholdings, corroborating the views of the policy makers and agricultural scientists. But the present study showed that the reasons for differential participation levels among the participants in the OPDP were manifold. Thus, rooting the participation levels in mere social categories like caste and class was found to be limited.

For instance, in the case of VEL, the ingredients are the electrons that jump effortlessly between electrodes; the consumers who reject the symbol of the motor car and who are ready to invest in public transport; the Ministry of the Quality of Life, which imposes regulations
about the level of acceptable noise pollution; Renault, which accepts that it will be turned into a manufacturer of car bodies; lead accumulators, whose performance has been improved; and post-industrial society, which is on its way’ (Callon, 1989, P 86).

As Callon would put it ‘one must abandon the conventional sociological analysis that tries to adopt the easy solution of limiting relationships to a restricted range of sociological categories’ (Callon, 1989, p95).

Among them, every element played a crucial role, because, as Callon says ‘if electrons did not play their part or if the catalysts became contaminated, the result would be no less disastrous than if the users rejected the new vehicle’ (ibid, p 86). Similarly in the case of the OPDP also failure of seeds to give fertile female plants, failure of oil palm plants to give yield and wastage of fruit due to bureaucratic delays in setting up oil crushing unit were inherent. In fact, those who got no yield reported a series of reasons like failure of monsoons, drought, male (sessile) flowering etc. -

There were farmers with lower economic and educational status, but with enthusiasm to learn new techniques and practise them. With the same given inputs in terms of technical consultancy, financial assistance etc., the performance of the adopters differed irrespective of their social back-ground. Thus, it shows that social-statistical analysis of participation and relating it to economic, social or educational status may not possibly give the dynamic behaviour of actors who are the active subjects in technology development.
This understanding was facilitated by actor-network perspective which helped in treating both technical and non-technical elements on a common plane with no assumption of hierarchy among the elements.

While criticising the lack of perception among sociologists in identifying heterogeneous associations in non-hierarchical terms in technology development, Callon, in fact, seems to have given more importance to technical elements. For instance, the rejection of the electric car and adoption of traditional motor car by the French society was found to have a series of reasons like the problem of catalysis, failure of electrons to perform, roles of fuel cells, electrodes and electrolytes, etc. The sociological elements identified by Callon were the styles of consumption of people, ministries which maintain technological standards and social movements. Thus, among the heterogeneous elements delineated by Gallon majority were found to be of technical nature and a few are of sociological nature.

As Callon dealt with industrial technology development whose potential target groups hailed from urban population in the Western societies, he may have treated human elements as a homogeneous category as the Western societies do have a degree of homogeneity in terms of culture and socio-economic status. But as the present study focuses on an agricultural technology and the adopters being drawn from an Indian rural society, homogeneity among human elements is least expected in this context.

Constitution and operation of actor-networks are con-
Context varies in terms of space, time and culture. Rural society in India is heterogeneous because of its stratification in terms of caste, class and diversity in religion, which seem to affect technology adoption. Therefore, inter-relationships among human elements drawn from heterogeneous groups in technology development cannot be neglected. The institution of caste was found to be particularly influencing the technology development in Indian rural society.

According to Callon, the engineer/innovator thinks sociologically before developing a new technology and becomes a model of inspiration for the sociologist. If one has to go by Callon’s notion, it looks as though a sociologist has no role to play and engineers are better sociologists. According to him, ‘the sociology developed by the engineer-sociologists is concretely evaluated in terms of market share, rate of expansion or profit rate’ (Gallon, 1989). But it gives more weightage to economic and technical factors than sociological factors.

Callon goes to the extent of saying that, ‘the purpose of academic sociology is to follow technology through out its elaboration, which means, its object of study is neither society nor social relations but the very actor-networks which give rise to society and technology simultaneously’.

Actor-networks which help in viewing society and technology on a common plane of course are very interesting units of study. But among the human elements there are many heterogeneous associations which play an important role in technology development and may be incomprehensible to engineers or scientists. Human elements
differ from each other in terms of their attitudes, values and meaning. **Therefore,** instead of saying that sociologists should follow engineers’ method of studying society, which Callon does not elaborate, it may be argued that, a sociologist should also play the role of an engineer **while** studying the heterogeneous associations among both human and non-human elements in technology development, just as the way an engineer builds up a sociological perspective before developing any technology.

Callon developed his model to qualitatively observe heterogeneous actors in technology development. In this study, along with qualitative methods, simple quantitative methods were also used and were found to be useful to describe actor-networks in more concrete terms.

**Major findings of the study are as follows:**

(a) The economic and social status of the farmers were related in the sense that, majority of the forward/higher castes possessed larger land holdings, thus suggesting a relation between two social attributes of the adopters, i.e., economic and social status.

(b) It was observed that education increased awareness about the technology. Those who had reasonable levels of education could to comprehend technological practices in a better way than others. Thus, the technical element in terms of technological knowledge and the social element i.e., the educational status of the adopters were found to have a nexus.
(c) While formal communication came into existence as part of network relations between adopters and promoters, the informal channel came into being among the adopters. Though mass media was one of the channels of communication, verbal communication was found to be more effective in building up a network relation in a rural society. In this study, majority of the participants in the OPDP received information about oil palm technology from co-farmers and village leaders. Very few learnt through mass media channels, suggesting that informal channel of communication plays significant role in the formation of network relation among the adopters in rural areas.

(d) Political affiliation and consequent leverage also helped respondents in getting access to information, credit sources and in initiating organized efforts in technology development. It was observed that, a minority of the adopters who had political power played major role in technology development. Thus, power was an ‘enabling’ factor rather than a constraining factor in the network and was found to have built a network relation with other technical elements like technical know-how, credit, subsidies, saplings and fertilizers.

(e) The important fallout of the oil palm technology was the formation of ‘Oil Palm Grower’s Association’. The unique feature of this association was that, it evolved as a response to a new technology, where, the adopters of oil palm technology came together to fight for a common goal of technology development, thus corroborating Callon’s view that technology gives rise to social movements.
(f) The network relation between the adopter and the technology was found based on several considerations of the adopters while adopting the technology. The reasons given by the adopters for adopting oil palm technology were: Profitability of oil palm compared to other crops; less labour requirement compared to other crops; less investment; subsidy from the government; venture for new crop; achievement satisfaction; and country’s self-reliance in edible oils. The considerations of adopters, when ranked, enabled to get a picture of Technology-adopter Nexus’. Among the various reasons given above, profitability was given the highest rank by 91 respondents (54.8%).

(g) The network relation between the technology and the adopter was also ascertained recording the performance of the adopters of technology. The output or yield was taken as the index of performance. The relationship between performance in terms of yield and social and economic attributes of the adopters such as caste and class, was drawn through contingency analysis.

Among the 83 farmers who obtained below average yield, 84.3% belonged to forward castes, 4.8% backward castes and 10.8% scheduled castes. Among the 61 farmers who obtained above average yield, 93.4% belonged to forward castes, 3.3% backward castes and 3.3% scheduled castes. Among those who obtained higher yield, majority of the adopters had higher size of land holdings, thus showing a network relation between the technical element i.e., yield (output of technology) obtained by the adopters and the social elements like caste and class background. The qualitative observations gave many
more insights into the reasons for the differences in performance. Those who belonged to upper caste and landowning class could afford to invest resources to employ labour and use latest methods of irrigation and performed even under adverse conditions like drought. It was found that the reasons for poor performance were varied and one should not relate it only to economic factors. In many cases, very low yield was obtained due to monsoon failure and subsequent drought, failure of tubewells during acute summer or male flowering which were more of technical nature than economic or social.

(h) The yield also depends on the degree of owner's involvement in production which is expressed through his labour activity. The study showed that the degree of direct involvement of the adopter depended on his economic status and capacity to employ labour. The higher the size of land holding the lesser was the degree of involvement. Those who are rich depend on the hired labour for cultivation and those who cannot employ labour, work on their own. Those who work along with labour irrespective of their affordability of labour are likely to get more yield. Thus the adopter's labour activity seems to have a network relation with both yield on one hand and the labourers on the other.

The unique feature observed in this study was that, the strength of the network relation between technology and the human element was intact in spite of aberrations caused due to geological (depletion of water table), technological or psychological factors. This is reflected by the persistence of the adopters in cultivating oil palm in spite of hurdles.
(i) The study showed that technological knowledge of the adopters differed from each other. An information scale was constructed in this study to test the information levels of adopters regarding various technological details in oil palm cultivation. The scores obtained by the adopters on the information scale indicated that the comprehension capacity increased with level of education. The study showed that school level education was the critical level for participation in the OPDR.

Among those who had no formal education, majority (88.8%) were found to possess first level of information. Among those who had school level education, 68.8% were found to possess first level and 23.3% possessed second level of information. Among those who had college level education, 36.3%, 31.8%, 31.8%, were found in first, second, and third levels of information respectively, showing that, the level of information (technical element) depended on one's educational background (social element).

(j) Apart from the above identified social and technical elements there are many heterogeneous associations found during the field work which directly or indirectly influenced the adopters' relation with the technology. Therefore, a participation scale was constructed to study all the possible heterogeneous elements, which might have been ignored otherwise. This was done in terms of adopter's involvement in the actor-networks of the OPDP right from the beginning to the end of the project, their relation with other actors like labour, fellow-adopters, technical knowledge in terms of information levels, tech-
nical considerations, performance in terms of yield etc. Thus, the participation scale was a cumulative scale taking into account all the human and non-human elements with which the adopters had network relations. Thus, it may be said that the participation levels of adopters themselves are the indicators of actor-networks. The level of participation of the adopter was categorised into low, medium and high, which indicated his tryst with the technology.

(k) The relation between the participation of the adopters and their social attributes in terms of social, educational and economic status were found in terms of contingency analysis. This analysis gives a comprehensive picture of network relation among all the heterogeneous elements involved in the OPDP, which are social, economic, technical and political in nature.

The relation between the participation and the social status of the adopters suggests that among the 145 adopters belonging to forward castes, majority (53.7%) were found to be medium level participants. Among the backward caste adopters, majority (57.1%) were low level participants, while none were high level participants. Among the scheduled caste adopters, majority (78.5%) were low level participants and none was a high level participant. Thus, the majority among backward and scheduled castes were low level participants and the majority in the case of forward castes, were medium level participants.

The level of participation of the adopters was also found to be strongly associated with their educational background, showing that those who had, at least, school
level education had high level of participation. Thus the school level education appears to be the critical level.

Strong association was found between the economic status and the participation level.

The statistical association is a reflection of the network relation between the participation of the adopters and their socio-economic attributes. However, mere statistical associations would not describe the roles of various actors in their expectations, negotiations with technology on the one hand and human elements on the other in the network in technology development. Actor-network perspective helped in overcoming these limitations by focusing on the dynamic behaviour of the actors.

(I) The relation between labour and the technology showed that there was a gradual displacement of labour as oil palm replaced other crops in the region. One of the considerations in adopting oil palm was that it required less labour compared to other crops. Another significant feature observed in the OPDP was that, it had completely displaced female labour.

The present study further supports the historical trend in which whenever a new technology is developed it is the women workers who get displaced first. The network relation between two actors i.e., technology and labour has been an important factor in the OPDP right from the beginning. It created two kinds of migration. Oil palm cultivation in the early 60s necessitated migration of farmers from Godavari and Krishna districts to Vizianagaram district in Andhra Pradesh for want of
cheap labour. During the OPDP phase, oil palm cultivation caused labour displacement. This study predicts that, in the post-OPDP phase, with the expansion of oil palm, there would be higher rate of labour migration from these regions in future.

**Methodological limitations:**

There were some methodological observations made during the field work, which were found to be universally applicable to the appraisal studies of any government sponsored project.

As the researcher tries to appraise a government-sponsored project generally, the universe is pre-selected by the government agencies. In government-sponsored projects the socio-economic background of the beneficiaries is given importance, before giving the development inputs including technological know-how. The sources from which government agencies collect data may not give correct information regarding income, size of landholding, household size etc.

Thus, discrepancies in income, land, etc may be found between the secondary data provided by the government agency and the primary data collected by the researcher. In the present study such discrepancies were recorded. For instance, a beneficiary enlisted for the OPDP, as a marginal farmer by the government agency, in reality, turned out to be a big farmer holding more than 100 acres of land.

The beneficiaries in the sample are identified by name
and location. The **unit** of the *sample* in these evaluation studies is so specific that one cannot reduce it or *replace* it by another unit. The sample cannot be *adjusted* in the case of absence of a respondent, because it is not a random sample and units of sample are identified by name. But even after two or three visits, if the researcher fails to meet the respondent or if the respondent refuses to *answer*, there arises a methodological problem. This makes it pertinent to evolve a foolproof method for *Beneficiary Performance Appraisal*.

It may be said that, the differences in *levels* of participation observed in this study, to some extent may have been caused due to these methodological problems some of which were beyond the control of the researcher. Callon's model has to be extended to different social contexts and technologies taking into account all the actors with possible heterogeneity.