ACTOR NETWORKS IN TECHNOLOGY DEVELOPMENT:

A case study of Oil Palm Demonstration Project in Andhra Pradesh

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This is to certify that I, **M V S Aparna,** have carried out the research embodied in the present thesis for the full period prescribed under **Ph D** ordinances of the University.
I **declare,** to the best of my **knowledge,** that no part of this thesis was earlier submitted for the award of the research degree of any University.

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CHAPTER I

INTRODUCTION

Edible Oil Scenario in India

The edible oil scenario in the country suggests a wide demand - supply disparity depleting foreign exchange reserves and causing balance of payments crisis. The growing demand for edible oil and subsequent scarcity made it imperative to attain self-sufficiency in oil seed production. Production of oil seeds is suitable to Indian lands because of their semi-arid nature. Having realised this, Indian farmers have been cultivating different oil seeds. One such oil seed recently added to the existing oil seeds is oil palm, which is dealt with in this study. Oil palm was ushered in at the back drop of technology policies and missions.

The technology development of oil palm has had an inter play of various actors and roles making it an interesting aspect for a sociological study. The efforts in production of oil seeds, though were remarkable in reducing the imports of oil, were still inadequate in meeting the oil demand, because, all the oil seed crops are rain - fed and dependent on monsoons. According to the Indian Council for Agricultural Research (ICAR) report of 1989, the supply of vegetable oil has increased at the rate of

2% per annuum in the past 25 years, while demand grew at the rate of 5% per annuum. This has necessitated the launching of Technology Mission of Oil Seeds (TMOS). The technology missions, are an out growth of science and technology policies of the country that developed over time. The objectives behind scientific and technological policies of the country have been to meet community needs and build an egalitarian society.

The Scientific Policy Resolution of 1958

The Scientific Policy Resolution of 1958 clearly indicates this objective:

" If is only through the scientific approach and method and the use of *scientific knowledge that reasonable material and cultural amenities and* services can be *provided for every member of the community and it is out of recognition of this possibility that the idea of a welfare state has grown."*

The policy identified that prosperity of a nation depends on effective utilization of human and material resources which requires education in science and training in technical skills.

The Technology Policy Statement, of 1983

The Technology Policy Statement, 1983, identified our immediate needs as

" attainment of technological self-reliance, a *swift and tangible improvement in the conditions of the weakest sections of the population and the speedy development of backward regions."*

It is recognised that technological development must be related to people's aspirations, must help in bettering their lives by more cost effective use of

materials and methods of work.

In the 1983 Technology Policy Statement, technology was viewed as covering agricultural and service sectors along with the manufacturing sector. While Green Revolution technology introduced in early 1960s increased cereal production, oil seeds production was virtually neglected causing a major crunch in the availability of edible oils. Hence the urgency to prove oil seeds production in mission mode.

Techn-ology Missions:

Technology Missions were aimed at speedy development in fulfilling crucial human needs and the mission mode was attempted to channelise technological inputs and extension services through effective management, communication and people's participation. One of the objectives of the TMOS was to increase production of oil seeds from 14 million tonnes (average 1985-90) to 20.6 million tonnes by 1994-95 and to develop improved integrated processing technology for major and minor oil seeds.[1]

Through the TMOS main thrust was given to the increased supply of certified seed, crop substitution, improved dry land farming techniques and dissemination of improved technology through mass media.

It was observed that traditional oil seeds like ground nut, sesamum, sunflower, rapeseed etc yield less than 0.5 tonnes of oil per hectare. This necessitated the cultivation of those oil seeds which are high yielding, at the same time meet the

1. *Source: Technology Mission on OH Seeds & Pulses, Dept. of Agriculture & Cooperation, Krishi Bhavan, New Delhi, 1991.*

regional demands in terms of fat and protein content and acid composition. By virtue of being able to meet the requirements like cost-effectiveness, low salts and minimum level of protein and yield around 2.5 - 5 tonnes of oil per hectare per year, palm oil has been realised to be an important oil seed for cultivation.Oil palm cultivation assures Indian farmer of regular income because of its continuous fruiting through out the year and employment prospects for the labour. It is a highly irrigated and upland orchid crop.

If one has to compare it to other upland crops like cotton, sugarcane, turmeric, tobacco, groundnut and other orchid crops like mango, coconut etc, the income from them is very meagre compared to the income expected from oil palm. While coconut can yield not more than Rs. 10,000/- per hectare per year, oil palm can get Rs. 15,000/- Per hectare per year. While coconut starts fruiting from the 7th year onwards and can yield 1 tonne oil per acre, oil palm can start fruiting from the 5th year onwards and yield 1 1/2 to 2 tonnes of oil per acre. According to the annual report of the Department of Bio-technology (1990-91), the net income is expected to be around Rs. 20,000/- to Rs.35,000/- per hectare per year in the case of oil palm.

The Case of Oil Palm:

The cultivation of oil palm originated in West Africa a century ago, but now it is an extensively cultivated crop in Latin America and Asia. In Asia,

Malaysia emerged as a leading exporter of palm oil. It is a heterozygous plant with unexplored variability giving enormous scope to the latest technologies like Bio-technology to be experimented. Having realised this hidden potential, many multinational corporations like Unilever, United Fruiting Company entered the oil palm field and introduced clonally propagated palms in the whole of the tropical world. Presently not only multinationals, but many government agencies, small bio-technology companies and industrial units in the third world also are experimenting with clonal propagation of oil palms.

Indian Efforts in Oil Palm:

In India, oil palm was introduced in 1960. Oil palm plantations were started by the government of Kerala in 40 hectares of land. The Andaman Forest Development Corporation had taken up the cultivation in 1600 hectares of land by importing seeds from Nigeria, Malaysia, Cote d' Ivoire, Papua New Guinea and Zaire. With the introduction of better management practices, an yield of 3 tonnes of oil per hectare per year was achieved. Oil Palm India Limited, Kerala took up the plantation from 1971 to 1982 and an area of 3705 hectares of land was planted with imported seeds. An yield of 2.7 tonnes of oil per hectare per year was achieved from these plantations.

In Andhra Pradesh, oil palm seeds indigeneously produced by the Central Plantation Crops Research Institute (CPCRI), Palode, were planted in 160 hectares in 1987-88. M/S Navbharat Enterprises,

a private firm has been planting in 200 hectares from 1988 onwards in Lakshmipuram, West Godavari district. In all these attempts, the yield could not rise above 2.5 tonnes per hectare per year and this failed to attract the attention of the farmers.

Oil Palm Demonstration Project (OPDP):

The Department of Bio-technology (DBT), Government of India, was entrusted with the oil palm cultivation as a part of the Technology Mission of Oil Seeds (TMOS). The DBT initiated Oil Palm Demonstration Project (OPDP) in 1988-89 in three states - Andhra Pradesh, Karnataka and Maharashtra - on 1000 hectares in each state. The objective was to demonstrate the possibility of oil palm cultivation under irrigated conditions. This was launched in East Godavari, West Godavari and Krishna districts in Andhra Pradesh, Shimoga district in Karnataka and Sindhudurg in Maharashtra.

Realising that commercial production of oil palm would help in achieving self-sufficiency in edible oils, this project was launched by the DBT in 1988-89. This project was unique for more than one reason. Unlike any other agricultural project, it was sponsored by the DBT rather than by the Department of agriculture. While the earlier attempts at oil palm production were made on government lands in Kerala, under this project it was introduced on farmers' lands in three states A.P.,Karnataka and Maharashtra. The DBT in collaboration with the regional department of

Horticulture had chosen 665 farmers in A.P. and 900 farmers in Karnataka.

In Maharashtra, the project was implemented through the Department of Industries by the Development Corporation of Konkan Ltd (DCKL). The DCKL had taken the land on lease from farmers where the project was being demonstrated. Total land covered in three states was 1050 hectares in A.R, 1114 hectares in Karnataka and 1000 hectares in Maharashtra.

In this project, imported elite seeds called tenera hybrid seeds and indigeneous seeds were planted in the ratio of 80:20 respectively. The seedlings were reared in nurseries for 15-20 months before giving to farmers. Oi) bearing Fresh Fruit Bunches come from 24-30 months after field planting. Oil extraction has to be done within 24 hours after harvest. The project was also unique because, inter-crops were grown here which were not grown any where else. This was to ensure source of income for the farmer till the economic viability of the crop was realised. To help the farmer, 100% subsidy was provided.

This project was unique in another respect since, an originally rain-fed crop was encouraged to be cultivated under irrigated conditions. It was not native to the land and its management practices were totally new. Technical expertise from Costa Rica was utilized to evolve new management practices for the cultivation.

Perspective of the Study:

Conventionally social scientists viewed transfer of technology from lab to land as a linear process from the innovation stage to the implementation stage. The actor - network perspective has changed this view completely. According to this, the context of invention and context of justification are only temporally separate but are related reciprocally. The operational aspects and likely consequences of the technology for social groups and society at large are conceived by the technologists right in the invention stage. This perspective also identifies the heterogeneous nature of actors. The heterogeneity is in terms of their socio - economic background, interests and participation. The study adopts actor-network perspective to understand the technology development in oil palm by focussing on the OPDR

Statement ofthe problem :

The study aims to understand the trajectory of the body of technology, transferred from innovators to adopters through a demonstration project. The establishment and acceptance of technology in the real life situation is equally pertinent as invention pf technology. A scientist / technologist while innovating a particular product or process has to tqke in to account the existing realities and necessities of people, while considering his own professional interests, because, ultimately his innovation is going to be utilized by the users. The acceptance of a particular technology depends on socio-economic, political and cultural conditions

of users and the success of any technological demonstration project depends on the level of participation of the people in the project. When we focus on agricultural technologies, the transfer of technology from lab to land is more complex as it involves rural social structure and culture and their role in moulding the interests of the acceptors of technology.

Hetero-geneity of actors :

The Indian rural social structure is stratified in terms of caste and class. The location of individuals and groups in the hierarchical caste and class system, to a large extent, influences one's access to technology and affordability of technology. Culture - beliefs, values and associated practices also influence attitude formation and acceptance of new techniques and ideas. Therefore, human actors in Indian society cannot be identified as homogeneous groups as in western society. They are heterogeneous in terms of their cultural values, social and economic status.

In any transfer of technology, heterogeneous actors are involved; the human actors are technocrats, technologists, agronomists, linking agents and acceptors while the non-human actors are the technology in terms of oil seeds, fertilizers, manure, pesticides etc., mechanical implements like tractor, water pipes, irrigation implements like drip etc., geographical factors like water resources, soil quality etc, socio-economic factors like caste, kinship, education, economic status etc. All these human, non-human, technical, non-technical, social, economic, political factors are considered as actors who have mutual relations and these

relations are not seen in hierarchical terms. Then it is interesting for a student of technology to study the association and its dynamics that exist among these heterogeneous actors and see how the network is maintained among these actors.The aim of the study is to study the network relations between the human actors (Adopters of Technology) and the non-human actor (Technology) in terms of participation of users in using the technology.

Objectives Of the Study:

The major objectives of the study are to :

(a) describe the profile of the adopters.

(b) analyse the extent of participation of the adopters.

(c) study the network-relations among various actors involved in the diffusion of technology and influence of network-relations on levels of participation.

SCHEME OF PRESENTATION

The thesis is divided into 6 chapters.

Chapter I contains the introduction, statement of the problem, objectives and concepts.

Chapter II deals with the review of literature covering the theoretical background and methodology discussing the sampling and plan of analysis.

Chapter III gives a profile of the districts and households covered in the districts.

Chapter IV describes nature and dynamics of actor-networks in the context of invention and context of dissemination of technology.

Chapter V deals with the network relations among the respondents and the technology in the context of justification.

Chapter VI provides a summary of the findings and conclusions of the study.

CONCEPTS

Context of Invention

Innovation: It is the first phase in diffusion of technology in which technology / knowledge is generated and improvised on the pre - existing edifice.

Context of Dissemination: It is the second phase in diffusion of technology in which technology / knowledge is propagated through diverse socio - cultural networks from producers to adopters through actor networks.

Context of Justification: It is the third stage in diffusion of technology covering the social milieu in which technology / knowledge is made available to adopters and feedback obtained to check the fallacies.

Actor: An actor is any element- human, technical, non-technical or social- that exists in a network relation with other elements.

Measures of Participation: The participation of the respondents is assessed in terms of frequency of their meetings with technical personnel, their labourinvolvement, their information levels, yield etc.

Level of Information: It is the

information the respondent has regarding oil palm ranging from empirical aspects of cultivation to conceptual information regarding the operational aspects as well as relevance of oil palm cultivation. Thus 6 levels are distinguished. For the purpose of analysis each level is given weightage which increases gradually.

Correlates of Participation:

The levels of participation are correlated with the socio-economic background, demographic profile, education and information levels to decide whether participants are active or passive.

CHAPTER II

SECTION A

REVIEW OF LITERATURE

Technology transfer in an international context is seen as the transaction between two countries, but internally it is seen as diffusion rather than transfer. But diffusion of technology from lab to land may also be called as technology transfer, because it is as complex as it is between countries and has similar features. It goes through a chain of events and a multitude of actors in its course of development.

THEORETICAL UNDERPINNINGS

The basic components of a technology are (a) hardware (tools) (b) soft-ware (knowledge underlying the construction of the tools) and (c) orgo-ware (social organisation for implementing the technology). There are different connotations of the term technology transfer that emerged in the past. A rather simpler definition is given by Samuel Doctors (1976) for technology transfer as *" the movement of technology developed in one institutional setting to an alternative use in a second institutional setting "* (as quoted in Lambright, 1976, p166).

But a more comprehensive examination of the term would suggest the primacy of cognitive component over the mere tools/ hardware in the entire transfer process. Samanta's (1982) definition would be nearer to this notion which defines technology transfer as" *the movement* of *information from a* research or an *innovation system through an extension system (which acts as an interpreter, disseminator and* a *facilitator) to the client system i.e. the target group ".*

It is thus necessary to look into the whole process of transfer of knowledge as to how it is generated, improvised and transmitted and the sociological and cognitive factors that contribute to its transmission.

SOCIO-LOGY OF KNOW-LEDGE:

Knowledge is information abstracted from reality and is conceptualised and expressed in a system of shared symbols. Merton (1968) differentiates between knowledge and information. Knowledge is systematically connected body of facts and beliefs which otherwise individually constitute information. The basic assumption of sociology of knowledge is that knowledge is socially and culturally conditioned. Sociology of science hence, concerned with how and to what extent knowledge is socially and culturally conditioned. Marx and Engels routed the basis of ideas to relations of production in the substructure. According to Marx, super structure comprises political, cultural and intellectual life which is built upon the substructure. Thus the idealistic and cognitive aspects are shaped by the mode of production.

Marx (1904) says,

" It is not the consciousness of men *that determines their existence, but, on the contrary, their social existence determines their consciousness."*

Karl Manheim was the one who gave a separate disciplinary status to sociology of knowledge. He started this movement as a response to German idealism. He conformed to Marxian conception of control of knowledge by extra-cognitive factors, but refused to accept that class is the only social category that conditioned knowledge. The groups needn't be only of economic nature but also be occupational groups and status categories that can have determinative effect on knowledge.

Real factoren determine knowledge

Manheim seems to have identified two dominant models of thought, aspirations and intentions which form the main content of knowledge and are controlled by the social order (Eisenstadt, 1987). He was in consonance with Durkheim's group affiliations and collective conscience. His attempt was to know how different contents of knowledge are shaped by various *'Real factoren'* (real factors) and which social conditions in particular determine knowledge.

As Eisenstadt criticises, Manheim believed knowledge to be purely technical and instrumental. He took the cognitive aspect of social action for granted but failed to explain how it enters the sphere of knowledge. According to Eisenstadt, he also refused to explain why real factors should determine knowledge.

Sociology of knowledge in Manheim's tradition is both theoretical and methodological (see Merton, 1968). The theoretical argument establishes the existential determination of thought and its bearing on objective validity.The methodological aspect helps in devising procedures to study the social determination by constructing ideal types of thought in different social strata like classes, sects etc.

Merton's critique of Manheim says that Manheim identified certain spheres of knowledge but could not really establish the connection between thought and society, as he believed that identification of groups and their ideological affiliations has to be empirically investigated. This is fallacious, as Merton says, because, if the relationship between a particular sphere of knowledge and society is not established, it becomes difficult to devise a research problem for empirical investigation.

Ideology as the basis of knowledge

Manheim too, like Marx and Engels, developed sociology of knowledge from the theory of ideology. He distinguished two conceptions of ideology: *'particular'* and *'total'*. The former takes only partial views of others as ideological, thus leaving scope for non-ideological forms too, where as, the latter takes for granted the entire theory of opponents as ideological. The former is at the psychological level but the latter is invariably bound up in a life-situation and purely sociological. According to Manheim, sociology of knowledge can emerge if we go one step ahead of ideology, where he

differentiates *'special'* formulation of conception of knowledge from *'general'* formulation.

In the special formulation, the conception of a selected few is taken as ideological depending on the social position, where as, in the general formulation, entire humanity's conception becomes ideological.

Manheim also gave three points to avoid fallacies in sociology of knowledge. In his view, a theory has to be contextually relevant, appropriate and adaptable to social conditions.

"A theory is wrong *if in a given practical situation it uses concepts and categories, which, if taken seriously, would prevent man from adjusting himself at that historical stage."* (as quoted in Merton,1968,p557).

Absolute validity is given to only those assertions which are socially demonstrated for their truthfulness. The assertions can possibly have sociological and temporal limitations. Conflicting perspectives of people from different struta in the social structure can lead to intellectual conflict as to which perspective has more validity of truth. This conflict can be avoided, according to Manheim, by having a common ground and he identified intelligentsia as the objective section of the society to judge intellectual development. While delineating the social basis of thought, there are multiple spheres of knowledge similar to the multiplicity of groups and group affiliations.

Whether all the spheres have an existential basis or only particular spheres have and if so which of them, was the ambiguous question left unanswered by the classical sociology of knowledge. It was revived again by Merton in the latter half of the 20 th century. According to him, knowledge is paralleled with culture and so,

"not only the exact sciences but ethical convictions, epistemological postulates, material predictions, synthetic judgements, political beliefs, the categories of thought, eschatolog'tcal doxies, moral norms, ontological assumptions and observations of empirical fact are more or less indiscriminately held to be existentially conditioned." (Merton, 1968,p521).

He differentiated between European and American schools of observing the social and cognitive phenomena. In the American tradition, Merton believed, more than the existential determination of intellectual doctrines and epistemological analysis, more importance is given to the spread of information to different social groups and the institutional arrangement in the production and dissemination of knowledge. The focus of sociology of knowledge has been shifted to analyse the institutional structure of science.

The sociology of science propounded by Merton and others was limited to studying the social structure and culture of scientists, who are the producers of knowledge. Manheim's observation that knowledge except scientific knowledge is

socially culturally conditioned has been challenged by Merton whose paradigm in sociology of science tended to share the Manheimian sociology of knowledge and rationalist epistemology has been questioned.

According to rationalist epistemology, scientific knowledge is rational, universal, atemporal and objective. Sociological explanation is needed only to account for irrational beliefs in science. However, the recent developments in sociology of knowledge attempt to show that all knowledge is socially caused. Thus the sociology of science has widened its gamut of operations from mere analysis of the social and moral aspects of science to the process of social construction of scientific knowledge and innovations, thus opening science to sociological scrutiny.

Differences between Science and Technology :

Conventionally a clear demarcating line between science and technology is drawn by philosophers and social scientists of science with the notion that *'science discovers, technology applies'*. For Derek Solla Price (1969), a scientist is *'papyro centric'* because the output of his research is in terms of publications, where as technologist is *'papyrophobic'* because his interest is in developing patents by hiding as muchas possible from his peers.

Koyre identified the difference between science and technology in philosophical terms, as, *episteme* (knowledge) and tec/inefart). (See Layton, 1977, p40). According to Layton (1971), they are *'mirrorimage twins, two different communities each*

with its own goals and systems of values' (p 565). De Sollaprice recognised that science and technology are symbiotic and on par with each other and they extend their distinct cultures while at the same time exploiting the others { Barnes, 1972 a, p166). The old notion that science is theoretical and technology is practical application of theoretical knowledge, was abandoned by the historians and philosophers of technology by recognition of the eventual interdependence of the two.

The distinction between science and technology is not between knowing and doing. They both are social.

As Layton (1977, p210) puts it,

" *science and technology have* become *intermixed. Modern technology involves scientists who 'do' technology and technologists who function as scientists. The old view that basic sciences generate all the knowledge which technologists then apply will simply not help in understanding contemporary technology".*

Then the social constructionist's view of science can also be applied to that of technology. Scientists and technologists operate in a social context and develop their knowledge claims and technological innovations according to the cultural ethos of the society.

The acceptance or rejection of a technology, as in the case of science depends on the social world rather than the mechanical world. Technology in a social context, involves organizational networks,

ideologies and human capital.

TECHNOLOGY AS KNOWLEDGE:

Technology is developed by applying rationality to practical matters. Beliefs, thoughts and ideas which are incidentally, instantaneously or temporally created are conceptualised by rigorous abstraction.

According to Misa (1992,p3-12) " *technology is knowledge about techne (art& crafts)*".

As Layton (1974, p 36) puts it, technology is

"the ability to design, a knowledge that is plastic geometrical, to some *extent non-verbal mode of thought."*

Langrish (1972, p 34) advocates that technology is not just hardware, but " *the concepts* and *knowledge which are embodied in the hardware".*

The beliefs and thoughts which have repeated recurrence are concretised and incorporated in the corpus of knowledge. The basic requirement for any thought to be materialised and called as knowledge would be its repeatability.

According to Agassi (1985, p154), any technological rationality may be called as scientific if the same result is produced repeatedly. Any thought or belief becomes traditional and gets ingrained into the system after being repeated for ages. So knowledge thus generated is *'scientific'*. Technology is also developed after repeated trial and error methods. The body of technology is evolved after rigorous cross-checking with existing methods and practices. So technology is *'scientific'*. Repeatability is elementary to both technology and knowledge. Thus both the terms can be used

interchangeably.

Technology was recognised by thinkers like Layton, Price et al, as an independent, parallel intellectual entity which has its own internal dynamics and laws that help in the creation of artefacts. Thus Layton pioneered the conception of *'technology as knowledge'*. Knowledge is regenerative, reproductive and recuperative. It is improvised orally, verbally and cognitively, the basic fact being tacit. Similarly technology is that which is tacit and patentable. Technological knowledge has a private character because of the private control over patent rights. It also has a public dimension as it has to be diffused through the market system (Parayil,1991). Vincenti (1984) gives three categories of technological knowledge as prescriptive, descriptive and tacit. The cognitive part of technology is descriptive and prescriptive while procedural part is tacit.

According to Parayil (1991), transmission of technological knowledge is possible without it being declared as *'certified knowledge'*, through traditional crafts and customary methods. Layton's argument is even deeper in that the basic edifice for technological artefacts and processes is laid in ideas, thoughts and human experiences.

The cognitive elements, if given a physical form and are externalised, embody technological artefacts. The cognitive faculties are improved in functioning by procedural technologies (Levinson,1988). Therefore, according to many historians of technology like Layton (1977), White

(1969), Ferguson (1974), Solla Price (1965), information and ideas are more fundamental to technology than its material artefacts. Since both knowledge and technology are characteristically similar, they can be used interchangeably.

TECHNOLOGICAL CHANGE AS KNOWLEDGE CHANGE:

We have seen that knowledge is built into technology. Then technological change would also mean knowledge change, change in information levels, perceptions and concepts. It would also mean change in practices, cultural as well as technical. Technological change according to Parayil (1991) is, *"the outcome of activities that humans engage in through their collective or individual organizational structures, to optimise their resources subject to constraints imposed by their own limitations in tandem with that of the environment."*

According to Saviotti (1986), any technological change is supposed to be having two characteristics: technological and service characteristics which are complementary to each other. The interface between the internal environment of the technological system and the external environment is represented by the service characteristics which provides the link between the technology and the external environment.

In the foregoing paragraphs we have seen the social origins of knowledge. Conventional thesis of technological determinism argues that technology shapes society and brings about

Social shaping of technology

social change but it is external to the social world and is seldom influenced by the society (See Mackenzie et al,1955). By contrast, the social shaping of technology approach corrects the fallacies in this notion by arguing that technology and society are mutually dependent entities. There seemed to be two broad approaches,- micro and macro- to social shaping of technology (See Mackay & Gillespie,1992). Three different schools of thought may be identified in the micro approach;

(1) the social constructionist approach which suggests that technological systems emerge out of choices between social groups and technology is socially constructed. (2) the *'systems'* approach which focuses on technologists as *'system builders'* and postulates that heterogeneous people, disciplines and organizations form a part of *'seam less web'* (Hughes,1992) and (3) the actor- network theory which gives a comprehensive approach to understand the development of technology focussing on the relations between actors of technical and non-technical world.

The micro approach neglects the political and economic context in which technology is developed and this is covered by the macro approach. Technologies advocate particular social organization of labour to achieve particular social objectives. Raymond Williams views that,

"technologies are created not by lone inventors or geniuses working in a social vaccuum, but by a combination of social forces and processes" (as quoted in Mackay & Gillespie,1992).

Actor Network Theory

There are two radically different views that emerged in sociology of technology. First is the view of technological determinism according to which technology is seldom shaped by social reality. It is the technology which determines social structure and culture. Second is the social reductionist view according to which social forces condition the growth of technological knowledge. But even this has limitations in the sense that it takes only *'social category'* as determinant of technology. Actor network theory helps in overcoming the limitations of both technological determinism and social reductionism. While accepting social categories as one set of the factors that determine technology, it recognises other factors such as political, economic and non-social technical factors too that affect technology. These factors are described as *'heterogeneous elements'* which may be social, natural, technical, non technical and political in nature. The purpose of the sociologist of technology is to study the interaction between these elements and account for the factors that promote / hinder stability among the networks which is called as *'heterogeneous engineering'* (Law, 1989).

The heterogeneous elements are called by Michel Callon (1989) as *'actors'* and the relationship among actors is described as an actor-network, which according to him, is not reducible to one single actor or network, but all - encompassing.

"An actor network is simultaneously an actor whose *activity is networking heterogeneous elements and a network that is able to redefine and transform what it is made of,"* (Callon,1989,p93).

Conventionally technological development is conceived as a linear model where technology is developed by the engineers/ technologists in a social vacuum and then transferred to the society. But Callon disputed this and advocated a non-linear model. According to him, the engineers who conceive technology and all others who participate in its design, development and diffusion construct and develop debate about the technology so much, that in the process they become participants in sociological analysis of technology. Thus they are transformed to become engineer-sociologists.

It is generally believed that, in the initial stage of technology development, only technical problems and compulsions are important and economic and social problems play secondary role. But Callon refuses to accept this and says 'right from the beginning technological, scientific, social, economic and political considerations are inextricably bound in an organic whole'. Gallon studied the technology development of electric car and its introduction into French society. In the development of this the non-linear, non-hierarchical model of technology development was perceived by Gallon.

Table 4.5

Labour requirement in paddy (per acre)

Operation	Man Days		Wages per Day		Total Amount spent on labor
	Male	Female	Male	Female	Rs.
Ploughing	2	-	25	20	50
Planting	-	20	-	20	400
Weeding	2	20	25	20	450
Watering	52	-	40	-	2080
Harvesting	-	10	-	20	200

"It means recognising that its proper **object** of **study** *is neither society nor so called social relationships but the very actor-networks that simultaneously* **give rise** fo *society and to technology."* (Callon,1989, p 99).

Hughes (1989, p197) describes these networks as *'systems'* which are the constructs that remain stable as long as conditions are conducive. The boundary between the system and environment is of fluid nature and conflict between disparate elements is not unconceivable.

Bijker (1989) introduced an **interactionist** concept called *'technological frame'* which is similar to Callon's *'network',* because it suggests the interaction among actors. It is a heuristic devise to study all the social groups that are the members of this frame.

"The inclusion of actors in a technological frame can be specified by describing their **goals,** *problem solving* **strategies,** *experimental* **skills,** *theoretical training and so on; then one should go on to indicate to what extent each of these elements is congruent* **with** *the respective elements of the* **technological frame."** (Bijker.1989, p174).

According to Bijker, a technological frame again cannot structure the interaction of members completely because of two reasons:

(a) the difference in the degree of inclusion of members in the frame. Those who have higher degree of inclusion will have higher interaction and vice versa.

(b) the multiple memberships of members in more than one technological frame.

Meanings are attached to artefacts by members of the technological frame. Those social groups which attribute common meanings to the artefacts are grouped together as relevant social groups.

The study of technology has been a subject of study for social scientists for quite some time. That itself can be turned into a sociological tool of analysis according to Callon (op.cit). The actor network theory proposed by him increases the methodological scope of sociology and helps inunderstanding technological development.

The method as per actor-networks is to study society through the eyes of scientists/ engineers / innovators through their investigations. This method is effective, according to Callon, because innovators would have studied society and developed sociological theories before innovating a particular product or process.

Law (op.cit) analyses two underlying methodological principles for the study of heterogeneous networks:

(a) first is that of *'general symmetry'* according to which, all the heterogeneous elements, whether of technical, social, political or economic nature should be treated as equals at the time of analysis and no particular element should be considered to be more fundamental than others.

(b) the second is that of *'reciprocity'* which says that, actors of the network exert influence on each

other and those actors who are united in their meanings and actions contribute to the stability of the structure.

Heterogeneity among human actors is in terms of their socio-economic background, interests, education, knowledge etc.This heterogeneity provides dynamic to the network. The actor network theory thus, is a framework different from technological determinism and absolute social reductionism and it treats all the factors, social or non social, technical or non-technical, on a common plane.

Having this theoretical base, development of technology may be analysed in terms of three phases:

(1) CONTEXT OF INVENTION/ INNOVATION: in which knowledge / technology is generated and improvised on the pre-existing edifice.

(2) CONTEXT OF DISSEMINATION: in which knowledge / technology is diffused through different socio-cultural networks from producers to adopters through diffusing agencies. Various actors that are involved constitute a network of actors.

(3) CONTEXT OF JUSTIFICATION: social milieu in which ideas, tools and practices are tested out in real life-situations. Knowledge / technology is made available to users and feedback obtained to check for the fallacies.

Earlier on, technological innovation was viewed as a linear process. But the actor-network framework views it as non-linear. Sociological

implications of the innovation are discussed right at the invention stage by the innovators, who may be called in Callon's terms as innovator-sociologists. Therefore, the above stages are only temporally separate but conceptually interrelated and reciprocal. However, the division of the process in terms of phases is made for purposes of analysis.

Context of Invention

In this context, knowledge/technology may be studied in terms of following interacting elements:

(a) the scientist / technologist - makes certain knowledge claims about a scientific phenomenon or a technological artefact- a product or a process.

(b) the community of scientists / technologists - which evaluates the knowlege claims in terms of logic and evidence - adequacy and appropriateness and aesthetic considerations and certifies/rejects the claims.

(c) technology - with its corpus of knowledge and distinct tools, equipment and management practices and social organization.

(d) private / public firms - which mediate between the technology and the adopter.

(e) Individual adopters and groups - who provide feedback to the technologist.

Determinants of Technology

Any technology developed by the technologist unless evaluated, in addition to its efficiency and productivity, in a cultural and valuational framework may prove to be inimical to the social fabric of life. In this context, Saviotti (1986) calls, the *'intrinsic properties'* of technology which are mutually coherent with the socio-economic environment.

Scientific inventions may occur either out of necessity or serendipity. But technological innovations emerge out of necessity or felt needs. In most cases, ideology plays a major role in new technological designs. (See Mackay & Gillespie,1992).

The need for a new concept or product, perceived to be essential and which awaits technological implementation, is called as *'cultural imperative'* by Schiffer. According to him, the need for a new concept, a product, a new crop or a new agricultural practice felt by potential users or a decisive group comprise policy makers, technocrats or entrepreneurs who perceive the needs and technological solutions to satisfy the needs.

The kinds of ideas which gain immediate acceptance by people are those that are simple and comprehensible, which are called as *'common sensical* ideas' by Agassi (1985). So the aim of a technologist is to transform sophisticated knowledge into common sensical one which at the same time improve efficiency and productivity. By doing this, new human knowledge is generated which is an admixture of sophisticated science and this would give way to democratic control of knowledge (Agassi, 1986, p163).

Context of Dissem-ination

The context of dissemination is pertinent because, especially in the case of agricultural technologies, technological innovations are diffused in a social context through a network of several actors. The interacting elements in this

phase are:

(a) Adopters - human actors who adopt/ implement technology.

(b) Agents of transfer - both government and corporate groups and their functionaries who introduce technology to adopters.

(c) Technology - with its technical elements like seeds, fertilizers and mechanical elements like equipment.

(d) Communication networks - the media networks that operate between adopters and agents and informal communication.

(e) Information - contents of message regarding the management of technology.

In the context of dissemination, the pertinent issues are the actors and the network of relations among them. The two discrete actors are the technology and the adopter. Therefore, two important issues in this context are: from the technology side, through what trajectory is technology being transferred and from the adopter's side, what is making him accept/reject the technology.

In the first case, technology has to pass through various agencies before reaching the target group, from the ..e context of invention through an extension system, facilitated by communication agents to the adopters. It invol ves imparting knowledge and practices to potential adopters by selecting appro- priate communication strategies and extension methods. In the second case, what

makes the adopter get the technology and how he gets ft are important. Whether need precedes the technology adoption or knowl edge of the technology creates the need. For Rogers (1983) it is a chicken and egg problem. It involves awareness of adopters, their evaluation of technology and decision making with regard to acceptance / rejection of the technology. According to Rogers, diffusion which is one of the phases in technology development may be divided in to five stages: (a) *'knowledge'* of the innovation (b) *'persuasion'* of the adopter (c) *'decision'* whether to accept or reject it (d) *'implementation'* and (e) *'confirmation'* of the decision. Rogers model helps in understanding technology development in the context of dissemination.

The adopters' interests are involved in accepting or rejecting a technological innovation. From the adopters' side there may be *'selective exposure'* or *'selective absorption'* of the technological knowledge.

In this context, what kind of propaganda has more chances of acceptance by people is important. Merlon (1968, p578) says that, one of the biggest problems in mass communication is *'pervasive distrust'* of the propaganda by receivers branding it as mere *'propaganda'* and discounting it.

This is particularly manifested in those cases where an attempt is made to appeal to sentiments. Merton (1968) advocates for *'technological propaganda'* or *'the propaganda of facts'* which

are fair and square which seem to have higher acceptance. He says, *'the fact, not the propaganda speaks'* (p 579), because it is more nearer to reality.

Merton (1968, p 580) also identifies those fads which have desired effect as *'startling facts'* and gives four characteristics which make them effective. They seem to have (a) attention value - because they are pragmatic. (b) diffusion value - because they are conveyed in tidbits. (c) confidence value - because they are 'cold' and 'straight'. (d) guidance value - because they only show right path and do not spoon feed.

Demonstration as a diffusion strategy

In the diffusion of technology, demonstration of technology is essential for exhibiting its potential to the users. A demonstration is deemed to be successful depending on its market penetration. There are three measures of success identified for demonstration projects (Brown et al,1993).

(a) Diffusion success: the goal of the demonstration project is to encourage adoption of technology by different sections of people. The increase in the number of adopters suggests the diffusion success.

(b) Information success: demonstration projects are meant to spread the informa tion about the technology and its management practices to people in an unbiased manner and allay fears of perceived risks. Then it is said to have information success.

It is said that, * *demonstrations can perform many information roles: they* can increase know/edge *(i.e., make potential adopters better informed about the technology), persuade potential adopters of the benefits of the technology (i.e., change attitudes), lead to an adoption decision (i.e., motivational) and promote implementation (i.e., help translate purchase intentions into actions)".* [Brown, 1993, p188).

(c) Application success - Demonstration projects are supposed to demonstrate the viability and practicability of a technology in a particular setting and if they do that, they are said to have application success.

Demonstration projects are different from field tests, in the sense that, field tests are to test the feasibility of a technology, but demonstration projects are to demonstrate the technology and it progresses to this stage passing through the first stage, that is field tests. Demonstration is thus one of the marketing strategies and an attempt at justification of technology in real life as against a lab situation.

The degree of success of demonstration would depend on the number of adopters it has convinced about the technology and their persistence with the technology even after the completion of the project. Their persistence depends on their conviction about the technology on the basis of its affordability, efficiency, simplicity, productivity etc. It also depends on information levels of the adopters which in turn is determined by their

position in the social structure.When it comes to enhancement of information levels of adopters, methods of communication adopted would be important. In the dominant paradigm of communication research, communication was defined as ,

"a process of *conveying informative and persuasive* messages from a *government* fo *the public in a downward, hierarchical way."* (Rogers, 1976, p133).

In this process, contact agents and mass media channels were to play active role of convincing people about new technologies and people to accept them passively.This approach was later realised to be inimical because of its one sided approach of communication to people.

Pye (1963, 3-4) identified this communication method a cause for 'down fall of traditional society'.

Lerner (1958) called mass media a *'magic multiplier'* in development efforts. While identifying the key factors of modernity, Lerner gave highest importance to mass media exposure at the individual level.

Schramm (1978) said that communication was thought to be a 'bullet' hitting a target with predictable consequences.

Rogers' emphasis is at the social system level. For him 'development' is 'modernization of the social system'.

"Diffusion is a special form of communication in which some change agent confronts (in person or by means of some *medium) the* members of a *social system with an innovation and persuades them to adopt it".* (Narula,1986, p228).

The dominant paradigm in development emphasized on one-sided, top-down approach to reach to facilitate development benefits reach masses. The ineffective results of this paradigm were attributed by the communication theorists to rigidity, passivity and resistance to change on the part of people, hierarchical caste and power relationships of the rural society and bureau cratic and exploitative tendencies of elites that precluded development and communication. It was realised that a development model would be typical of a country's social and political structure.

Emulation of a western model of development and definitions would be non-contextual in a developing society. According to the new paradigm, as de'ineated by Rogers (1976, p 129),development was defined in terms of quality of life, encouraging popular participation, self reliance and self management of resources by people and attainment of distributive justice. Communication in this paradigm is seen to depend on traditional, contextual, 'society specific' networks rather than technologically imposed communication.

Because in a developing rural society, oral, bottom-bottom communication was found to be more effective in reaching wider people than top-down communication or communication through

mass media channels.Dissanayake (1981) identified inter-personal channels of communication to be more effective because they give scope for sharing values and experi ences than mass media which indulges only in spreading information.

According to Schramm (1983,14-15) *'Communication is* now seen as a *transaction in which both parties* are active. *It is illuminating to think of communication as a relationship built around the exchange of information.'* Rogers (1976) identified diffusion to have two elements; first, recognition of needs by masses and second, fulfilling those needs with available local resources and innovations. (see Narula,1986, p 40).Mass media channels, have a wider network with their print and audio-visual paraphernalia and carefully structured messages. Their diffusion also reaches masses equanimously with no social constraints. Even then, if the inter-personal channels of communication are found to be effective, it would mean that people attach more bignificance to messages received orally than through electronic media. This necessitates us to look into the social structure and social relationships where these channels of communication operate.

Context of Justification

It is the context, in which technology is deployed in a real life-situation where heterogeneous human actors adopt technological innovations.The heterogeneity of these actors in terms of strata-caste, class - to which they belong is society specific. Therefore it is essential to look into the social structural, cultural features in which the actors are

located. Indian society is a complex society, with diverse structural entities.

It has a unique system of stratification. People are stratified according to the status groups: caste affiliation determines the social status and class affiliation shapes the economic status. Caste as a structural phenomenon can be viewed as a 'closed rank status group' and as a cultural phenomenon it can be viewed as a 'set of values, beliefs and practices'.

Earlier on, caste as a corporate group was characterised by its ascribed status, hierarchy, commensality, endogamy etc. But in recent times it has changed its form like commensality, while still playing an important role. Class as mentioned above determines one's economic status and subsequently political power. Therefore, in Indian society class and caste affiliations cut across each other.

The concept of *'dominant caste'* introduced by M.N. Srinivas is particularly relevant in the context of transfer of technological innovations. Because members of the dominant caste may either facilitate or hamper technological innovations by virtue of their strength. In Srinivas's (1955) words,

'A caste is dominant when it is numerically the strongest in the village or *local area and economically and politically exercises a prepondering influence'.*

According to him, it need not be the highest caste in terms of traditional hierarchy. The fundamental criterion for any caste to become dominant would be land ownership, which would give them economic strength and subsequently political and numerical strength. A dominant caste, which controls means of production transforms itself into the dominant class.

The land ownership has also given rise to class differentiation in the Indian rural scene. There has been a decade long debate on mode of production in Indian agriculture which has also identified the class categories and class relations in Indian agriculture (Thorner, 1982).

The earlier semi-feudal mode of production has changed into capitalistic mode of production in Indian agriculture with the advent of mechanization, commodity production, recycling of surplus value and production for the sake of market. [Patnaik (1976), Rudra (1978), Chattopadhyay (1972), Bhaduri (1973) et al). This capitalistic mode of production has given rise to two major classes: capitalists and wage labourers, with all other classes of farmers in between.

Labour too, in Indian society, exists in myriad forms, varying from the most free casual labour to the most unfree bonded labour. It can exist as Jajmani labour where it is caste obligatory or contractual or exchange labour where it is purely independent.

In the context of justification, ft is more pertinent to observe the network relations among various

social, political, economic and cultural factors of the society on the one hand and development and deployment of technology on the other. Thus in Indian rural society, characterised by historically specific features, network relations may be studied between technology, the inanimate actor on the one hand and all other social, economic and political actors like caste, class, labour relations, caste relations, education and information etc on the other.The various actors in this context are:

(a) Adopters: heterogeneous human actors who adopt technology.

(b) Caste: the caste affiliation of the adopter and its role in technology development.If a caste group is a dominant one in a given area the actors belonging to this group by virtue of their dominant position either facilitate or hamper technology development.

(c) Class: the economic status of the adopter and its role in technology transfer.

(d) Labour: those human actors vho are affected by the technological innovation in terms of acquisition of new skills, displacement etc.

The heterogeneity is caused due to diversified socio-economic background and interests. It subsequently causes heterogeneity in the levels of participation of actors in technological adoption. Therefore, technology can be analysed regarding its justification by observing the participation of animate actors in adopting the inanimate actor i.e.,technology. In this context, let us look at various connotations 'participation' has been given by

various theorists.

Cohen and Uphoff (1976) delineated four forms of participation: viz,

1. Participation in decision-making;

2. Participation in implementation;

3. Participation in results of development programmes; and

4. Participation in evaluation.

Coombs (1980) distinguished between *'active'* and *'passive'* participation.

'Passive participation occurs when *local residents listen politely to messages in a top-down pattern and accept handouts but do not alter their customary views or behaviour.'*

'Active participation occurs when a village organizes itself democratically to examine its needs and options to make decisions, mobilize its resources and seek outside help when it needs it'.

Participation is differentiated into *'functional participation'* and *'popular participation'* by Silberman (1979). The former occurs when government mobilizes people for preset goals, while the latter occurs when people pursue their goals through their self-designed programmes.

Participation in development is interpreted by Lele (as quoted in Oakley, p9) as a *'means in its broadest* sense to *sensitize people and thus increase the receptivity and ability of people to respond to development programmes, as well as to encourage local initiatives'.*

Participation according to Lisk (as quoted in Oakley, p9), includes *'people's involvement in decision making processes,* in *implementing programmes... their sharing in the benefits of development programmes and their involvement in efforts to evaluate such programmes'.*

Participation, according to Pearse (as quoted in Oakley, p9), involves,*'organized efforts to increase control over resources and regulative institutions in* given *social situations on the part of groups or movements of those hitherto excluded from such control'.*

Participation instead of seeing as a means, has to become an end in itself to make rural development programmes a success. This was realised by many social scientists (Techranian, 1985, Alamgir, 1988, Bamberger,1988, Diaz Bordenave, 1989). It is recognised as a birth right and equated with other basic necessities. It is seen to empower people and progress in development programmes of their own choice.

Diaz Bordenave observes (as quoted in Melkote, 1991, p237):

'Participation is not a fringe benefit that authorities may grant as a concession but every human being's birth right that no authority may deny or prevent'.

Participation is identified by Oakley (1989) as 'marginal' and 'substantive', depending on the degree of involvement.

Table 5.2
Relation between yield and social status

Yield	Caste			Total
	F.C.	B.C.	S.C.	
Belowaverage	70	4	9	83 (57.6)
Above Average	57	2	2	61 (42.4)
Total	127 (88.2)	6 (4.2)	11 (7.6)	144 (100.0)

impediments to popular participation :

(a) the paradoxical nature of development concept which demands self-reliance and decision under the umbrella of centralised planning.

(b) the economic and political structure of the society which thwarts the self-assertiveness of masses.

(c) inequity in terms of resources as well as quantity and quality of information imparted to elites and masses alike.

{d} dearth of development motivation given to masses except unloading of heavy technical information which makes them apathetic to the entire project.

(e) the very social structure with its caste and class differentiation encouraging polarisation in the society. There is no denying that earnest attempts were made by communication experts and social scientists in analysing development. But the Indian rural scene has changed in recent times.

While it cannot be denied that caste and class demarcations do operate in Indian society, it may also be affirmatively said that there is no dearth of information or opportunities given to rural masses through public policy. In the changed scene of distributive justice, we need to look for participation at the individual level. By extending Cohen's definition a little further, active participation can be said to have the initiative from one-self to take part in innovative projects (self-designed as well as sponsored), earnestness to gather more

information from as many sources as possible and trying to be creative in evolving new strategies and management practices apart from sticking to the set practices and giving a timely feedback. Performance, in terms of reaching the targets, of course is the hallmark of active participation. This definition of participation was adopted to study the human behaviour in the OPDP which will be dealt with in subsequent chapters.

Summary

The technological theory passed through various connotations and ideologies in the past decades. It took birth in Manheimian sociology of knowledge, which highlighted the primacy of social reality over production of scientific knowledge. According to sociology of knowledge, a scientist can not develop scientific theories in a social vaccuum. Later sociology of science was developed by Merton, to study the scientific community and the social context of science.

The latter theories either talked of technological determinism or social reductionism. It can be said that Callon took cue from these theories to study technology development in a social context. But he found the limitations of conventional sociologists in delimiting their study of technology development to only social categories. Instead, he suggested that all the technical and social elements should be treated on par with each other in technology development.

Callon developed actor-network theory to study technology development, overcoming the limitations of the previous sociological theories and

suggested that sociologists should follow the engineers while studying technology development. This study is based on Callon's model.

SECTION B

METHODOLOGY

Universe Of the Study:

The Oil Palm Demonstration Project (OPDP) was launched in three states viz., Andhra Pradesh, Karnataka and Maharashtra. Among them Andhra Pradesh was chosen for the present study. In Andhra Pradesh the districts chosen for the project are W.Godavari, E.Godavari and Krishna. The universe of the present study consists of 665 farmers selected by the department of Horticulture, Andhra Pradesh for the demonstration project in these three districts viz., 284 in W.Godavari, 197 in E. Godavari and 184 in Krishna.

Samp-li-g-

From the universe a sample of 50 % of farmers were chosen to be covered from three districts together. Five mandals (revenue blocks) were identified in W.Godavari, five mandals in E.Godavari and three in Krishna by the department for the project. Among the mandals chosen, 2 mandals in each district were selected for the study. While choosing the mandals, the primary objective was to cover 50 % of the total number of adopters. The mandals in the sample are: Kamavarapukota and Chintalapudi in W.Godavari district; Gandepalli and Jaggampeta in E.Godavari district; and Nuzivid and Musnuru in Krishna district. All the villages in these mandals were covered in the study i.e.,7 villages in W.Godavari, 7 villages in

E.Godavari and 6 villages in Krishna district. But as there were a few discrepancies in the data, the sample size had to be reduced. The reasons for reduction in the sample size are delineated below:

In many cases in order to get more benefits of the project, many names were registered as adopters from the same household but only the head of the house-hold would be actually controlling land and also organization of oil palm cultivation. All the persons in a household registered in OPDP were related. Therefore, the opinions and performance of the other members were influenced directly or indirectly by the head of the household. That is, in a given household more than one beneficiary were found.

Many reasons were found for enlisting more than one person from the same household for participating in the project. As per the policy, the government fixed the upper limit of 5 hectares of land for planting oil palm for each farmer for the purpose of providing the subsidy and other facilities.

Therefore, many of the farmers who wanted to plant oil palm in more than 5 hectares enlisted the names of their kith and kin so as to have access to more subsidy. Thus the researcher found a few households having oil palm cultivation in more than 5 hectares, when the maximum limit fixed by the government was 5 hectares. The probable reason for distribution of land on different names could be due to land ceiling act. The other reason

is that joint family still exists in Indian rural setting and land is controlled as joint property. Therefore, many adopters related through blood and marriage were found in the same household. In all these cases, the decision maker of the family was found to be one and he influenced, directly or indirectly, the participation and attitudes and opinions of the rest of the members in the family. In these cases, even if the researcher probed, the other adopters refused to respond and tended to say that the head of the household had all the information.

With all these inadequacies in the information regarding adopters, the sample was adjusted safeguarding from possible methodological errors. Taking one or two representative respondents from each household and removing absentee land lords, sold - out cases, absentees and refusals, the size of the sample came to 166 from three districts, 61 from E. Godavari, 24 from Krishna and 81 from W.Godavari district. The reduction in the size of the sample is given in detail in a tabular form.

Table **2.1** follows **in** the **next page**

Table 2.1
Distribution of households in the sample

District	Total Number of Participants	Sample size drawn	Actual Sample size included
Krishna	184	84	24
E.Godavari	197	106	61
W.Godavari	284	114	81
Total	665	335	166

Pilot Study

In this attempt, pilot survey was carried in W.Godavari district in which adopters in two mandals were approached with a questionnaire. In the pilot survey it was realised that personal interaction through an interview schedule would be more effective in a rural society than a questionnaire with preset questions. Moreover, new insights were also obtained regarding the entry of corporate sector into oil palm cultivation. Their involvement in convincing masses, their methods of communication and people's reaction to their entry were the new facets that were needed to be investigated. Therefore, the questionnaire was reconstructed and it was decided to use an interview schedule for data collection.

Data Collection

Both primary and secondary data were collected in this study. Secondary data in the form of list of adopters was collected from the department of Horticulture from each district headquarters viz., Eluru in W. Godavari district, Rajahmundry in E. Godavari and Vijayawada in Krishna district. This list had the details of names of adopters, area in hectares allotted by them to oil palm, date of planting and their class and caste background in terms of government's classification. Their class was denoted by categories like Big farmer, Marginal farmer and Small farmer and caste status as Other Castes, Backward Castes, Scheduled Castes, and Scheduled Tribes. Census data about the profile of the districts was obtained from Census 1981 and 1991. The details of the yield obtained by farmers right from the fourth year onwards were obtained from the corporate houses viz., Godrej,

Indian Tobacco Company (ITC) and M A Chidambaram (MAC) Industries. Primary data was collected from adopters, corporate officials, government officials and the labour. Since the nodal agency for the project was the DBT , some agricultural scientists who conceived the idea of oil palm and were involved in the project right from the beginning were interviewed to obtain data regarding the primary objectives and characteristic features of the project. Since the Indian Council for Agricultural Research (ICAR) is the main body which transfers technology through its departments of Horticulture in each state, its director for AP was also interviewed. At the district level, government officials like Assistant Directors of Horticulture and Horticulture officers were approached in the three districts under study with separate question naires and were interviewed at length.

Primary data

Adopters are the main sources of primary data. They were approached with an interview schedule for an indepth study. Agricultural labour though were not part of the sample, a few were also interviewed separately in order to know the impact of the technology on them. As many as hundred variables were identified covering a range of aspects of the households of participants, their information levels, social organisation of oil palm production, participation levels etc.

Variables Included in Interview Schedules:

I. Interview Schedule for the adopters :

1.(a) Household data - Size, composition, dependents,caste, literacy level, occupation etc.

(b) Landholdings - irrigated and unirrigated.

(c) Land under oil palm cultivation.

2.Sources of knowledge about oil palm.

3. Decision to plant oil palm - voluntary or persuaded by implementing agencies reasons for adopting oil palm are also important.

4. Oil palm cultivation : social organisation of production in terms of labour - family or hired labour, wages, costs etc.

capital - credit facilities, subsidies etc.

Irrigation - source, costs.

Inputs - seeds, fertilizers..

5. Interaction with implementing agencies at various levels.

6.Opinions about agencies.

7. Performance measured in terms of information levels, yield etc.

II Interview Schedule for the government as well as the corporate officials on

(a) the method of selection of farmers.

(b) methods of diffusion of information.

(c) monitoring and intervention at various stages.

(d) opinions about farmers' participation.

Data Analysis:

Both qualitative and quantitative techniques were adopted while analysing the data. Qualitatively, through observaitons and field notes, contents of the responses of the respondents were analysed. Quantitatively variables were measured on appropriate scales like nominal, ordinal, interval and ratio and appropriate statistical analysis with the help of statistical packages was carried out. Relevant statistical analysis like cross - tabulations, correlations were calculated. Statistics like percentages, measures of central tendency were calculated in order to get a clear picture of performance of adopters in the project.

CHAPTER III

DISTRICT PROFILE

In Andhra Pradesh (A.R), 40% of the geographical area is under cultivation, out of which 36% is irrigated. The State is divided into five regions by the National Commission on Agriculture on the basis of annual rainfall and cropping pattern. The first two regions comprise the coastal areas; third region Rayalseema (southern A.R); fourth and fifth regions are in Telangana(northern A.R). The coastal areas have irrigation facilities compared to other regions. The dominant source of irrigation comprises two major rivers - Krishna and Godavari - in the coastal areas. The Oil Palm Demonstration Project (OPDP) was launched in three districts which come under region I i.e., E.Godavari, W.Godavari and Krishna.

Agronomically oil palm is a rain-fed crop requiring an evenly distributed annual rainfall of 2500-4000 mm and temparature between 20 and 35 degrees Celsius. It grows on any type of soil but it flourishes on black soil and it needs heavy irrigation. The three districts West Godavari, East Godavari and Krishna, were chosen for oil palm

demonstration project keeping In view the above said prerequisites for oil palm cultivation. The annual rain fall recorded as per the census 1981 in West Godavari was 1081.7mm and in East Godavari 1137.8mm. All the three districts in the study get rain fall during the south-west as well as the north-east monsoon seasons.

WEST GODAVARI

The district occupies an area of 7742 Sq.Kms which is divided in to three natural divisions, the delta, the upland, and the agency tract.

Rivers

The rivers that flow in the district apart from the Godavari are Tammileru, Yerrakalva, Byneru, Juleru etc. The Kolleru lake is formed between the alluvial deposits of the Godavari and Krishna canals.

Soils

The different kinds of soils that are found in the district are red sandy loams, sandy clay loams, clays, alluvial, delta alluviams and arenacious soils. The red sandy loams and sandy clay loams are found to have high permeability and suitable for the cultivation of different crops.

Rainfall

The climatic conditions of this district are extreme. The annual rain fall recorded as per the 1981 census is 1081.7mm. The district gets maximum amount of annual rain fall through south west monsoon.

Crops

The main crops grown in the district are paddy, sugarcane, banana, lemon and coconut. Jower and bajra are also raised in the areas of Chintalapudi. Pulses, oilseeds, tobacco, sugarcane, chillies, fruits are also grown in this district.

The major crops grown in the district as per their distribution in the total area are rice (83.82%), sugarcane (4.14%), tobacco (4.25%), banana (0.66%), chillies (1.33%), coconut (1.09%), groundnut (1.36%), turmeric (0.15%), sesamum (1.40%), gram (0.58%), cotton (0.15%), maize (0.17%), jowar (0.55%), arhar (0.26%) and onions (0.02%). The gross irrigated area as percentage of the gross cropped area is 86.29% and the average size of operational holding is 1.19 hectares.

Population

The total population of the district is 3517.57 thousands among which male population is 1764.09 thousands and female population is 1753.48 thousands. Total literacy of the district is 53.38 % in which male literacy is 59.75% and female literacy is 46.98 percent.

Mandals

Two mandals that were covered in the district for the present study are Kamavarapukota and Chintalapudi. The villages that come under these mandals are Tadikalapudi, Veerisettigudem, Veerampalem, Adamilli and Sagipadu in Kamavarapukota and Pragadavaram and Venkatapuram in Chintalapudi mandals. The Census,1991 data of the villages in these two mandals that were included in the oil palm demonstration

project is given in Table 3.1. Since a few of the above villages are hamlets, their data is included in bigger villages.

Amenities

As far as the amenities are concerned, these villages have primary schools. Pragadavaram and Tadikalapudi have primary and secondary schools. These two villages also have medical and child welfare centres, post and telegraph offices, etc. The rest of the villages are remote and depend on these two villages for amenities. Wells and tanks are the sources of drinking water and tanks and tubewells are the sources of irrigation. The approach to these villages is only by road and mode of transport is by bus.

Table 3.1 follows in the next page

Table 3.1

West Godavari District

Village	Area	Total	Population		Literates		Mainworkers		Cultivators		Agri-labour	
	(sq.km)	population	M	F	M	F	M	F	M	F	M	F
Tadikala pudi	6151.6	13080	6600	6480	2253	1735	3990	1953	1129	44	2015	1663
Pragada varam	3862.7	9830	4960	4870	1948	1414	2790	1264	809	77	1241	932
Venkata puram	388.9	975	479	496	173	127	283	149	123	7	107	134

Source: Census of India, 1991.

EAST GODAVARI

This district occupies an area of 10,807.0 sq.kms bounded by Orissa, Vishakhapatnam, Bay of Bengal and West Godavari district. The district can be divided into three zones; the agency, the hilly tracts, the delta and the uplands. The district experiences high humidity through out the year.

Rainfall The district gets 61 % of the rainfall during the south-west monsoon and 28 % during the retreating monsoon season. The average annual rainfall as per the census 1981, in the district is 1137.8mm.

Soils There are three kinds of soils found inthe district viz., red, deltaic alluviams, coastal sands and lateritic soils. Among these, lateritic soils are found in Rajanagaram, Rangampeta etc., where oil palm cultivation was demonstrated. The main source of irrigation in the district is through Godavari canals.

Crops Different crops grown as per their distribution in the total area are rice (75.97%), coconut (4.91%), sugar cane (2.46%), banana (1.54%), tobacco (1.81%), chillies (0.86%), tapioca *(2,22%).* ground nut (1.87%), bajra (2.55%), cotton (0.73%), turmeric (0.08%), sesamum (2.50%), arhar (1.49%), maize (0.22 %) and jowar (0.53%). Gross irrigated area as percentage of gross cropped area in the district is 68.10 percent and the average size of the operational holding is 1.15 hectares.

Population

The total population of the district is 4541.22 thousands, the male population being 2272.96 thousands and female 2268.26 thousands.The literacy in the district is 48.79 %, the male literacy is 55.32 % and female literacy 42.26 %.

Mandals

The two mandals covered in this district were Gandepalli and Jaggampeta. The villages that come under Gandepalli mandal are Gandepalli, Murari, N.T.Rajapuram, Ramayyapalem and Singarampalem and under Jaggampeta are Ramavaram and Somavaram. The census data of the bigger villages among these is given in Table 3.2.

Table 3.2 follows in the next page

Table 3.2

East Godavari District

Village	Area	Total	Population		Literates		Mainworkers		Cultivators		Agri-labour	
	(sq.km)	population	M	F	M	F	M	F	M	F	M	F
Gande palli	1244,4	4748	2328	2420	904	739	1450	625	322	5	732	522
N.T.Ra japuram	677.8	2672	1309	1363	302	211	822	505	158	43	555	430
Murari	2352.4	6873	3406	3467	1379	1207	2266	857	756	14	1150	781
Singar ampalem	1235.9	1121	564	557	278	234	375	360	132	1	226	251
Ramava ram	1497.7	4586	2337	2249	556	476	1439	503	182	4	1040	461

Source: Census of India, 1991.

Krishna

Rivers

This district is spread over an area of 8,727 sq.kms. The rivers that flow in this district are Krishna, Munneru, Tammileru and Budameru. The river Krishna extends over an area of 1,280 sq.kms. The climate of the district is tropical.

Rainfall

The district gets two-thirds of its rainfall during the south-west monsoon season.

Soils

The three main types of soils in the district are the alluvial, the black-reger and the red-ferruginous.

Crops

The major crops grown in this district as per the distribution in the total area are rice (80.2%), chillies (2.4%), sugarcane (2.6%), groundnut (5.5%), tobacco (1.4%), turmeric (0.4%), cotton (2.5%), banana (0.1%), arhar (1.5%), jowar (2.3%), coconut (0.1%), maize (0.3%), sesamum (0.3%), onions (0.02%) and coriander (0.1%). The gross irrigated area as percentage of gross cropped area is 59.28 % and average operational holding in the district is 1.27 hectares.

Population

The total population of the district is 3517.57 thousands (Census,1991) among which male popu lation is 1 764.09 thousands and female population is 1753.48 thousands. The rate of literacy is 53.38% in the district where male literacy accounts 59.75% and female literacy 46.98 percent.

Mandals

The two mandals covered in this district were Nuzivid and Musnuru. The villages that come under these mandals are Pallerlamudi, Narsannapalem, Marribandham, Seetharamp

uram and Vempadu in Nuzivid and Chillaboinapalle in Musnuru. The census data of these villages is given in Table 3.3.

Amenities

All the villages have primary schools, only one village Pallerlamudi has secondary school.For all the villages medical amenities are available only at a distance of 5 to 10 kms. Postal services are available only in two villages Pallerlamudi and Seetharampuram. Motorable roads to these villages are also available at a distance of 5 to 10 kms from the villages. Wells, tanks and tube wells are the sources of drinking water and also sources of irrigation.

Table 3.3 follows on the next page

The network relation between the technology and the economic status of the adopter through the out put may be seen by means of a contingency analysis. As mentioned above, yield is taken as an indicator of out put of technology and size of land holdings as an indicator of class.

Among the 83 farmers who obtained below average yield, 8 (9.6%) were marginal farmers, 13 (15.7%) small farmers, 22 (26.5%) medium farmers and 40 (48.2%) big farmers. Among the 61 farmers who obtained above average yield, 3 (4.9%) were marginal farmers, 7 (11.5%) small farmers, 11 (18.0%) medium farmers and 40 (65.6%) big farmers (see Table 5.3).

Among those who obtained higher yield, the majority of the adopters had higher size of land holdings, thus suggesting a positive relationship. During the field work, it was observed that those farmers with better economic status, i.e., higher size of land holdings, had the ability to bear risks. They could afford to invest resources to employ labour, use latest methods of irrigation and perform even under adverse conditions like drought.

Table 53 follows on the next page

Social background of Planters

In West Godavari, East Godavari and Krishna districts, the total number of farmers who participated in the OPDP was 665. West Godavari accounts for 42.7% of the planters followed by East Godavari district 29.6% and Krishna district 27.7 percent.In terms of the land the planters allocated for oil palm, we find that in three districts put together, the largest number of planters allocated one to two acres. In all the three districts only 20 out of 665 (3.0%) planted oil palm in 4 to 5 acres of land. In the case of Krishna district, one third of the planters allocated up to 1.00 acre of land, where as in West Godavari and East Godavari districts, this proportion is 44.3% and 37.5% respectively. In terms of area of land between 1.00 to 2.00 acres under oil palm, the proportion of farmers is comparable in all the three districts. East Godavari accounts for relatively large number of farmers who planted oil palm in 4.00 to 5.00 acres. That is, fewer farmers planted oil palm in relatively large area (4 to 5 acres of land) (see Table 3.4). The average area of land under oil palm in East Godavari district is 1.764 acres followed by Krishna 1 .602 acres and West Godavari 1.398 acres. The area under oil palm plantation ranges from 0.070 acres to 4.500 acres in Krishna district; 0.160 to 4.05 acres in West Godavari and 0.250 to 4.750 acres in East Godavari . Another observation that may be made here is that the range is much wider in the case of East Godavari compared to the other two districts. (see Table 3.5)

Tables 3.4 and 3.5 follow in the next pages

Table 3.4

Extent of land under oil palm among the planters in the OPDP

Coverage	District			Total
	Krishna	W.Godavari.	E.Godavari.	
Upto 1.00	62 (23.7) (33.6)	126 (48.1) (44.3)	74(28.2} (37.5)	262 (100.0) (39.4)
1.01-2.00	68 (32.4) (36.9)	86 (40.9) (30.2)	56 (26.7) (28.4)	210(100.0) (31.6)
2.01-3.00	29 (27.6) (15.7)	50 (47.6) (17.6)	26(24.8) (13.1)	105 (100.0) (15.8)
3.01-4.00	22 (32.3) (11.9)	21 (30.9) (7.3)	25 (36.8) (12.6)	68(100.0) (10.2)
4.01-5.00	3 (15.0) (1.6)	1 (5.0) (0.3)	16 (80.0) (8.1)	20 (100.0) (3.0)
Total	184(27.7) (100.0)	284(42.7) (100.0)	197 (29.6) (100.0)	665(100.0) (100.0)

Table 3.5

Statistical summary of the extent of oil palm plantation in OPDP

S.No	Statistic	District		
		Krishna	W.G.	E.G.
1.	Mean	1.602	1.398	1.764
2.	Standard Deviation	1.037	0.931	1.242
3.	Minimum	0.070	0.160	0.250
4.	Maximum	4.500	4.050	5.000
5.	Range	4.430	3.890	4.750

Categories of farmers among the planters

In terms of the category of farmers, in all the three districts put together, nearly 40 % of the planters are 'other' farmers, meaning medium and big farmers owning above 5 acres of land . In Krishna and East Godavari districts, 'other' farmers constitute the majority of the planters.

As mentioned earlier, the implementing agencies claim that farmers voluntarily participated in the OPDP. However there is over representation of the medium and big farmers among the planters. Perhaps the implementing agencies may have selected medium and big farmers keeping in view their 'risk bearing' capacity and their 'progressive' attitude towards new technology. In all the three districts put together planters belonging to marginal farmers constitute about 20% and small farmers 34.4 percent.

Among the three districts the lowest number of marginal farmers participating in the OPDP are from Krishna district. The highest proportion of planters belonging to the category of marginal farmers participated in West Godavari district (78 % of 132 marginal farmers in all the three districts). If we look at the intra -district distribution of different categories of farmers among the planters, we find that in Krishna district, as mentioned above, the category of 'other' farmers are over 65.0% and in the case of East Godavari, they are over 50 percent.

In West Godavari, there is a greater degree of participation by marginal farmers and small farmers [put together 84.1%). { See Table 3.6).

Social groups to which planters belong

In terms of social groups to which the planters belong, we find that across the districts the highest proportion 87.1% belong to 'other' castes (higher castes). Planters belonging to scheduled castes and backward classes constitute less than 10 % in all the three districts. Intra- district distribution also reflects a similar trend. Nearly 97.0 percent in Krishna, 85.2 % in West Godavari and 80.7 % in East Godavari district among the planters belong to 'other' castes. (see Table 3.7).

Tables 3.6 and 3.7 follow on the next pages

Table 3.6
Category of farmers among the planters

Category	District			Total
	Krishna	West.Godavari.	Easr.Godavari.	
Marginal	8(6.1) (4.3)	103(78.0) (36.2)	21(15.9) (10.7)	132 (19.8)
Small	26(11.3) (14.1)	136(59.4) (47.9)	67(29.3) (34.0)	229 (34.4)
Other	120(45.6) (39.4)	40(15.2 (65.2)	103(39.2) (14.1)	263 (52.3)
Unreported	30(73.2) (16.3)	5(12.2) (1.8)	6(14.6) (3.0)	41 (6.2)
Total	184(27.7) (100.0)	284(42.7) (100.0)	197(29.6) (100.0)	665(100.0) (100.0)

Table3.7
Social group affiliation of planters

S. No	Social Group	District			Total
		Krishna	W.G.	E.G.	
1.	Scheduled Caste	3(8.3) (1.6}	33(91,7) (11.6)	-	36(100.0) (5.4)
2.	Backward Caste	1(2.7) (0.5)	4(10.8) (1.4)	32(86.5) (16.2)	37(100.0) (5.6)
3.	Other	178(30.7) (96.7)	242(41.8) (85.2)	159(27.5) (80.7)	579(100.0) (87.1)
4.	Unreported	2(15.4) (1.1)	5(38.5) (1.8)	6(46.1) (3.0)	13(100.0) (1.9)
	Total	184 (100.0)	284 (100.0)	197 (100.0)	665 (100.0)

To find out the inter-district variation in the categories of farmers among scheduled castes, backward classes and other castes, a three way cross tabulation is done (see Table 3.8).

Data on all three variables were available for 623 planters. It is evident from Table 3.8 that in Krishna and East Godavari districts, majority of 'other farmers' (medium and big) are drawn from 'other' castes (higher castes). One can see a clear association between the caste status of planters and the category of land holding group to which they belong. That is, among the participants in the OPDP the majority in Krishna and East Godavari belong to medium and big farmers and higher castes.

Intra - district distribution of planters in terms of size of the land holdings and their caste background shows that in Krishna district only two out of 154 marginal farmers belong to scheduled castes and the rest of the planters of all categories of farmers - marginal, small and other farmers are drawn from higher castes. In Krishna none of the planters belong to backward classes.

In West Godavari district, proportionately more planters (11.82 %} are drawn from scheduled castes than from the backward classes (0.36 %), where as in East Godavari, proportionately planters are drawn from backward classes (16.8 %) and none from scheduled castes. Further, higher proportion of planters belonging to backward classes are found among marginal and small farmers.

The inter and intra - district variations in the caste and class background suggest that in Krishna and East Godavari districts the majority of the planters drawn from higher castes are medium and big farmers. West

Godavari differs from the other two districts in that there is relatively higher degree of participation by marginal and small farmers.

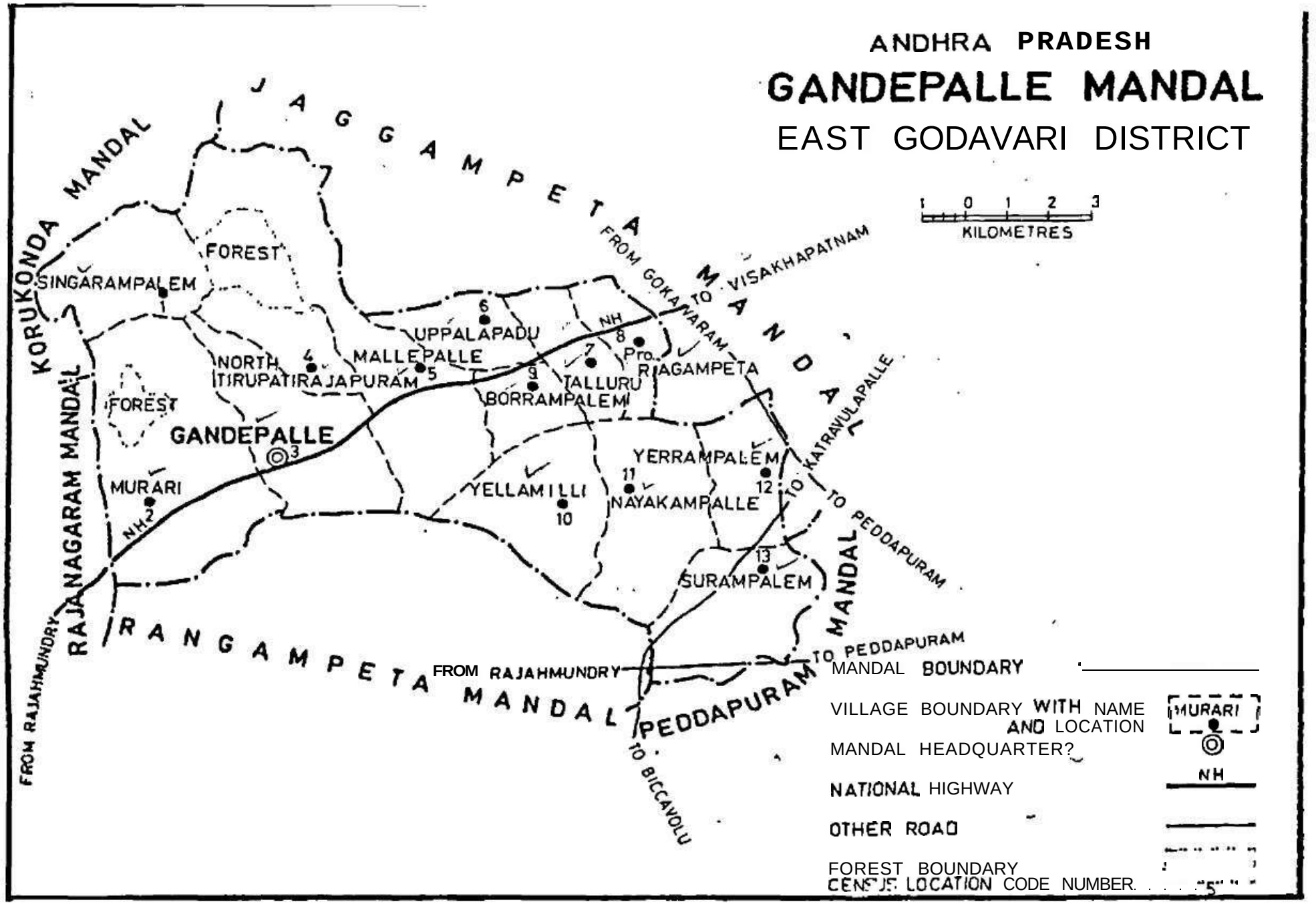
In Krishna district participation by the scheduled castes and backward classes is negligible compared to higher castes. In the case of East Godavari participation by backward classes is relatively more compared to that of the scheduled castes.

The secondary data at the outset indicates that enrollment in the OPDP of the scheduled castes and backward classes is generally low compared to that of the higher castes.

Table 3.8 follows on the next page

Table 3.8
Category of farmers and caste background of planters in three districts

Category	Krishna district				W Godavari diatrict				E Godavari district			
	SC	BC	OC	T	SC	BC	OC	T	SC	BC	OC	T
Marginal	2	-	6	8	17	2	84	103	-	12	8	20
	100.0	-	3.9	5.2	51.5	50.0	34.7	36.9	-	37.5	5.1	10.5
Small	-	-	26	26	16	2	118	136	-	16	51	67
	-	-	17.1	16.8	48.4	50.0	48.7	48.7	-	50.0	32.2	35.2
Others	-	-	120	120	-	-	40	40	-	4	99	103
	-	-	78.9	77.9	-	-	16.5	14.3	-	2.5	62.6	54.2
Total	2	-	152	154	33	4	242	279	-	32	158	190
	100.0	-	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0	100.0	100.0


ANDHRA PRADESH
GANDEPALLE MANDAL
EAST GODAVARI DISTRICT
1 0 1 2 3
KILOMETRES
KORUKONDA MANDAL
JAGGAMPETA MANDAL
RAJANAGARAM MANDAL
RANGAMPETA MANDAL
PEDDAPURAM MANDAL
FROM GOKAVARAM TO VISAKHAPATNAM
FROM RAJAHMUNDRY
TO PEDDAPURAM
TO KAIRAVULAPALLE
TO BICCAVOLU
FOREST
SINGARAMPALEM
UPPALAPADU
NH
MALLEPALLE
NORTH TIRUPATIRAJAPURAM
Pro. RAGAMPETA
TALLURU
BORRAMPALEM
GANDEPALLE
YERRAMPALEM
MURARI
YELLAMILLI
NAYAKAMPALLE
SURAMPALEM
MANDAL BOUNDARY
VILLAGE BOUNDARY WITH NAME AND LOCATION
MANDAL HEADQUARTER?
NATIONAL HIGHWAY
OTHER ROAD
FOREST BOUNDARY
CENSUS LOCATION CODE NUMBER

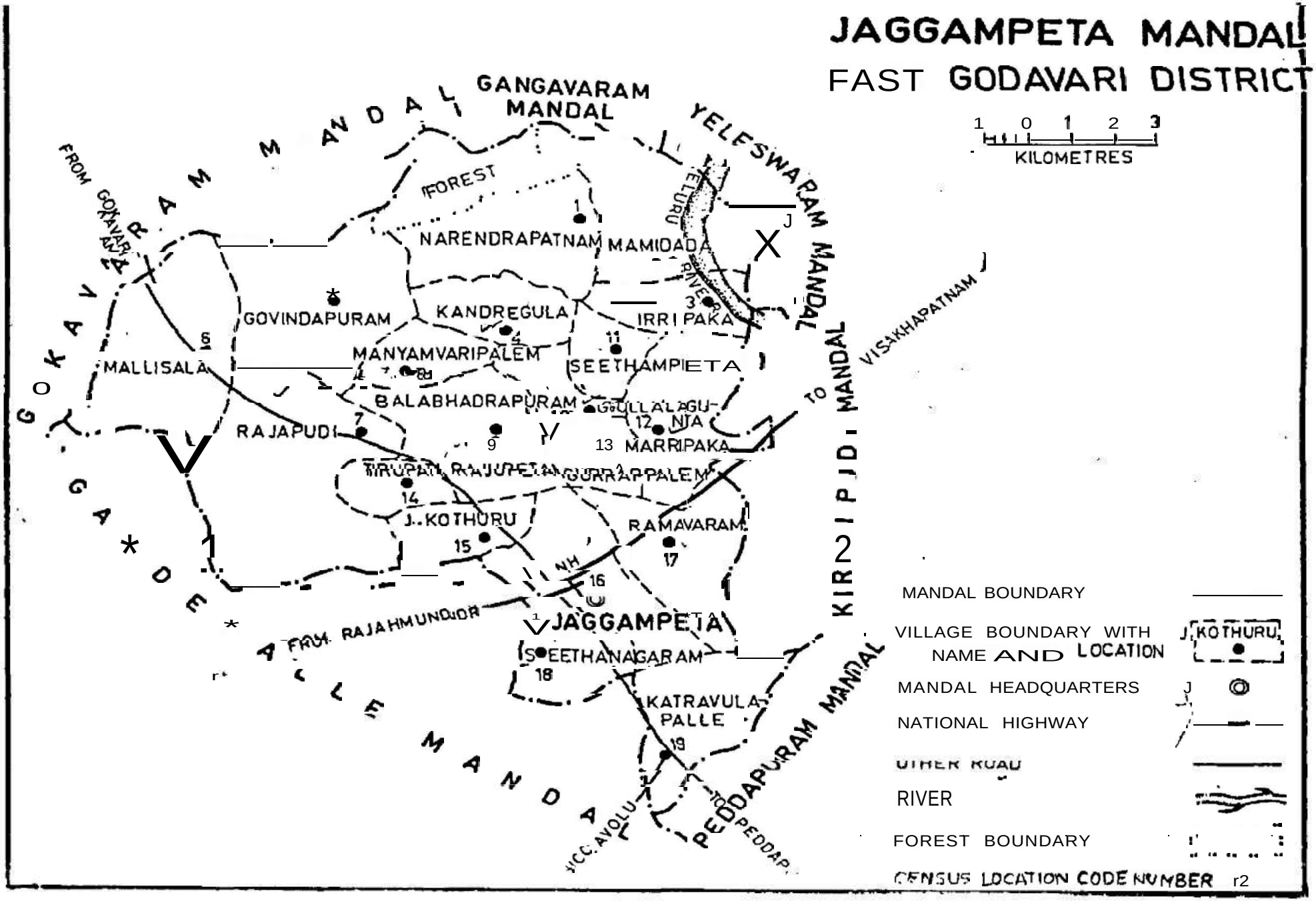
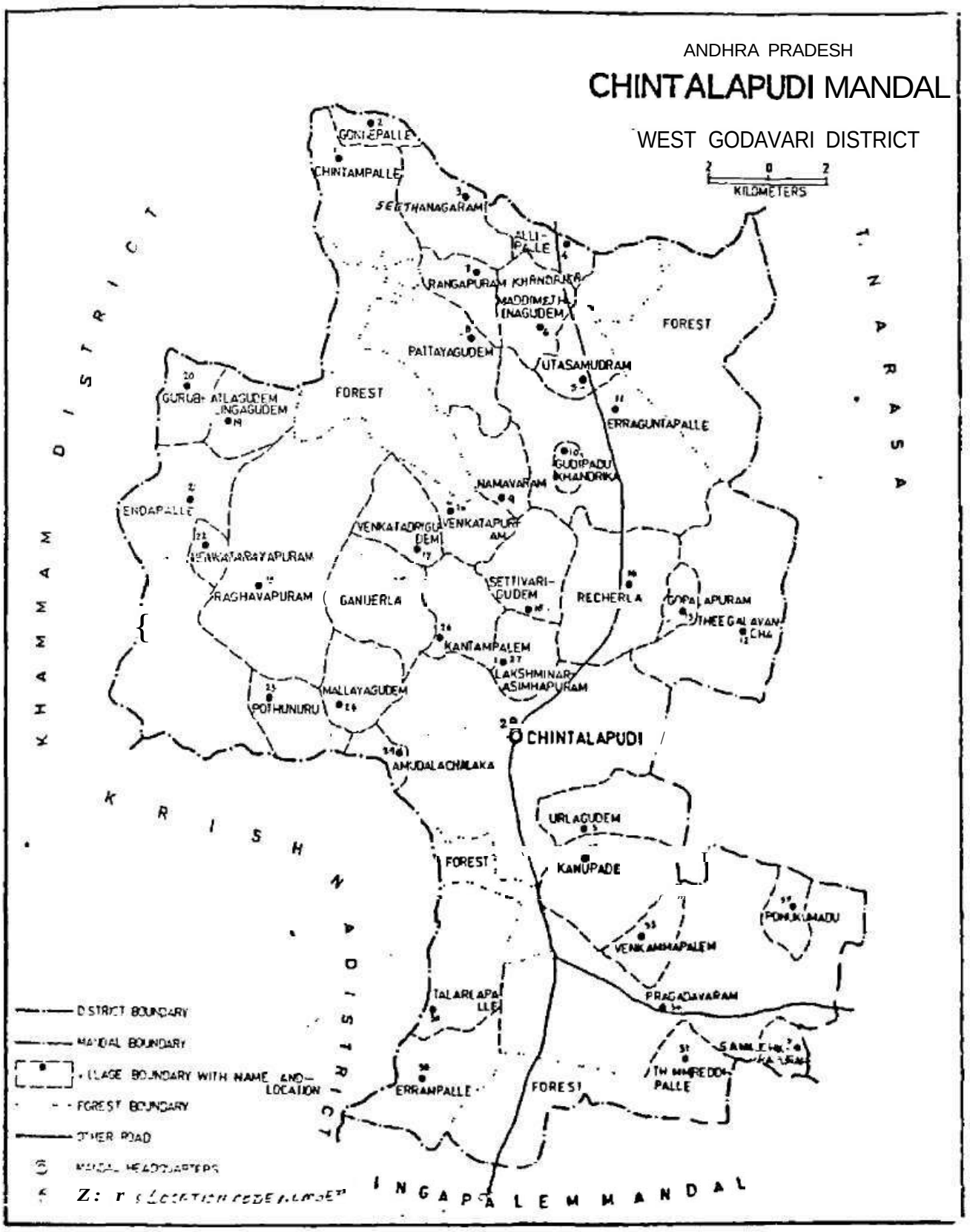

JAGGAMPETA MANDAL
FAST GODAVARI DISTRICT
1 0 1 2 3
KILOMETRES
GANGAVARAM MANDAL
YELESWARAM MANDAL
KIRLIPUDI MANDAL
PEDDAPURAM MANDAL
GOKAVARAM MANDAL
FOREST
NARENDRAPATNAM
MAMIDADA
ELURU
RIVER
GOVINDAPURAM
KANDREGULA
IRRIPAKA
MANYAMVARIPALEM
SEETHAMPIETA
MALLISALA
BALABHADRAPURAM
GULLALAGUNTA
RAJAPUDI
MARRIPAKA
GURRAPPALEM
J.KOTHURU
RAMAVARAM
NH
JAGGAMPETA
SEETHANAGARAM
KATRAVULAPALLE
FROM RAJAHMUNDRY
TO VISAKHAPATNAM
MANDAL BOUNDARY
VILLAGE BOUNDARY WITH NAME AND LOCATION
MANDAL HEADQUARTERS
NATIONAL HIGHWAY
OTHER ROAD
RIVER
FOREST BOUNDARY
CENSUS LOCATION CODE NUMBER r2

Table 5.3
RELATION BETWEEN YIELD AND ECONOMIC STATUS

Yield (Kg/acre)	Economic Status				Total
	Marginal Farmer	Small Farmer	Medium Farmer	Big Farmer	
Below Average	8 (6.3)	13 (11.5)	22 (19.0)	40 (46.1)	83 (57.6)
Above Average	3 (4.6)	7 (8.4)	11 (13.9)	40 (33.8)	61 (42.4)
Total	11 (7.6)	20 (13.9)	33 (22.9)	80 (55.6)	144 (100.0)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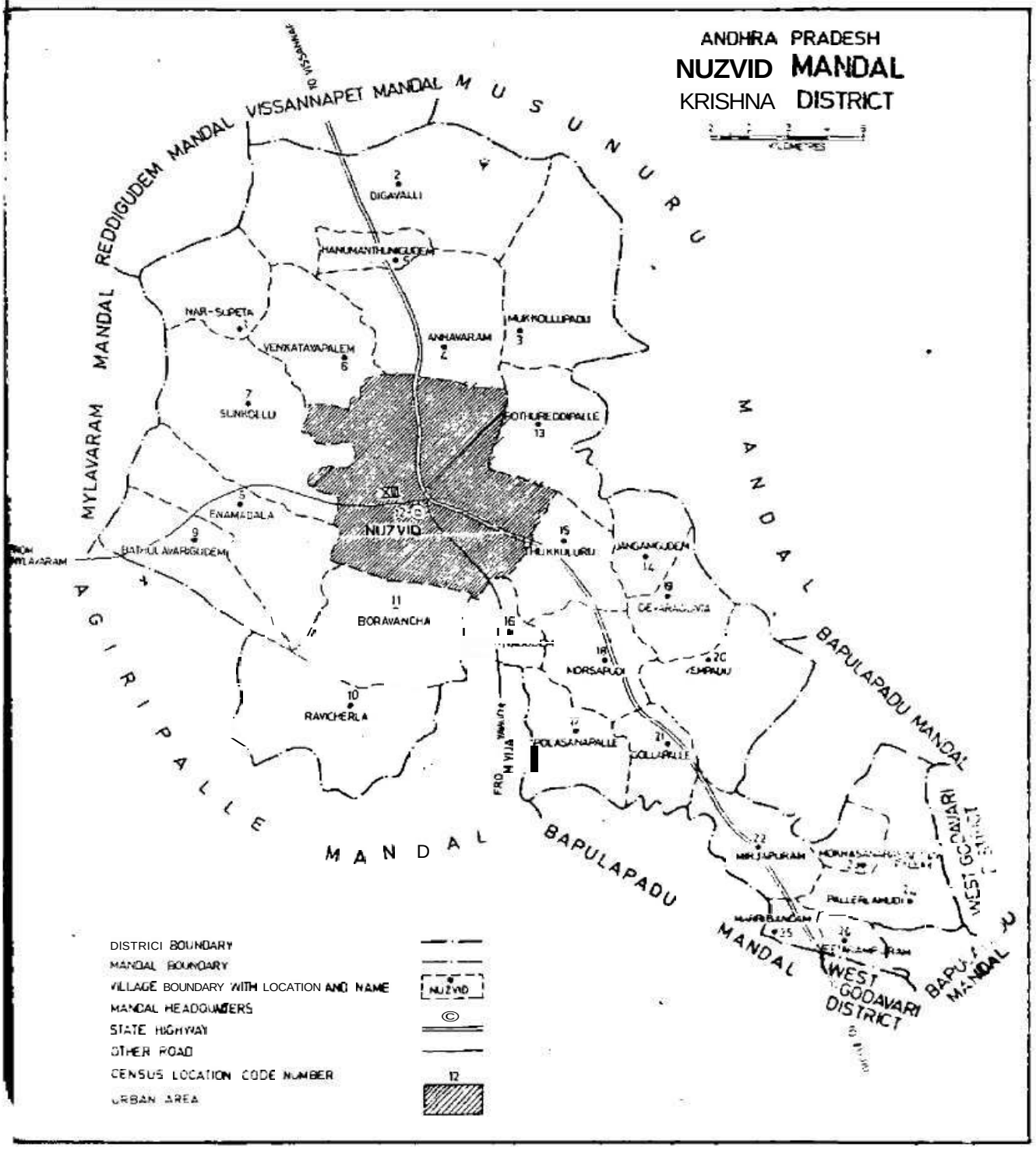
CHINTALAPUDI MANDAL
WEST GODAVARI DISTRICT
2 0 2
KILOMETERS
KHAMMAM DISTRICT
ANDHRA PRADESH
KRISHNA DISTRICT
GONEPALLE
CHINTAMPALLE
SEETHANAGARAM
ALLIPALLE
RANGAPURAM KHANDRIKA
MADDIMEDA (NAGUDEM)
FOREST
PATTAYAGUDEM
UTASAMUDRAM
GURUVAREDDIGUDEM (NAGUDEM)
FOREST
ERRAGUNTAPALLE
GUDIPADU KHANDRIKA
NAMAVARAM
ENDAPALLE
VENKATADRIGUDEM
VENKATAPURAM
VENKATARAYAPURAM
RAGHAVAPURAM
GANJERLA
SETTIVARIGUDEM
RECHERLA
GOPALAPURAM
THEEGALAVANCHA
KANTAMPALEM
LAKSHMINARASIMHAPURAM
MALLAYAGUDEM
POTHUNURU
CHINTALAPUDI
AMJDALACHAKA
URLAGUDEM
FOREST
KANUPADE
PONNAMADU
VENKAMMAPALEM
PRAGADAVARAM
TALARLAPALLE
ERRAMPALLE
FOREST
TH MINREDDIPALLE
INGAPALEM MANDAL
DISTRICT BOUNDARY
MANDAL BOUNDARY
VILLAGE BOUNDARY WITH NAME AND LOCATION
FOREST BOUNDARY
OTHER ROAD
MANDAL HEADQUARTERS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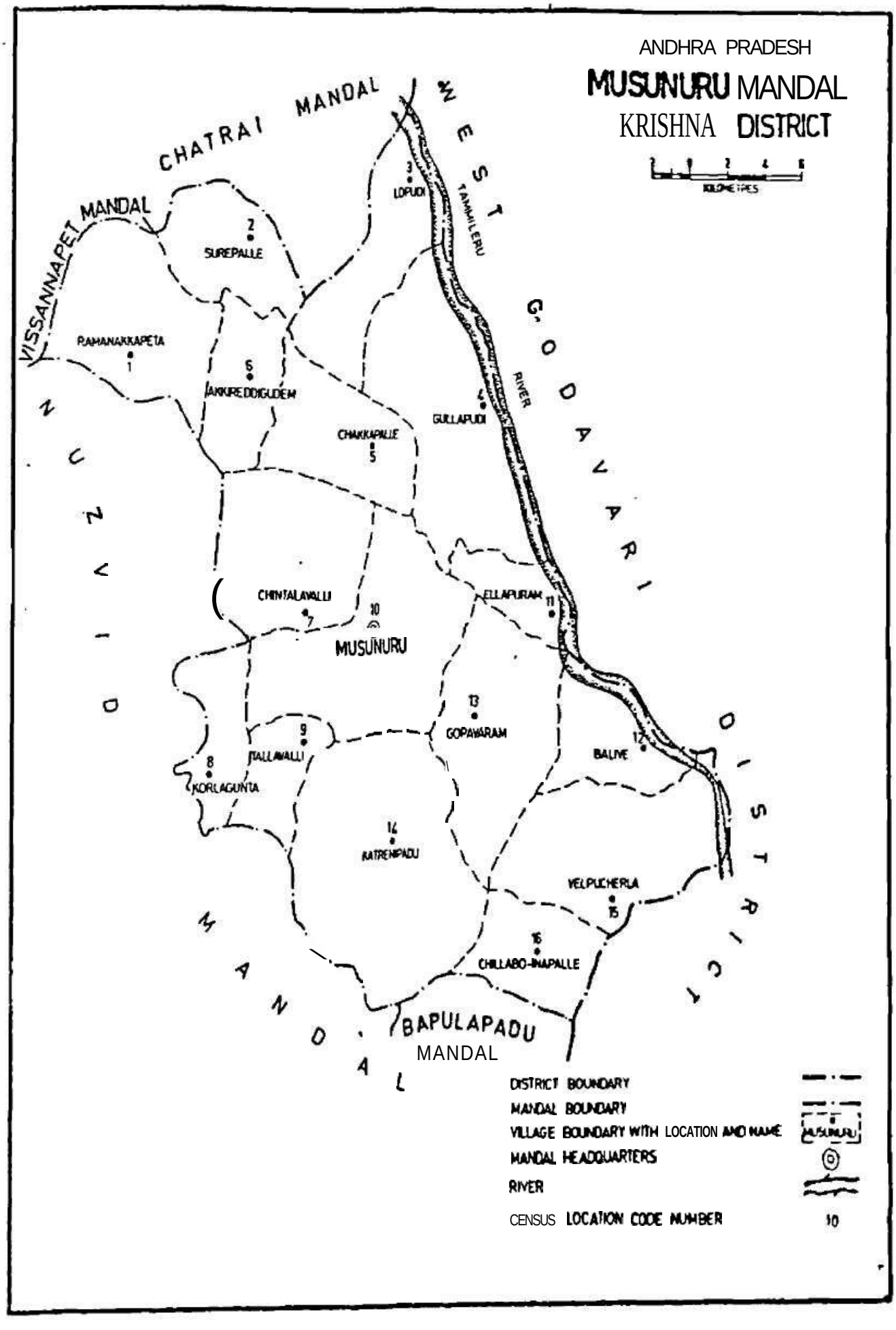
NUZVID MANDAL
KRISHNA DISTRICT
KILOMETRES
VISSANNAPET MANDAL
REDDIGUDEM MANDAL
MYLAVARAM MANDAL
MUSUNURU MANDAL
BAPULAPADU MANDAL
AGIRIPALLE MANDAL
DIGAVALLI
HANUMANTHUNIGUDEM
NAR-SUPETA
VENKATAYAPALEM
ANNAVARAM
MUKKOLLUPADU
SUNKOLLU
KOTHUREDDIPALLE
ENAMADALA
BATHULAVARIGUDEM
NUZVID
THUKKULURU
ANGANGUDEM
BORAVANCHA
RAVICHERLA
MORSAPUDI
EMPARU
POLASANAPALLE
GOLLAPALLE
MYLAVARAM
VISSANNAPET
DISTRICT BOUNDARY
MANDAL BOUNDARY
VILLAGE BOUNDARY WITH LOCATION AND NAME
MANDAL HEADQUARTERS
STATE HIGHWAY
OTHER ROAD
CENSUS LOCATION CODE NUMBER
URBAN AREA


ANDHRA PRADESH
MUSUNURU MANDAL
KRISHNA DISTRICT
KILOMETRES
CHATRAI MANDAL
VISSANNAPET MANDAL
MACHILIPATNAM MANDAL
BAPULAPADU MANDAL
WEST GODAVARI DISTRICT
TAMMILERU RIVER
1 RAMANAKKAPETA
2 SUREPALLE
3 LOPUDI
4 GULLAPUDI
5 CHAKKAPALLE
6 AKKIREDDIGUDEM
7 CHINTALAVALLI
8 KORLAGUNTA
9 TALLAVALLI
10 MUSUNURU
11 ELLAPURAM
12 BALIVE
13 GOPAVARAM
14 KATREMPADU
15 VELPUCHERLA
16 CHILLABOINAPALLE
DISTRICT BOUNDARY
MANDAL BOUNDARY
VILLAGE BOUNDARY WITH LOCATION AND NAME
MANDAL HEADQUARTERS
RIVER
CENSUS LOCATION CODE NUMBER
10

CHAPTER IV

Actor-networks in Oil Palm Demonstration Project

We have seen in chapter I that the whole process of technology right from its conception to implementation is a network relation. There are various heterogeneous elements involved in the networking relation. The development of technology in OPDP is studied in three stages. The three stages are identified for the purpose of analysing the roles of the actors and their inter-relationships in diffferent stages. As proposed by Callon, the actor networks are not reducible to one actor or network, but are all-encompassing. This is clearly observed in the OPDR The unique feature of this study is that it focuses on an agricultural technology. Callon's study concentrated on technology in industrial sector. Therefore, this study encounterd heterogenity of a different kind among the actors and the networking among them.

The three stages identified are; the context of invention, context of dissemination and context of justification. In each stage there are several actors that interact with each other forming a net-

work relation. This network again becomes an actor and interacts with actors in the other stage. The actors within the network in each stage limit their relations and when juxtaposed with the actors in the other stage maintain network relations.

Thus the definition and characteristics of actor-network given by Callon may very well be identified in the case of OPDR The OPDP may be seen as a network of heterogenous actors .

Context of Invention

The actors involved in the context of invention are;

(a) scientists, who conceived the idea of oil palm as panacea for edible oil production in the third world and constructed a social reality in which the farmers would be economically better off and consumers would be healthy because of low fat content in the palm oil.

(b) agricultural technologists, who observed its success in other third world countries and brought it to India.

(c) agricultural scientists at home who experimented with indigeneous production of oil palm seeds who constructed a social reality specifically in relation to Indian farmers and consumers.

(d) poliy makers (government and bureaucrats) who framed policies to propagate oil palm cultivation in India and

(e) the technology which is a package of actors like indigeneous seeds, elite seeds, fertilizers, manures, pesticides and subsidies. (see Fig.I)

The possibility of oil palm cultivation in India has been explored right since 1950s by various directors of the central department of agriculture.

From 1950 to 1972 attempts were made to convert forest lands to oil palm fields. In 1985 agricultural scientists of Central Plantation Crops Research Institute (CPCRI), explored the possibility in A.P., Tamil Nadu, Karnataka and Maharashtra and identified 2.4 lakh hectares for oil palm cultivation. A central working group was constituted by the government of India on oil palm under the chairmanship of Dr.K.L. Chadha which has identified the feasibility of oil palm cultivation in 5.75 lakh hectares in nine states.

In 1987, Dr.D.L. Richardson from Costa Rica visited India for expert guidance and suggested location specific research and recognised Indian weather and soils as ideal for oil palm cultivation. The agronomists and agricultural scientists at Indian Council for Agricultural Research (ICAR) produced oil palm seeds, independently and grown them in farmers' lands.

It was their brain child to propagate oil palm cultivation in India to increase productivity with less cost of production. It was their conv.ction that oil palm would be the most suitable oil for Indian farmers and middle class consumers in terms of its cholesterol content and nutritional value. With this profound hope, they made their subsequent attempts to increase per hectare tonnage of oil from 2.7 to 4.6. They constructed a picture of Indian society with healthy population fed on nutritive edible oil and economically better-off farmers who would benefit by cultivating oil palm. Because economic prosperity and health are the cornerstones of any society and the efforts of scientists

would usher in a society with a quality of life much higher than what obtained before oil palm production. Thus in Callon's terms the scientists acted as sociologists by considering the society while developing technologies. While in Callon's study electric car was developed for the aristocrats of French society, in OPDP oil palm was developed as a panacea for Indian farmers and consumers. There the engineers played the role of sociologists, while in OPDP agricultural scientists played the role of sociologists, thus corroborating Callon's view that scientists are no less than sociologists in constructing social reality.

These attempts by the scientists of ICAR made technologists and policy makers realise the omnipotence of oil palm in India and the immediate necessity to increase its production. Thus, it was included in the Technology Mission of Oil Seeds (TMOS) and through the mission, the DBT was entrusted with the responsibility to launch the OPDR

Its main objective was to demonstrate the viability of oil palm cultivation to farmers in terms of its technical feasibility, productivity etc,. The DBT imported seeds from countries like Malaysia, Gosta Rica, Papua New Guinea etc., which have already created waves in oil palm production. Eighty percent of imported seeds mixed with twenty percent of indigeneous seeds were given to farmers.

The project was conceived carefully by choosing farmers of progressive nature and risk bearing capacity in three states. In this whole process of introducing oil palm in India, the agronomists,

agricultural scientists and policy makers thought of technology, its improvisation, quality improvement and subsequent improvement of quality of life of farmers and consumers. Thus they have become, to be called in Callon's lines, agronomist-sociologists by constructing a picture of Indian society which consisted of economically prosperous farmers and a healthy population with minimal cholesterol-related ailments and thus lessening potential expenditure on health care.

In this whole process, the need of Indian middle class consumer for a proteinacious, affordable edible oil with reasonable cholesterol content was kept in mind. The middle class consumer would prefer oil palm for its reasonable cholesterol content and poorer sections would prefer palm oil due to its affordability. The rich have other alternatives than oil palm. Thus, along with technological aspects, social and economic aspects were thought over in the invention/innovation stage itself.

Technology Mission on Oil Seeds was launched for speedy development involving people's participation and targets were set in terms of production and foreign exchange saving. In this stage technology was not considered as sole important factor, but, infact, all the other non-technological aspects were also considered important.

Another important actor is the technology itself, with its seeds, indigeneous and imported, fertilizers and subsidies. Technology with its package of actors is another actor in this network at invention stage. Failure of any one actor disrupts the network and the network redefines its identity. This

actually happened in oil palm case, where earlier only seeds indigeneously produced were tried for cultivation. But when they failed to increase production to more than 2 to 3 tonnes of oil per hectare and in some cases produced sterile plants, the network got disrupted, remoulded its identity by including another actor in terms of imported, high yielding, elite seed called tenera hybrid seed.

Context of Dissemination

In the context of dissemination, various actors involved are;

(a) scientists-turned bureaucrats at the DBT who evaluated the suitability of various regions. Three states A.R, Karnataka and Maharashtra were found to be conducive for OPDP and districts and beneficiaries were chosen.

(b) directors and assistant directors of horticulture at state and district levels who were incharge of the implementation of the project, in selection of beneficiaries, dissemination of information etc.

(c) horticultural officers and other extension personnel who interacted with beneficiaries.

(d) village leaders, opinion leaders and Village Development Officers who acted as communication agents.

(e) technology as a package of actors like palm oil seeds, pesticides, subsidies, other mechanical implements like tractors, bullock carts, drip irrigation facilities, oil extraction factory etc.

(f) corporate agents who acted as communication agents who wanted to enter oil palm production and distribution by providing saplings and

services.

(g) labour- Under various kinds of arrangements- employed by the farmers participating in the project. (see Fig.I)

In the context of dissemination the actors are highly dynamic in nature. Each actor influences and in turn influenced by various heterogeneous elements and forces. The relations among these actors are also equally dynamic and multifarious in nature.

(a) Bureaucrats :

Initially the scientists-turned bureaucrats at the Department of Bio- technology appointed experienced scientific personnel who had expertise especially to deal with the oil palm. The objectives were to demonstrate the economic viablity of oil palm in the Indian context, for which the entire genetic material was imported from Costa Rica. Those farmers who had the potentials of adaptability to new technologies and risk-bearing capacity and who could influence others were rhosen. Thus the scientists-turned-bureaucrats acted as liaison agents between the technology and the beneficiaries. Then, as mentioned above, they studied Indian agronomic conditions and chose three states that were highly suitable to oil palm cultivation viz., A.R, Karnataka and Maharashtra.

The cultivation of oil palm was of course a policy decision, but growing a rain-fed crop under irrigated conditions was decided by the scientists at the DBT. The unique features which they introduced in this project, were that:

(a) Cultivation of oil palm was encouraged under irrigated conditions, which actually was a rain-fed crop in Malaysia, Costa Rica etc, from where seeds were imported; (b) It was to be grown in tidbit areas whereas it is a large plantation every where else; (c) Inter-crops were to be grown in this project which was not done any where else; (d) The crop is not native to India and irrigational practices necessary for oil palm were not known; and (e) the genetic material was being imported for the sake of introduction and being developed on the expertise of Indian scientists.

The scientists visualised social, cultural ethos of the farmers of A.R before introducing the oil palm. The farmers of coastal Andhra Pradesh turned out to be more enterprising and had political associations. That regional politics might promote/ hinder technological growth was apprehended by scientists at the DBT before the launch of the project. Against the back drop of all these features oil palm cultivation was demonstrated.

(b) & (c)Directors & Assistant Directors and Horticultural officers:

Under the aegis of the DBT, the department of Horticulture, at state level which had its department head offices in each district headquarter was entrusted with the task of implementing the project. The department of Horticulture generally looks after garden crops, horticultural and ornamental plants and plantation crops. Though there is a department of oil seeds under the department of

agriculture in the central government which is responsible for the TMOS, oil palm cultivation was allotted to the department of horticulture and within the department a special wing was started for oil palm. An altogehter new organizational structure parallel to that of other crops was started for new technology called oil palm technology at the state level.

There is an Assistant Director of Horticulture (A.D.H) for each district under whom the officers of Horticulture work. For the sake of oil palm cultivation, four to five Horticultural Officers (H.O.s) were deputed to work on the project and were provided with office assistants and staff. The role of the A.D.H. and H.O. was to interact with farmers and help them in cultivation by providing technical guidance.

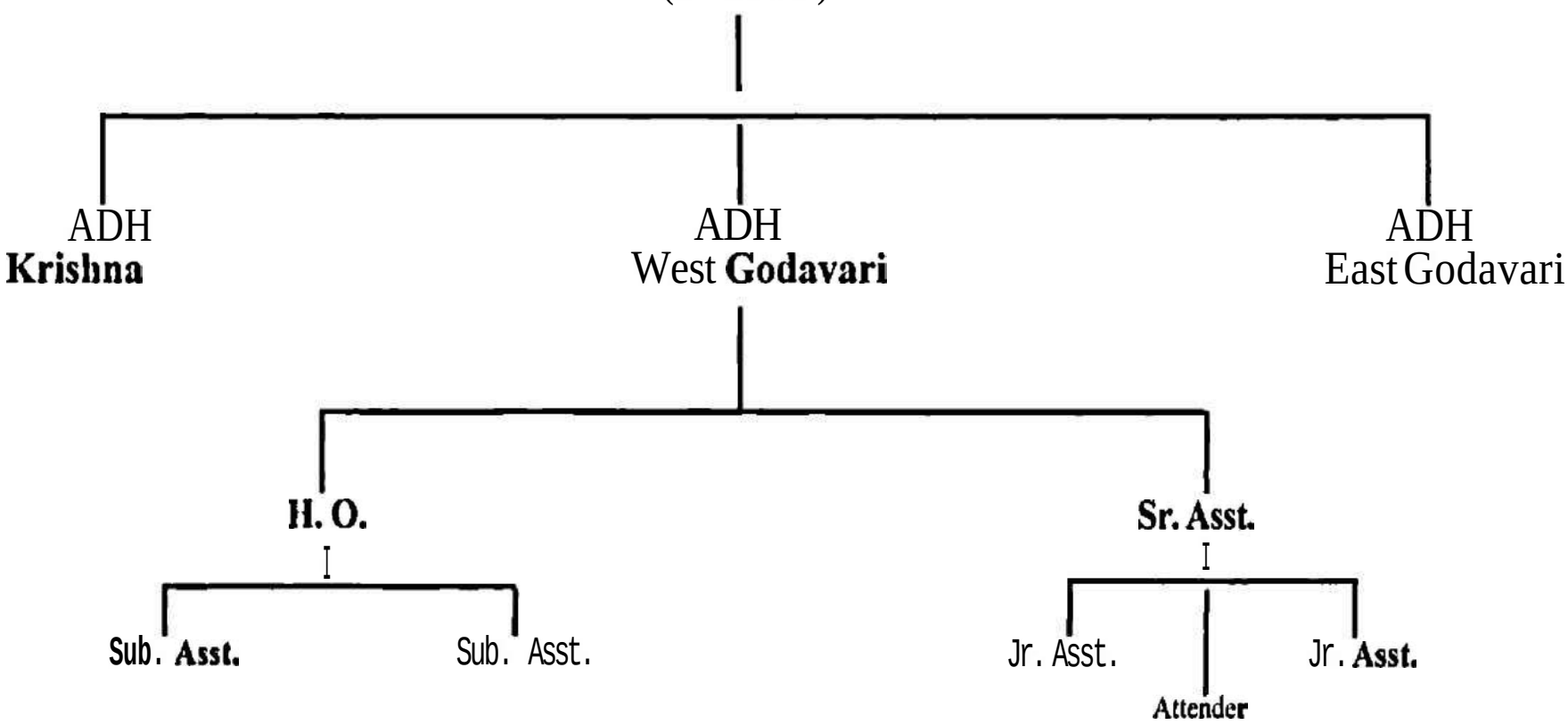
The assistant directors meet the director at state level regularly to discuss the policy matters regarding plan targets, subsidies and support prices and thus mediate between bureaucrats and farmers. They are the only technological experts within the reach of farmers to gain knowledge.

Horticulture Officers are the extension personnel who give consultancy to farmers throughout the cultivation. This organizational structure was specially created to deal with oil palm cultivation and thus it enters into network relation with the oil palm technology and the farmers.

Organization chart follows **in the next** page

ORG. CHART I

ORGANIZATION CHART OF STATE DEPARTMENT OF HORTICULTURE



(d) Village leaders & opinion leaders:

The Assistant director in many cases, himself visited villages, interacted with farmers and informed them regarding the new technology package and created an awareness among the villagers. But for listing out the beneficiaries, he had to take the help of village leaders. Indian society is a complex society with structural cleavages like caste, class and value system and attitudes. Bureaucracy and technocracy had to take these into account in the selection process.

In village communities, oral communication-personal, face-to-face - rather than impersonal and formal channels- tend to be effective which bureaucrats and technocrats had to depend on for communication. Farmers in Indian villages have loyalties to their village leaders who may be called in communication terminology, as opinion leaders who can influence their opinions. These panchayat leaders become opinion leaders by their economic, political, cultural strength and by their access to information, awareness and education. Dominant caste in these situations plays a role by its numerical, political and economic strength.

In Indian villages dominant caste was found to be effective to such an extent that it could either promote or hamper adoption of technology. The present study found evidence for this in two villages included in this study, Pragadavaram and Tadikalapundi, both in W. Godavari district.

Pragadavaram, 50 Km from Eluru town, is a small village in Chintalapudi mandal with a total popu-

lation of 7,985 (census, 1981). The village is surrounded by 14 hamlets where Dalits are inhabited. The number of households are 1687 and literates are 2145 (26.8%). The caste groups include Brahmin, Reddy, Kapu, Goud, Yadava, Barber, Washermen, Potter, Scheduled castes etc,. On the whole 65% of the households belong to Reddy caste. In the demonstration project, among the total 51 adopters of technology, 43 (84.3%) are Reddys, 2(3.9%) are Kapus, 2(3.9%) are barbers and 4(7.8%) are Scheduled castes.

Tadikalapudi, 20 km from Eluru town, is another small village in Kamavarapukota Mandal with a total population of 9903, among whom literates are 2072 (20.9%). Total number of households is 2119 (census of India, 1981). The caste composition comprises Brahmin, Kapu, Kamma, Goud, Yadava, Barber, Washermen, Potter and Scheduled castes etc. On the whole 35% belong to Kapu caste and 30% belong to Kamma caste.

It is observed that Reddy caste is the dominant caste in Pragadavaram and Kapu caste is the dominant caste in Tadikalapudi in terms of their economic, numerical and political strength. In these villages Reddy and Kapu leaders are the opinion leaders who were the first sources of information about the technology for the rest of the caste groups. At the begining of the demonstration project regional extension officials sought the help of these leaders in choosing the beneficiaries of the protect. The dominant caste group leaders had ample opportunity to facilitate an impartial diffusion of technology. These two villages are unique in their

own way, because, inspite of having similar opportunity, dominant caste in Pragadavaram hampered the equitable diffusion of technology while dominant caste in Tadikalapudi helped in effective and equitable diffusion of technology. Both the village panchayat presidencies are reserved for Scheduled Castes, but in reality political and economic power is wielded by the dominant castes.

In Pragadavaram, two rich farmers (from the dominant caste) tried to monopolise the technology by getting the target population exclusively from their own extended families and lineages by getting names of relatives registered for the participation in the OPDP for the entire land targetted in the village. They could not succeed in this attempt. However, they managed to get beneficiaries from their own caste, that too those who are politically or economically equal to them included in the project. These leaders also use this technology as an instrument of increasing dependence on them by promising their supporters acess to oil palm in further expansion. It is also observed that these leaders channelised the information about technology only to their caste and blocked its transmission to members of other castes. Very few members from other caste groups could get themselves enrolled in oil palm project because of their political affiliations.

In Tadikalapudi, it is a different scene where leaders of the Kapu- dominant caste- acted as agents of diffusion. These leaders chose the beneficiaries impartially from different caste groups, including

their own group and channelised free flow of information about the technology equitably to households of all caste groups.

Realising the role played by leaders of the village, the ADHs of the districts had to take the help of these leaders in selecting participants in the project. Where traditional leaders were not effective, the Village Development Officers (VDOs) were entrusted with the job. The participants seldom have direct access to the Assistant Director. So in practice, in many villages, these village leaders act as technical consultants to the participants regarding the management practices and usage of pesticides and fertilizers. Thus the village leaders, who are also the beneficiaries of the technology, enter into network relations with technology, bureaucrats on the one hand and the participants in the village on the other. They are also the representatives of their villages and act as communication agents linking corporate houses, government on the one hand and participants on the other.

(e)Technology as an actor:

It is an ensemble of actors consisting of heterogeneous elements like the oil palm plants, kinds of seeds, fertilizers, pesticides, sources of irrigation, mechanical implements etc. These are the characteristics of technology from the technology side. From the paticipants side, this package also includes technological knowhow and sources of financial assistance like subsidies and loans and knowledge about intercrops. These will be discussed in the next chapter.

Agronomically oil palm is a rain-fed crop re-

quiring an evenly distributed annual rainfall of 2500-4000 mm and temparature between 20 and 30 degrees celsius. It grows on any type of soil but it flourishes on black soil. It is a monoecious and heterozygous plant and oil is extracted from its mesocarpic fruit.

The fruit is a sessile drupe, varying in shape from heary spherical to ovoid or elongate. They are 3-5 cm long and weigh about 3-30g. The fruit has three layers, pericarp which consists of exocarp of skin, mesocarp which has oil content and endocarp, the hard, stony shell. The endocarp together with the kernel forms the shell. The shell is covered by two to three kernels. Oil extracted from mesocarp is used for edible purposes where as oil extracted from kernels is used for commercial purposes.

Three forms of fruit are identified depending on the type of shell.

Dura- Where the percentage of mesocarp is in the range of 35-50 percent of the fruit. The kernel is large and oil content is 17-18% of the fruit.

Pisifera- has no shell, kernel is small with tufts of fibres, the mesocarp is large and oil content high. But usually branches abort at the time of development and so this variety is considered as sterile.

Tenera - this variety is obtained by crossing the dura and pisifera types. The shell has a thickness of 0.5 mm to 4 mm, mesocarp is comparatively large, 60-90% of the fruit. It produces more fruit bunches and has 22-24% of oil.

The plants start bearing fruit from the third year

and fruiting of high economic value starts from the eigth year. The oil has to be extracted within 24 hours of plucking the fruit in order to avoid unpleasant odour resulting from storage. It means that the oil extraction plants must be located very close to the plantation areas and sound transport and communication links must be ensured.

According to the annual report of the DBT (1990-91), the average yield is estimated to be 20 tonnes of Fresh Fruit Bunches (FFBs) per hectare from which 5 to 6 tonnes of oil can be extracted. Gross income is estimated to be Rs 50,000 per hectare per year at the rate of Rs 2,500 per tonne of FFBs. According to the DBT estimates, a producer can realize Rs 40,000 profit per hectare after meeting the production costs. It is a perennial crop and ensures income round the year, though there is little variation seasonally. The life span of the plant ranges from 20 to 25 years and it yields oil for nearly 15 years.

These are some of the attractive features of oil palm for the planter. It is a heterogeneous plant with a great deal of variability which is unexplored yet. This feature allows enormous scope for development of new technologies in its production and propagation. It is this potential which has been attracting several multinational companies such as Unilever, United Fruiting Company to invest enormous capital in exploring the possibility of employing tissue culture techniques in the production and propagation of oil palm.

In the OPDP, saplings of two varieties of seeds were distributed to farmers, one is the imported

tenera hybrid from Costa Rica and another indigeneously produced variety of CPCRI, Palode. Among these, it was observed in Krishna district, the fruit produced by the Indian variety was big in size and also had more oil content than the imported variety. This Indian variety failed to produce female flowers in the early experiments prior to the OPDR That was due to defective pollination which the scientists at CPCRI rectified in their subsequent attempts. The peak season for fruiting is for five months, from May to September.

It was observed in the study that farmers were getting 8 to 10 tonnes per acre, much higher than the expectations. Usually during the lean season they get 1/6 of the peak yield. It is observed that the imported variety gives no yield at all in the lean season while the Indian variety gives 250 kg/ acre. Thus the Indian variety was proved to give better results.

Management practices: The cultivation of oil palm is simple compared to other plantation crops. There are five operations that are compulsory in the cultivation. They are planting, basing and weeding, watering, manuring and harvesting. Lands with medium textured, well drained soils are suited for oil palm. Before planting, basing and weeding has to be done. Initial ploughing has to be deeper because oil palm has no holding roots in the soil. Pits of 60 cm x 60 cm x 60 cm should be dug for each plant. Basing has to be increased every year by 2m second year on wards. Saplings have to be planted with this pre- requisite in mind and not more than 50 to 51 plants can be planted in an

for manuring. Vermiculture is culturing of earthworms on garbage and producing manure. For this empty oil palm bunches, after the fruits are crushed, are recycled and turned into manure through vermiculture which is realised to double the production. As much as 5 kg of manure per tree was used by farmers which give castings in two months. Organic manure, according to scientists is said to have less proportions of phosphorous and nitrogen but Indian farmers have confessed that it is the secret behind their miraculous yield even before the 5 years gestation period. This has given the farmers confidence that they can get Malaysian success in oil palm within short time which Malaysia has taken two decades to get.

Source of irrigation: Water is essential for oil palm cultivation. Good yield depends on the amount of water the plant is fed. Having realised this, only those farmers were chosen as participants in the project who had tube-wells. In West Godavari district, farmers were affected by severe drought for one year during the gestation period because of which very less yield was obtained and in extreme cases fields were devastated due to lack of water. On the contrary in Krishna and East Godavari districts farmers had taken care of their fields through extensive watering. In a village called Ramayyapalem in East Godavari district, where majority are small farmers who could not afford borewells individually, joint bores were dug in collaboration among three to four farmers and an average yield of 1 to 2 tonnes/ acre was obtained.

The respondents in the sample discovered an-

other alternative to ordinary borewells ie. submersible pumps which can be used to lift water from as deep as 400 feet. With the help of a motor water can be extracted with heavy pressure and utilised with no wastage of water. They cost a lakh rupees for installation along with overhead charges, but provide ample quantity of water.

Another alternative, which a few big farmers could afford to get was drip irrigation. For this a 2 inch bore pipe is used. The sprinkled water through drip can fill the basing in 2 hours and provides consistent supply of water. Technical experts like Richardson discouraged dripper saying that it would be confined to the region where drip is fixed and instead preferred flood irrigation. But practically farmers experimented with drip irrigation and got good yield which they attribute to the constant supply of water. Shortage of water causes occurence of male flowers and so drip was found to be effective. This is another innovative practice which farmers employed.

If the oil palm crop is left to be a rain-fed crop, it would not give yield through out the year. It gives yield as long as it gets water. Therefore, yield throughout the year can be obtained only through irrigation. Drip irrigation has many advantages. It saves time of the farmer while ensuring constant supply of water. It saves labour and power charges for watering and reduces wastage of water. Each oil palm tree requires 90 to 100 litres of water at a time and through drip irrigation 120 litres of water can be supplied in 5 hours.

A subsidy of Rs 6 to 7 thousand is given by the

government for drip irrigation. Subsidy for drip irrigation causes a network relation among many human actors which is discussed in the next section.

Oil Palm crushing unit: This is an important element in the technology package because the final success of the technology is determined by an oil extraction factory. The government has promised to set up a factory before the end of the 5 year gestation period, but had bureaucratic delays. The farmers started getting yield from 3rd year on wards and because of non-availability of the crushing facility, fruit was wasted. If the fruit is not crushed within 24 hours it loses 1% of oil content. Thus oil palm requires an efficient crushing unit with adequate capacity and good machinery and management skills. The crushing unit was established by the government at Pedavegi after a long delay and it has 5 to 6 tonnes capacity which is highly insufficient for the bountiful production of oil palm in the region.

The crushing unit demands a netwo k relation between the farming community and the factory personnel because the quantity of production and the capacity of the plant should match. If the production is more than the capacity of the plant, fruit will be wasted. At the same time, if a machinery of higher capacity is set up with heavy investment and if the production is not achieved by the farmers, investment would be wasted.

The crushing unit of oil palm also provides employment opportunities. As fruit production is continuous, there is no season in oil palm, but pro-

duction varies from time to time. Therefore, crushing facility goes on through out the year. The fruit cannot be stored in godowns like coconut because it gets damaged. So oil has to be extracted within 24 hours. This demands employment of adequate number of workers to finish the job. Thus oil crushing unit causes a network relation among labour and the technology as such.

(f) Corporate sector as an actor:

The corporate industrial houses are late entrants into the network of OPDP, though they have been seen since the beginning of oil palm cultivation in India.

In Kerala, Oil Palm India Ltd had cultivated Oil Palm from 1971 to 1982 in 3705 hectares of land, by importing seeds from Malaysia. Though the performance was not remarkable the experience gave some ideas to business houses, agricultural scientists and farmers, of the potential of oil palm cultivation. In Andhra Pradesh, Navabharat Enterprises had planted indigeneous variety of seeds in 200 hectares in 1988 in Lakshmipuram in West Godavari district.

In the OPDP initially five companies entered in the third year, viz., MAC Industries, Godrej Soaps Limited, Navabharat Enterprises, Food, Fads and Fertilizers Limited and Co- operative Oil Growers Federation. Among many competitors, three reputed companies viz Godrej Soaps Limited, ITC and MAC Industries succeeded in convincing the governmentand farmers of their interests. These three were given a monopoly by the government over three districts West Godavari, East Godavari

and Krishna respectively to help farmers in transporting the fruit to the oil crushing units and marketing oil.

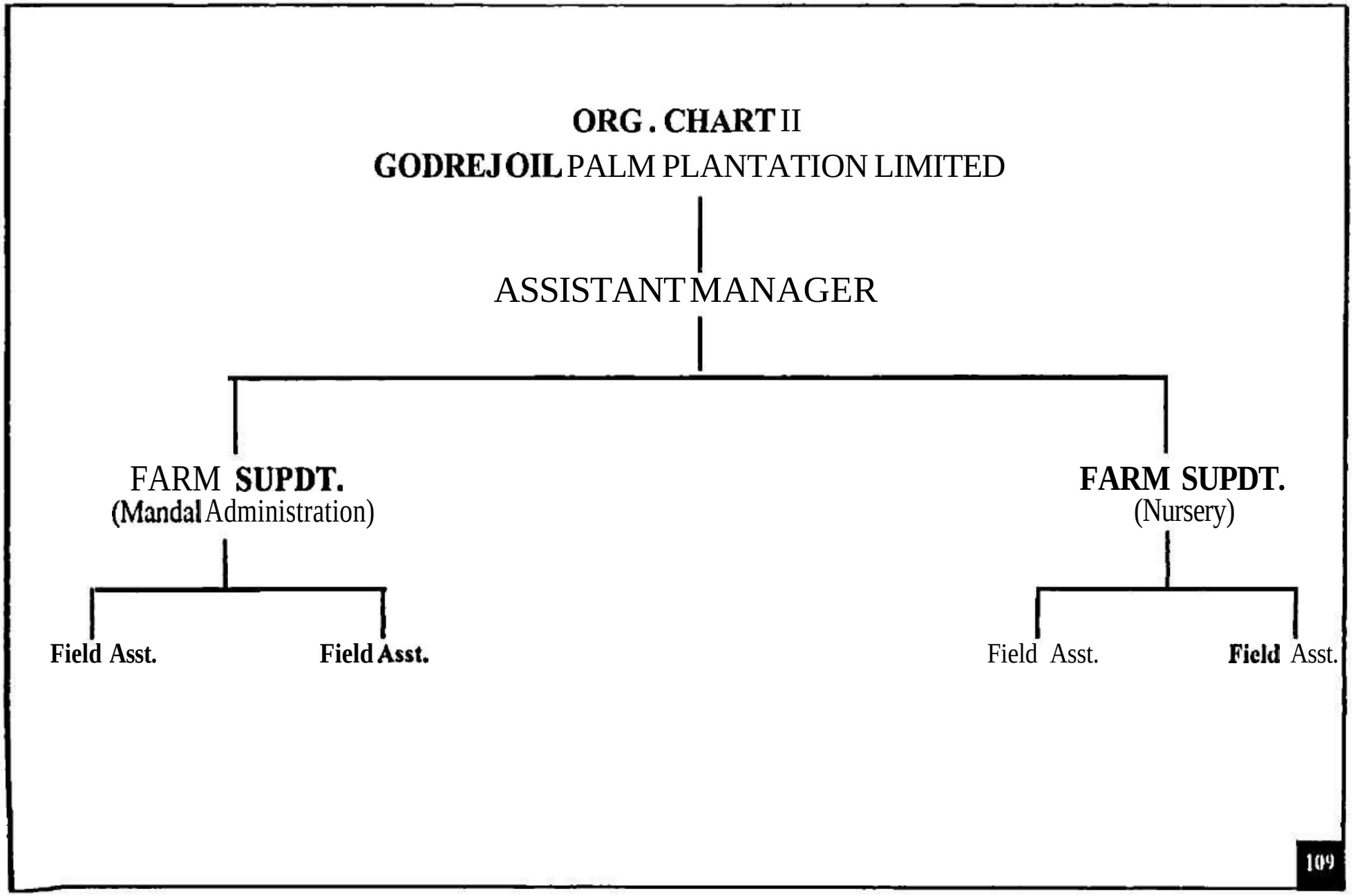
In order to discuss the network relations we have to primarily study these corporate houses as actors in terms of their goals, strategies and role in the OPDP and their organisation structures. Their network relations can be studied in terms of their interaction with other actors like technology, government machinery, financial institutions and beneficiaries (farmers).

The three companies have already had an international acclaim for their products. Godrej has a wide array of products like office equipments, speciality computers, furniture, home appliances, real estate, machine tools, chemicals, soaps, detergents, cosmetics, seeds, agro chemicals, edible oils, animal feeds, and foods. Godrej has been importing palm oil for soaps for the past one decade. ITC has been known for its products of oil, tobacco etc. MAC is a sister company of SPIC which is well ahead into fertilizers. Through MAC it exports food products like, cashew, coffee, spices, edible oil, shrimps and fish.

The companies have entered the OPDP with their own long term interests and strategies. Domestic production of palm oil would save imports for Godrej. ITC, which has already explored sun flowers for oil, can capture the market of another edible oil. The primary motive behind the entry of MAC industries is to enter into edible oil market with their own brand of oil. The technological viability of oil palm in terms of its higher productivity

per hectare and high recovery of oil has attracted these companies to enter into this field. Presently MAC has its own oil crushing unit with 5 1/2 tonnes per hectare capacity but the target is to import machinery with high capacity of 30 tonnes per hectare.

With these ambitious plans these companies entered the oil palm cultivation. Their role in OPDP was initially limited to helping farmers in transporting the fruit from the fields to the government oil factory at Pedavegi. They offered this service free of cost and farmers used to go to the factory only to collect their remuneration. Gradually these companies extended their services by buying the fruit from farmers on fields, paying them regularly and transporting it to the factory. The rate is fixed by the government at Rs 2000/- per tonne. The farmers are obligated to sell the fruit only to that company which is given monopoly over the region. Slowly these companies have started their own nurseries where they could grow the seeds, sell the saplings to farmers at the rate fixed by the government, provide technical consultancy to farmers and buy bock the fruit from them. In order to provide these services, the companies have recruited professional personnel with relevant professional expertise in oil palm cultivation and the administrative personnel for better management. These companies have created separate organisation structures with separate staff to implement the technological package . Godrej has started Godrej Oil Palm Plantation Limited with its headquarters in Eluru in West Godavari district. ITC similarly has started Palm Tech India Limited in Rajahmundry in East Godavari district. For example Godrej company's Oil Palm Plantation Ltd has the following organisation structure:


ORG . CHART II
GODREJ OIL PALM PLANTATION LIMITED
ASSISTANT MANAGER
FARM SUPDT.
(Mandal Administration)
FARM SUPDT.
(Nursery)
Field Asst.
Field Asst.
Field Asst.
Field Asst.

In terms of interaction with other actors in the network, these companies entered into network right from the day they entered the OPDP. But they were only transporting the fruit in the beginning. Later they started importing seeds. They imported tenera hybrid seeds from Malaysia, Costa Rica and Papua New Guinea. These high yielding seeds are grown in primary nurseries of these companies for three months and then transplanted to the secondary nursery.

These seedlings are sold to farmers for planting in fields after 14-16 months. While they are in their nurseries, they are grown in well irrigated conditions through drippers, taking care of temparature and humidity. Those plants that are prone to produce male flowers are detected in the nursery itself and removed. In the course of their involvement the companies discovered the following interesting features:

(a) the height of oil palm plants is less and so manageable; (b) it gives consistent yield through out the year; (c) an yield of 35 tonnes per hectare can be expected; and (d) it has a relatively high oil recovery rate of 20% to 30% from the fruit when compared to other oil seeds. To increase productivity efficient management practices are essential in oil palm cultivation. For this purpose, these corporate houses recruited professional personnel who gained research experience abroad in this particular crop and worked in Malaysia. They also send their personnel abroad for training and get experts from these countries for consultancy.

These companies entered into a dialogue with the government right in the third year of the OPDP when they realized the technological viability of this crop.

There was disagreement between the government and farmers of the three districts regarding the location of oil factory, as farmers whose plantations were quite far away from the crushing plant would find it difficult to transport the fruit bunches in time for crushing.

At this juncture, Godrej volunteered to arrange free transport of the fruit produced by the farmers. Then the private firms entered into a tripartite agreement with government and National Agricultural and Rural Development Bank (NABARD). As per the agreement, the private companies would stand on behalf of farmers and facilitate in getting loans from the banks and arranging subsidies. They would sell the plants at a rate fixed by the government and buy back the fruit at the rate again fixed by the government. These corporate houses have come to playthe role of facilitators connecting many actors while at the same time realizing their own interests.

In order to get subsidy for drip irrigation, a farmer's application has to be recommended by the company to the government. After the approval from the government, the bank would sanction the loan. This operates in c network where a farmer primarily applies to the company that has monopoly over the region for oil palm propagation to recommend him for subsidy. The company registers this application with the Assistant Director of Horticulture of the district who recommends it to the Director of Horticulture. From there it is forwarded to the bank which gives 50% of the loan directly to the agents who sell drippers and arrange drip irrigation facilities in the fields of the farmer. This whole network is monitored by the corporate house which is linked with every other actor. In this web of actors, even

if one actor is removed, the whole network collapses.

The network relations between corporate actors and respondents is all- encompassing. The corporate companies acted as agents of communication, technical consultants and mediators. They acted as communication agents in facilitating free flow of information regarding technical details, financial aspects and management practices to all the farmers without discrimination. For effective communication, they used all the media channels- oral, print as well as audio-visual. With the help of brochures, write-ups and casettes they communicated to farmers the technological viability of oil palm and its subsequent impact on the socio-economic status of farmers.

The innovative methods of communication adopted by the companies encouraged farmers to venture into oil palm cultivation. The idea here is to suggest the strength of the relation that is built between farmers and the corporate houses. The technical consultants of these companies have given information to farmers right from the beginning regarding the operations, technical details, management practices, fertilizer usage etc,. Apart from that, they visit the fields regularly, observing personally the growth of the plants, suggest new methods regarding irrigation, fertilizers and pesticides etc,. At the time of fruiting, they take special care to get those fruits with maximum oil recovery. As mentioned earlier, they act as mediators between farmers and other financial institutions in facilitating loans and subsidies. Thus network relation has been built between these two actors.

In this study, the perceptions of farmers regarding the degree of involvemet of the corporate officials in terms of their field visits were gathered on a five point

scale. Out of 166 farmers, 55 (33.1%) reported that corporate officials visited them frequently, 26 (15.5%) reported that they visited frequently, 14 (8.4%) mentioned that they rarely visited and 64 (38.6%) were neutral. The technical assistance provided by the consultants was felt to be completely sufficient by 25 farmers (15.1%). Where as 54 (32.5%) felt it to be adequate, 15 (19.0%) felt it to be insufficient and 65 (39.2%) were neutral. Regarding the sincerity of the corporate officials, 26 (15.7%) farmers found them to be very sincere, 56(33.7%) sincere and 62 (37.3%) were neutral. The corporate officials were found to be insincere by 16(37.3%) farmers and most insincere by 6 (3.6%) farmers.

As a part of the study of relation between the companies and participants, the respondents were asked, for their choice of sector (government or private) for organising oil palm cultivation, right from sapling distribution to marketing of oil. As many as 71 (42.85%) farmers preferred private sector and 11 (6.6%) farmers wanted it to be managed by private companies under the aegis of the government as joint sector, 55 (33.1%) farmers preferred it under the government completely, 1 (0.6%) wanted it in co-operatives, 20 (12.0%) held no opinion, 5 (3.0%) felt both public and private sectors to be good and 3 (1.8%) felt both to be bad.

The strength of social relation between the formers and the corporate houses depends on the interacting individuals and extent of knowledge of technology held by the corporate house. The hierarchy of officials would have different degrees of expertise and knowledge. The lower level field staff would have only partial knowledge about the technology. Development officers, Area

managers and Horticulture officers would be able to impart more knowledge to farmers because they have expertise. The conviction of the farmers depends on the knowledge they get about the technology and they interact with people who are competent and fulfil their expectations. Among the 71 farmers that preferred private sector management for oil palm cultivation, 33 got training from field staff, 26 from the development officer, 11 from the horticulture officer and 1 from the district manager.

Among 55 farmers who preferred public sector and management for oil palm cultivation, 39 obtained consultancy and training from the field staff of the private corporate houses, 13 from development officer, 1 from horticulture officer and 1 from area manager. Among 11 farmers who preferred joint sector, 6 obtained information from field staff, 5 from development officer. Among 20 farmers who were indecisive about the management, 2 obtained no consultancy from any one, 17 obtained information from the field staff and 1 from development officer. Among the 5 farmers who thought both public and private sectors to be good, 4 have contacted the field and 1 contacted the development officer. Out of 3 farmers who felt both public and private to be bad, 2 interacted with the field staff and 1 with the development officer.

(g) Labour:

Labour enters into network relations by virtue of its indispensability in the organisation of production. The success of any technology depends on the degree of involvement and skill levels of labour, be it an agricultural technology or industrial technology.

In the adoption of oil palm technology too, labour played a determining role. Prior to the launch of the OPDP, a few farmers in East Godavari district got interested in oil palm cultivation, but could not start it due to relatively higher labour costs in the region. Therefore they migrated to Vizianagaram where labour wages were relatively less and started the cultivation of oil palm. Thus labour availability at affordable cost was one of the criteria that determined technology adoption right in the beginning.

The cost of labour and the kind of labour available in the region also influences the decision of the farmer while adopting a technology. Thus labour has network relation with technology determining its success or failure further. In W.Godavari district, the availability of local labour is less and expensive and so migrant labour are recruited for skilled jobs.

There are two kinds of labour that are found to be employed in the OPDP i.e. family labour and hired labour. Family labour is that where the related members of a household including the head of the household work and hired labour is that where labour is hired for a wage. There are three categories of hired labour viz, (a) annual farm labour, (b) casual labour and (c) contract labour.

Annual Farm Labour

Labour that is hired by the farmer on an annual basis is the annual farm labour (Paleru). They ore employed based on trust and familiarity with the family and the [ob of the labourer varies according to the necessity. He works in the field when casual labour is not available and atttends to the domestic duties of his employer when there is no farming season. His wage

payment varies according to the size of the land holding and quantum of work that he has to do, which obviously is related to economic status of the farmer. If the labourer works under obligations of attachment or some kind of bondage due to debts advanced to worker's parents his job is almost round the clock, in return he is given meals and clothes which make him part of the household apart from paying Rs.5000/- to Rs.6000/- per annuum. In certain cases, rice equivalent to the amount agreed upon is given per annuum. Loans are given to these farm servants for festivals or other necessities.

The wage payment for these annual farm servants varied in the three districts. In East Godavari district, the payment ranges from Rs. 4000/- to Rs.9000/- per annuum depending on the size of land holding and economic status of the farmer. In many cases, the labourers are employed on a monthly basis for wages that vary from Rs.450/- per month to Rs.700/- per month. In those situations where rice is provided, the quantity of rice ranges from 12 bags of rice to 30 bags per annuum.

In Krishna district, the wages are a little higher and go up to Rs.850/- to Rs.900/- per month i.e. Rs.10,000/- to Rs.11,000/- per annuum.

In West Godavari district, the wages for annual farm labour range between Rs.3000/- and Rs.5000/- Per annuum. There is again a categorisation of these wages in terms of with one meal a day or without meal.

Earlier the social relationship between the farmer and the annual farm labour was not limited to the mere work interaction as in the case of other forms of labour. The labourer was attached to the farmer, in the sense

that, he would take the responsibility of not only the agricultural practices for which he was employed, but also for every other cultural and familial activity in the owner's household.

In this study, it was observed that this traditional role- relationship has changed. Now, the farmer is interested more in getting the work done rather than entering into a personal relationship with the labour. For this, he has to give a few additional incentives apart from the annual salary to get the maximum output. Even the labourers are looking for more incentives and additional benefits while considering annual farm employment. One respondent in Pallerlamudi said that, 'the labour has become more demanding, oflate, in extracting concessions and more benefits, while the efficiency of the labourer is on decline'. Where as a labour leader in Veerisettigudem said, 'there is no benefit in going as annual farm servant, where, there is more work and less pay'.

In the same village, a perfect network relation was observed between farmers and the labour, regarding wages. Instead of wage decision being a one-way flow, collective bargaining was observed where the farmers and the labour would meet at the beginnig of the season and decide wages for that particular season.

In the case of oil palm cultivation, the nature of the work is flexible depending on the convenience of the farmer. The operations in oil palm cultivation are not time-bound. They can be completed either by employing labour at a stretch or can be done over a period of time by the farmer himself. For instance, basing has to be done thrice an year as per the technical guidelines, but the negligence of this is not devastat-

ing. Therefore, the interested farmers employed labour and got basing done thrice and a few others did it only once or twice. This flexibility in the nature of the work made labour relations dynamic in nature. The wages also vary because of this fluid nature of the work demand.

Casual Labour

The labour that is employed on a daily wage basis is the casual labour. They are employed exclusively to work on fields mostly for seasonal operations. The wages of casual labour too differ from district to district. In East Godavari and West Godavari districts male workers are paid Rs.25/- per day and female worker Rs.20/- per day. In Krishna district the wages are a little higher i.e., male labour are paid Rs.30/- per day and female labour Rs.25/- per day.

In West Godavari district it was found in one or two cases where male labour are paid Rs.30/- for watering and they are paid Rs.12/- per day for weeding. The wages of the casual labour, except in one or two cases, are the same through out the district. However, wages for casual labour has seasonal var.ations. During the peak season, a male worker is paid Rs.40 to Rs.45 and female Rs.30 to Rs.35 per day.

Contract Labour

The labour employed on a piece rate basis for particular operation is called the contract labour. A contractor agrees to do an operation by employing his group of workers. The farmer does not directly interact with workers. The contractor mediates between them. Contract labour is usually employed when operations require completion in a stipulated period of time like in sugarcane cutting. But in the OPDP too, contract la-

bour was found to be employed, mostly in Krishna district. The wages for contract labour are decided for particular operations on a contract basis irrespective of the man days required for the operation.

Contract labour is more impersonal. As mentioned earlier, in oil palm cultivation, there are five operations involved viz, Planting, Basing and Weeding, Watering, Manuring and Harvesting. Table 4.1 gives the average number of man-days in an year that are required for each operation in oil palm and wages are given on an average in the table.

But generally contract labour is paid less. The contractor fixes a certain amount for a given operation and distributes the wages after taking his own share even though he may or may not actually work.

Table 4.1 follows on the next page

Table 4.1
Casual labour requirement in oil palm (per acre)

Operation	Man Days		Wages per Day		Total Amount spent on labor
	Male	Female	Male	Female	Rs.
Planting Basing &	6	-	25	•	150
Weeding	6	-	25	-	150
Watering	104	•	25	•	2600
Manuring	6	-	25	-	150
Harvesting	52	*	25	-	1300

As per the requirement, the total mandays required per acre for all the operations in oil palm cultivation would be 174. Total area where oil palm is planted in all the three districts put together is 1050 hectares. Therefore total casual labour absorption in oil palm cultivation in three districts is 2.5 x 1050 x 174 = 4,56,750 mandays. The total land covered in three districts individually is 350 hectares in East Godavari, 400 hectares in West Godavari and 300 hectares in Krishna district. Therefore, casual labour absorption in three districts individually would be 1,52,250, 1,74,000 and 1,30,500 mandays respectively.

Table 4.1 shows requirement of casual labour. But, as mentioned above other kinds of labour is also employed. Because, family labour or annual farm labour cannot be quantified easily as their involvement in each operation is far greater both in quantity and quality. Contract labour is another kind where they work under an agreement to complete a piece of work at certain price. As such, ploughing and planting requires one day per acre. Basing and weeding takes three days on an average for one acre.

Watering has to be done twice a week which would require one male labour per acre. That would mean 104 days per year. Manuring is done thrice an year for one day on each occassion. Harvesting is expected from 3rd year onwards and is done once a week. That would mean 52 days per year.

Table 4.2 follows on the next page

Watering is the third operation for which as much as 83 (50.0%) farmers have employed annual farm labour, 76 (45.8%) farmers use family labour, 5 (3.0%) farmers employ casual labour and only 1 (0.6%) farmer relied on contract labour. This operation is a continuous one and requires involvement through out the year and hence involvement of annual farm labour and family labour is greater.

For manuring 53 (31.9%) farmers have employed casual labour, 62 (37.3%) family labour, 41 (24.7%) annual farm labour and 8 (4.8%) employed contract labour. For harvesting, as much as 84 (50.6%) farmers have relied on family labour, 70 (42.0%) farmers employed annual farm labour, 8 (4.8%) farmers employed casual labour and there is no contract labour absorption for harvesting. Thus, for one time specific operations casual labour is employed in most cases.

Table 4.2 suggests that casual labour has more scope for employment in oil palm cultivation only at the time of planting. Basing and Weeding and Manuring which are done only for three days each on year hove scope for casual labour. But Watering and harvesting which are done through out the year are managed more with the help of family labour and annual farm labour.

Table 4.3 follows on the next page

Table 4.3

District-wise Absorption of Labour in Oil Palm

	East Godavari					Krishna					West Godavari				
Operation	F.L	A.L	Ca.L	Co.L	T	F.L	A.L	Ca.L	Co.L	T	F.L	A.L	Ca.L	Co.L	T
Planting	18	2	40	2	61	2	2	6	14	24	16	1	51	13	81
	29.5	3.2	65.5	3.2		8.3	8.3	25.0	57.3		19,7	1.2	62.9	44.8	
Basing &	21	5	25	9	61	7	2	8	7	24	18	1	50	12	81
Weeding	34.4	8,1	31.1	13.1		29.1	8.3	33.3	29.1		22.2	1,2	81.9	14.7	
Watering	21	38	-	-	61	12	10	2	1	24	43	35	33	-	81
	34.4	62,2				50.0	41.6	8.3	4.1		53.0	43.2	3.7		
Manuring	23	26	11	-	61	12	5	3	3	24	27	10	39	5	81
	37,7	42.6	18.0			50.0	20.8	12.5	12.5		33.3	12.3	48.1	6,1	
Harvest	23	33	3	-	61	10	10	2	-	24	51	27	3	-	81
•ing	37,7	54.0	4.9			41.6	41.6	8.3			62,9	33,3	3,7		

More reliance on casual labour for Basing and Weeding is seen in West Godavari (81.9%) and Krishna districts (33.3%) where as in East Godavari district more reliance is on family labour (34.4%). The next significant distribution of labour for Basing and Weeding, is casual labour (31.1%) in East Godavari, family and contract labour equally (29.1% each) in Krishna district and family labour (22.2%) in West Godavari.

The absorption of casual labour for Watering in all the three districts is much less compared to family labour or on annual farm labour. In East Godavari district, there is more reliance on annual farm labour (62.2%) for Watering, where as in Krishna and West Godavari districts, more of family labour (50.0% and 53.0% respectively) is used.

For manuring, more casual labour is employed than others (48.1%) only in West Godavari, whereas in East Godavari annual farm labour (42.6%) and in Krishna, family labour (50.0%) are used more. The next significant usage of labour in these districts for manuring is; family labour (37.7%) in East Godavari, annual farm labour (20.8%) in Krishna and family labour (33.3%) in West Godavari.

For harvesting, employment of casual labour is much less in all the three districts compared to employment of either annual farm labour or family labour. In East Godavari, 54.0% employed annual farm labour, whereas in West Godavari majority (62.9%) employed family labour. In Krishna district both family labour and annual farm labour (41.6% and 41.6%) are equally employed.

wages

Three kinds of labour - annual farm labour, casual labour and contract labour i.e., differ in terms of the quantum of wages and its mode of payment. As mentioned earlier, annual farm labour is employed annually on the grounds of trust and familiarity. The nature of work of the annual farm labour is varied and continuous like 'call duty.' It is a kind of cushion against fluctuations in availability of casual labour. A worker hired on annual basis by a farmer would work on rice field, oil palm field and help in transporting inputs etc. Therefore, calculating the wages for annual farm labour for each operation in oil plam cultivation is difficult. Another significant feature is that wages of annual farm labour depend on the land holding size which is an index of the economic status of the farmer or employer. Therefore, they differ not only from district to district, but also within a given district.

Wages for contract labour are fixed for each of the operations irrespective of the mandays required for a given operation. In oil palm cultivation, an average of Rs.250/- to Rs.300/- is paid for planting and basing and weeding and Rs.700/- for manuring. Contract labour is not employed any where for harvesting and in only one case it was employed for watering where Rs.200/- are paid for a month. The number and composition of the labour depends on the contract leader. Therefore, the exact wages for each operation as per mandays cannot be calculated.

The total wages of casual labour can be calculated by taking wages per day multiplied with mandays required for each operation. The wages for the casual labour are found to have increased in the past five years. In 1990's male labourers were paid Rs.15 and

The statistical association is a reflection of the network relation between the educational background and the participation of the adopters in the network. However, this would not mean limiting relations to a few attributes, because the scale for participation was constructed specifically to include all the heterogeneous elements in terms of adopter's involvement in the project, their relation with other actors, both human and non-human and their relation with the technology.

Among the 51 adopters at the low level of participation, majority (33.3% and 31.4% respectively) were medium and small farmers. Among the 84 medium level participants, majority (59.5% and 27.4% respectively) were big and medium farmers. Among the 31 high level participants, majority (87.1%) were big farmers (see Table 5.10).

Table 5.10 follows on the next page

Table 4.4
Absorption of Labor and wages in oil palm

Operation	Wages per Day per head		Total Casual labor absorpt -ion
	Rs. 25	Rs.30	
planting	91 (93.8)	6 (6.2)	97(100.0)
basing& weeding	75 (90.3)	8 (9.7)	83(100.0)
watering	3 (60.0)	2 (40.0)	5(100.0)
manuring	50 (94.3)	3 (5.7)	53(100,0)
harvesting	6 (75.0)	2 (25.0)	8 (100.0)

roj

Comparison With Other Crops:

If we compare oil palm with other crops, the labour requirement in oil palm cultivation is less compared to other crops like rice, coconut and sugar cane. Table 4.5 shows labour requirement for paddy. Throughout the rice crop season there is scope for labour to get employment. Another feature is that any operation takes longer time than that of oil palm. Similarly coconut plantation (Table 4.6) has more usage of labour and female labour is also used.

For sugarcane plantation (Table 4.7), mostly contract labour, is employed because it needs skilled work. Contract labour consists of migrant workers in Krishna district. The migrant labour hail from eastern part of Andhra Pradesh - Srikakulam, Vizianagaram and Visakhapatnam.

Among the contract labour usually a team consists of three male and two female workers. The harvesting spans over a period of four months and for this the local labour is not employed.

Table 4.5, 4,6 and 4.7 follow on the next pages

Table 4.5
Labour requirement in paddy (per acre)

Operation	Man Days		Wages per Day		Total Amount spent on labor
	Male	Female	Male	Female	Rs.
Ploughing	2	•	25	20	50
Planting	-	20	-	20	400
Weeding	2	20	25	20	450
Watering	52	-	40	-	2080
Harvesting	-	10	-	20	200

Table 4.6
Labour requirement in coconut (per acre)

Operation	Man Days		Wages per Day		Total Amount spent on labour
	Male	Female	Male	Female	Rs.
Ploughing	18	-	30	•	540
Planting	2	1	30	-	85
Weeding	6	4	30	25	280
Watering	52	-	40	-	2080
Harvesting	12	-	40	•	480

Table 4.7
Contract Labor Absorption in sugarcane (per acre)

Operation	Labor composition			Total Amount spent on labor Rs.
	Male	Female	total	
ploughing	8	2	10	300
planting	6	4	10	600
weeding	2	8	10	300
watering	2	0	2	800
manuring	2	1	3	600
harvesting	5	5	10	800

Stage I: Prior to Oil Palm Plantation

Prior to oil palm plantation the crops which had high labour absorption potential in the region were paddy,coconut and sugarcane. The labour required for these crops on an average in terms of mandays and wages are given in Tables 4.5, 4.6 and 4.7.

Nature and Scope of Labour Requirement: The operations involved in food and plantation crops are (a) Ploughing (b) Planting (c) Watering (d) Manuring (e) Harvesting.

Among these five operations, almost every operation requires hiring of labour at once, whether it is casual labour as in the case of paddy and coconut or the contract labour as in the case of sugarcane.

Stage II: Gestation Period of Oil Palm Cultivation

The gestation period of oil palm spans over four years before the harvest starts. The operations involved in oil palm cultivation are Planting, Basing & Weeding, Watering, Manuring and Harvesting. In the first year, the first four operations are carried out, in second and third years, the next three operations are carried out. From the fourth year onwards harvesting starts.

Nature and Scope of Labour Requirement:

Only ploughing and planting requires relatively larger number of mandays of labour. Basing & Weeding is done once every year for three days. Manuring requires two male labour for one day in every four months. Thus only the first three operotions require hiring of labour, that too in small numbers compared

to paddy and coconut and not skilled as in the case of sugarcane. Watering can be done with the help of family labour or annual farm labour over a period of time. Thus even during the gestation period of four years, oil palm cultivation absorbs less labour compared to other crops and expenditure towards labour is also very less.

As it has been observed, in many cases where a high demand for labour had been prevalent earlier were replaced with oil palm thus curtailing the scope of labour employment. But as intercrops were grown in first two years of the gestation period, the labour had alternate sources of work during the gestation period of the oil palm in the OPDR

Stage III: Productive Stage **of Oil** Palm

From the fourth year onwards, fruiting began in the three districts. The principal operations in oil palm cultivation then were Watering, Basing & Weeding,Manuring and Harvesting. Among these operations casual labour is employed only for basing & weeding for one day. Manuring is done once in four months. The significant feature here is that labour can be hired for these operations when there is a slack season for labour. Thus labour charges will not be more. As it has been observed in Tables 4.2 and 4.3, there is very less absorption of casual labour for watering, manuring and harvesting. In many cases they are managed with the help of family and annual farm labour. Thus in the productive stage of oil palm, the labour required and amount spent on labour would bo very meagre compared to other crops.

Thus there is a gradual displacement of labour as oil

palm replaces other crops in the region. Another significant feature observed in OPDP is that, no where has female labour been employed for any operation. Thus female labour has been completely displaced in oil palm cultivation.

In a village called Veerisettigudem in W.Godavari district, after the introduction of oil palm cultivation, female labour has shifted to mulberry. This can be done on their own fields and at home for which they got a subsidy of Rs. 18,000 per acre from the government.

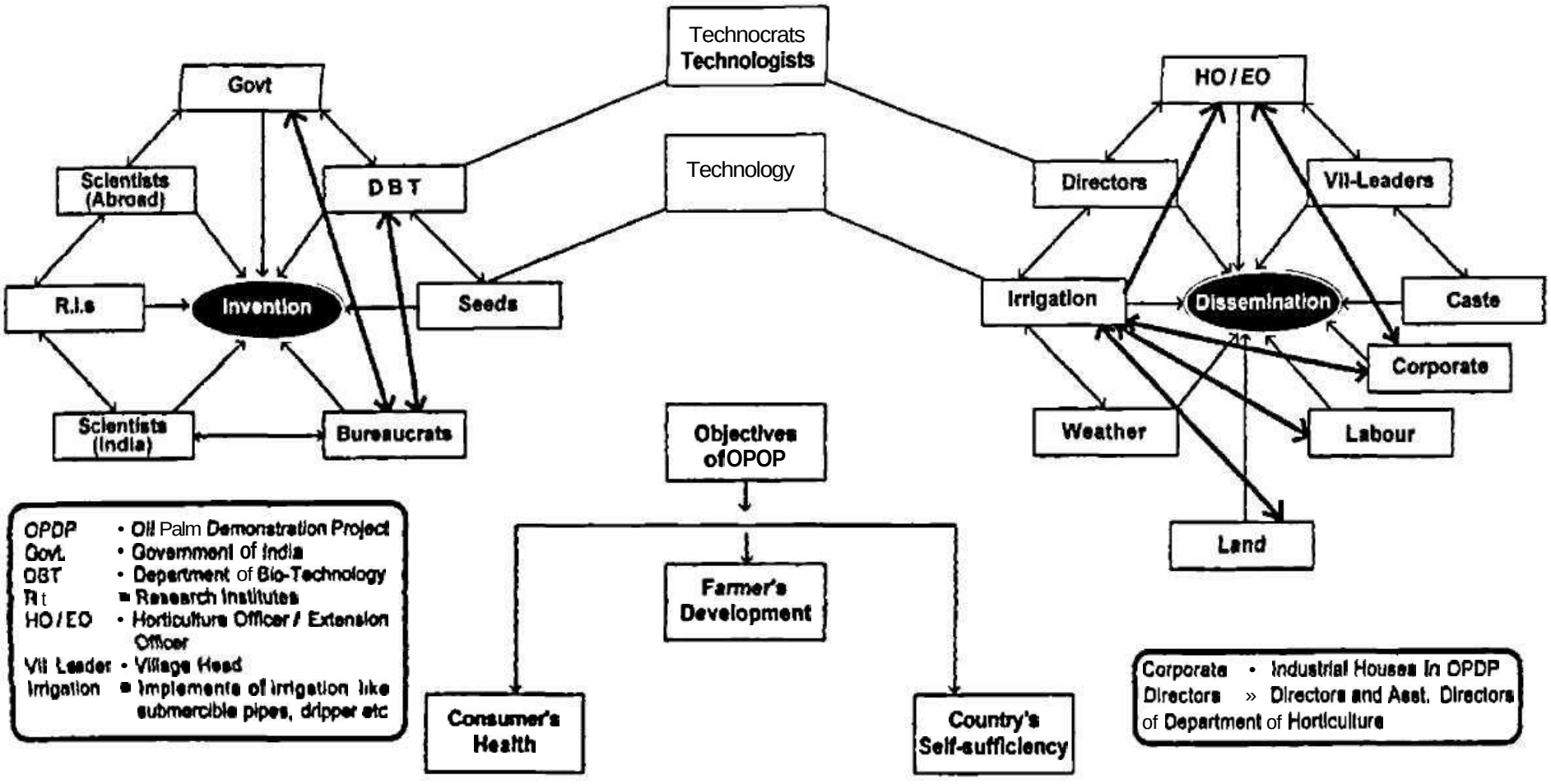
The network relations between two actors i.e., technology and labour have shown wide possibilities in the OPDR As said earlier, the phenomenon of less labour costs caused migration of farmers from Godavari to Vizianagaram in order to adopt new technology i.e., oil palm cultivation prior to the OPDR In the OPDP the technology has caused labour displacement due to streamlining of operations. In the post OPDP phase, if oil palm cultivation is encouraged more in place of other crops, labour migration from these regions can be expected.

In this chapter, the network relations among different heterogeneous associations that operated in the stages of invention and dissemination in the OPDP are discussed.

FIG.I

ACTOR-NETWORKS IN OIL PALM DEMONSTRATION PROJECT

CONTEXT OF INVENTION & DISSEMINATION



CHAPTER V

Technology and Adopters Network-relations

The actors in a network, as delineated by Callon, are of both human and non-human nature. Among the human elements, adopters of technology constitute a vital group. The adopters tend to be heterogeneous in terms of social attributes, interests, attitudes and values. Their preferences and factors which influence their choices while adopting the technology also vary. In this chapter, Callon's actor network model is extended to look into the heterogeneous adopters that are involved in technology development. As the OPDP is considered as a network of interacting actors, participation of the adopters in the project may be studied in terms of network relation between the technology and the adopter.

As mentioned earlier, the third stage in technology development is the context of justification where technology is evaluated in real-life situation. The actors involved in this stage are:

Adopters of technology: They get into net-work

relation along with other adopters, promoting agencies, scientists and innovators with varied social, economic and political attributes. Their relation with technology includes absorption of technical know-how, exploitation of technology with local innovative methods and improvisations, performance in terms of yield and participation in the project right from the beginning to the end of the project. In the present study one may use yield as an observable indicator of the performance, the greater the yield the higher the level of performance.

Technology:

A package of heterogeneous elements like subsidies, chemical fertilizers, intercrops and mechanical elements, the access and control over which are related to the economic status of the adopters of technology, the output of the technology in terms of yield and conceptual and functional knowledge of the adopters in oil palm technology.

The success or failure of a technology is evaluated by the degree of acceptance of the technology by the adopters in the context of justification. The adopters get into network relations with many other human actors like government officials of the department of Horticulture at the district and state levels, officials of the private corporate houses who helped in realisation of the fruits of technology, labour that helped in implementation of the technology and technology as a package of elements like technical know-how, yield, etc (see Fig.II)

Attributes of the Adopters :

The social attributes of the adopters of technology considered in this study were: (a) demographic variables like age and sex; (b) family and kinship; (c) social or ethnic affinities in terms of caste, religion etc; (d) economic status in terms of size of land holdings; assets in the form of instruments of production - implements like bullock cart, tractor etc; (e) access to various sources of information; and (f) contact persons in government and corporate offices etc.

In the present study, in a sample of 166 adopters of oil palm technology, majority (97.6%) were men while very few (2.4%) were women. In terms of religious background, 153 (92.2%) were Hindus and 13 (7.8%) were Christians. Though women were a minority in the sample, it was observed that the households headed by them performed well in terms of participation in the project. In a village called Veerampalem in West Godavari district, there was one ferrale cultivator who with the help of hired labour cultivated oil palm on her own and got good yield.

In Vempadu in Krishna district, another female cultivator planted oil palm in 50 acres and obtained good yield. It was observed that these women cultivators were more informed than their male counterparts regarding the methods of cultivation, labour requirement and charges etc., because they were more vigilant about the cost of cultivation.

Caste background: In terms of social or ethnic background, the distribution of households was as

follows: Kamma (54.8%), Kapu (13.9 %}, Reddy (10.8 %), Brahmin (1.2 %), Yadava (1.8 %), Barber (0.6 %), Washerman (1.2 %), Raju (3.0 %), Balija (1.2 %), Padmasali (0.6 %), Velama (2.4 %) and Scheduled Castes (8.4 %). As per the government classification, these castes are categorised into three groups; forward castes (Kamma, Kapu, Reddy, Brahmin, Raju, Balija and Velama); backward castes (Yadava, Barber, Washerman and Padmasali); and scheduled castes (Forward castes are those which have higher economic and/or social status).

District-wise distribution shows that the majority of adopters belonged to forward castes. Among the 61 adopters in East Godavari district, 58 (95.1%) belonged to forward castes and 3 (4.9%) to backward castes. In Krishna district, the total of 24 (100.0%) belonged to forward castes.In West Godavari district, among 81 adopters, 63 (77.8%) belonged to forward castes, 4 (4.9%) backward castes and 14 (17.3%) scheduled castes.

Class background: The size of landholding indicates the economic class background of the adopters. The size of landholdings in the sample ranges from 1 acre to 250 acres with a mean size of 22.5 acres. As per the government classification, those who have land between 1 and 2.5 acres are called as marginal farmers, those who have between 2.6 and 5.0 acres small farmers; those who have between 5.1 and 10.0 acres medium farmers and those who have above 10 acres are big farmers. Among the 166 adopters , 11 (6.6%) were marginal farmers; 25 (15.1%) small formers;

41 (24.7%) medium farmers; and 89 (53.6%) big farmers. In E.Godavari district, out of 61 adopters of technology, 7 (11.5%) were marginal farmers; 11 (18.0%) small farmers; 8 (13.1%) medium farmers; and 35 (57.4%) big farmers.

In Krishna district, there were no marginal farmers, while, only 1 was a small farmer, 4 (16.7%) were medium farmers and 19 (79.2%) were big farmers.

In W.Godavari district, there were 4 (4.9%) marginal farmers; 13 (16.0%) small farmers; 29 (35.8%) medium farmers; and 35 (43.2%) big farmers. In all the three districts the majority of the farmers were big landlords.

The economic status is also assessed in terms of assets or instruments of production like, bullocks, bullockcart and tractor, tube wells and borewells, submersible pumps and drip irrigation equipment etc,.Among the adopter-households in the sample, 149 (89.8%) possessed bullocks, 113 (68.1%) bullockcart and 131 (78.9%) tractors. While tubewell was one of the prerequisites set by the government to adopt oil palm technology, 147 (88.6%) in the sample had tubewells, while, 17 (10.2%) shared tubewells with others and 2 (1.2%) had no tubewell. The economic and social status of the farmers were related in the sense that, majority of the forward/ higher castes had larger land holdings (see Table 5.1).

Table 5.1 follows on the next page

TABLE 5.1
Relation Between Caste and Economic Status

Economic Status	Caste			Total
	F.C.	B.C.	S.C.	
Marginal Farmer	8 (72,7)	1 (9.0)	2 (18,3)	11 (6,6%)
Small Former	17 (68,0)	2 (8.0)	6 (24.0)	25 (15.1%)
Medium Farmer	33 (80.5)	3 (7.3)	5 (12.2)	41 (24.7%)
Big Farmer	87 (97.8)	1 (1.1)	1 (1.1)	89 (53.6%)
Total	145 (87.3)	7 (4.2)	15 (8.4)	166 (100.0)

Education: It is generally believed thai education increases awareness about technology and associated practices. It also may help in formation of positive attitudes towards innovative practices. Data on the educational background of the adopters was collected. In the sample nearly one third (32.5%) had no formal education. However, because of their enormous farming experience, their level of comprehension of the technology was very high.

This was observed in Krishna district, where respondents possessed extensive knowledge not only of variousagricultural technologies, but also other national and international issues. Their political awareness was so wide that they influence the agricultural policies of the state government through their village leaders and representatives in the state legislature.

Among those who had education, majority (54.2%) had education upto school level and very few (13.3%) college and professional education. In a rural society, having education higher than school level is relatively big achievement because of many social, economic and infrastructural constraints. In the villages that were surveyed in these districts the maximum education facilities that were available were upto high school level. In E.Godavari district, among 61 adopters, 25 (41.0%) had no formal education, 28 (45.9%) had upto school level and 8 (13.1%) college and professional education. In Krishna district, out of 24 adopters, 9 (37.5%) had no formal education, 12

(50.0%) upto school level and 3 (12.5%) college and professional education. In W.Godavari district, out of 81 adopters, 20 (24.7%) had no formal education, 50 (61.7%) limited their education upto school level and 11 (13.6%) upto college and professional level.

Communication is vital in actor-networks while disseminating information about technology and obtaining feedback from adopters. The essential communication in the OPDP was (a) across adopters and ; (b) between adopters on the one hand and promoters of the OPDP on the other. The channels were informal and formal. White formal communication could be seen between adopters and promoters, the informal channel operated among the adopters.

Though mass media is one of the channels of communication, in a rural society, verbal communication through village leaders and co-farmers builds up the network relation among the villagers of different classes. In tha OPDP while 86 (51.8%) among 166 farmers received technical information from extension officers, the rest received from various other sources. Among them, majority (19.3%) received information about oil palm technology from co-farmers and 22 (13.3%) from village leaders. Very few (15.6%) reported that their sources of information were mass media (Radio, TV, Newspaper) .

It shows that communication is both cause and consequence of network relations. Though stratification of the society in terms of caste and class

was seen in the rural society, when it came to sharing of technical information and adoption of technology, farmers of these villages depended more on their fellow men than on the mass media. It suggests that informal channel of communication plays significant role in the formation of a network of actors in rural areas.

Political affiliation to political parties and consequent leverage help farmers in getting access to information, credit sources and in initiating organized efforts at collective level in the development of new technologies. Numerically, very few (8.4%) in the OPDP have had political affiliation to any particular political party.

However, it was observed that, a minority of the adopters, who had political affiliation played major role in technology development and in some cases, were instrumental in bringing the technology to their villages. For instance, there were two leaders in two villages Pragadavaram and Tadikalapudi respectively of West Godavari district. Both of them were ex-presidents of village Panchayat, having membership in Telugu Desam Party and Congress Party respectively. According to the respondents they were the ones who brought technology to their respective villages, informed and educated farmers about the technological aspects and advantages of oil palm cultivation. In this endeavour, they concentrated not only on their villages, but also informed farmers of surrounding villages of their mandals (revenue block) and included them in the project. While the reason for

this involvement could be very well rooted in political motives, it could also be said that because of their political involvement they had access to bureaucrats and technocrats and learn from them the latest technologies. Having known their political power, the bureaucrats also approached them first to learn about the profile of villages and entrusted them with the responsibility of choosing enthusiastic farmers and educating them about the project. It was also observed that for the marginal and small farmers, these leaders were the sole source of inspiration as well as information about different cultivational practices of oil palm. Their trust on these leaders eventually caused technology adoption. In the network relation power may be seen as an enabling factor rather than a constraining factor. However, the role of power relations vary in different contexts .

Movement: There was an important fallout of the oil palm technology. It created conditions for the development of an association and a movement. The formation of 'OIL PALM GROWER'S ASSOCIATION'is an example. This association was formed by the adopters of oil palm technology initially at the district level and later at the state level. The necessity for this association was felt by the respondents in order to have an organized body at the state level to act as a pressure group. The respondents right from the first year of the OPDP had to fight with the bureaucrats to minimize delays in meeting their demands like, timely payment of subsidies, fertilizers and pesticides, tech-

nical consultancy and timely setting up of the oil crushing unit. The confrontation between the respondents of the three districts on the one hand and the government on the other occurred regarding the location of the oil crushing plant. The central government had allocated budget to the department of Horticulture, government of A.R, for setting up only one oil crushing unit for the three districts.

The farmers of these districts demanded that the plant be located in their respective districts which would minimise transportation problem. The deliberations had finally resulted in a mutually acceptable solution to locate the plant at Pedavegi, a location accessible to all the participants in the OPDR This collective negotiation with the government, simultaneously united the farmers and made them realize the necessity of an association to realize their interests. Thus the Oil Palm Grower's Association came into existence in the year 1995.

The unique feature of this association was that, it evolved as a response to a new technology. The adopters of oil palm technology came together to fight for a common goal of technology development and their economic advancement through technology utilisation and thus corroborating Callon's view that technology gives rise to social movements.

Technology:

Another actor in the context of justification is the technology which has heterogeneous elements, which would have been thought over by the

adopters before adopting it.

Attractions/ benefits of technology:

Primarily, the high yielding characteristic of oil palm in terms of tonnage per acre was the most attractive aspect. It was expected to yield a minimum of 2-4 tonnes and a maximum of 10 tonnes of fruit per acre with more oil content than other varieties of oil seeds. For enterprising farmers, oil palm cultivation, which was not native to the land, was an opportunity to experiment. For instance, for one of the respondents, a big landlord in Tadikalapudi of West Godavari district, experimenting with new crops is a hobby. His penchant to excel in the cultivation of new crops made him adopt oil palm readily. For the big farmers of East Godavari and Krishna districts, experimenting with new crops and cultivation methods are not unusual practices, because they belong to the green revolution belt of the state.

Higher returns; less requirement of labour; 100 % subsidy from the government; less gestation period; and its perennial nature attracted small and marginal farmers. As the marginal and small farmers were more in West Godavari district (20.9 %), majority of them (8.4%) responded to the economic attraction of oil palm in this district.

The farmers of the coastal belt of Andhra Pradesh perceived this crop to be better than all other plantation crops like coconut, mango, etc., because the fruit is not edible and useful only for extraction of oil which is possible only in a factory.

Further, this crop needs very less expenditure in terms of money and time and management is simple, leaving enough time and energy to look after other crops as well. It provides scope for growing intercrops which is another source of income for the farmer. The intercrops that were usually grown in these districts, as per the advice of the technical personnel of the Department of Horticulture, were turmeric, groundnut etc., which generated income to the farmers in the first three years of the gestation period.

In one case in Krishna district, one farmer planted Lilly flower crop as an intercrop which fetched him a bumper production of 40 kilograms per acre. Lilly as an intercrop also helped in oil palm cultivation which fetched him record production of 10 tonnes per acre. The reasons as delineated by him were: the roots of oil palm start spreading from the second year onwards and therefore it is not advisable to plough the land then. If an annual intercrop is planted, land has to be ploughed in the second year for anotr sr crop, whereas, Lilly is a triannial crop and so avoids ploughing of land once planted. As it also requires less water, oil palm can have larger share of water.

Thus choice of intercrop was found to be the secret behind the massive yield achieved by this particular farmer who holds a record of getting second largest yield among the three districts. Thus intercrop was one of the various technical elements on which the fruits of the technology depended thus establishing a dependent relation in the network.

In the view of those respondents in the study who were informed of the country's edible oil position, cultivation of this crop would result in self-sufficiency of the country in edible oil production. One of the respondents who thought of country's edible oil position is a rich land lord who has 250 acres, the highest acreage under oil palm in the study. He was very inactive interms of his involvement in cultivation though he had 250 acres in East Godavari district, as he is also a film producer. What attracted him and brought him back to the village, as delineated by him, was the country's edible oil scenario and the possible contribution of oil palm in achieving self-reliance in edible oils. There is high demand for this oil because of less cholesterol content. It is also commercially viable. Added to these factors, was the assurance from the government of an oil extraction facility.

Respondents were also encouraged by the fact that high yielding seeds were imported from the pioneering countries in oil palm cultivation like Malaysia and Costa Rica under the aegis of the Department of Biotechnology. Further, a separate governing body was created to encourage oil palm cultivation in the state.

The past successful attempts in oil palm cultivation by the Indian Council for Agricultural Research (ICAR) and the publicity given through mass media about the viability of the crop were also encouraging factors. Committment of a few technocrats at the centre and a few officials of the Department of Horticulture at the state also encouraged farmers to adopt the technology.

Risks and uncertainities:

Though adoption of oil palm technology seemed lucrative at the outset, it had its own bottlenecks at the operational level, that could have been perceived by a thoughtful farmer. Firstly, it was a new technology whose management practices were little known to technocrats and scientists who brought the technology. Theoretically speaking, technology is deemed to be demonstrated after its feasibility is tested . In the case of the OPDP, the technology which was proved successful in foreign lands was brought to India for demonstration. Therefore, risk and uncertainity were higher.

Oil palm cultivation was encouraged by the government by giving subsidies and free saplings with the promise that oil extraction plant would be set up by the end of the gestation period. But the bureaucratic delays were too familiar to Indian farmers. Uncertainity in crushing the fruit at the right time and uncertainity of oil support price were inherent. Predictably, setting up of oil extraction unit got delayed. Farmers in Krishna district started getting yield right from the third year onwards, with no oil extraction facility. Some respondents in the study who are progressive farmers in Pallerlamudi village of Krishna district, boiled the fruit at home and extracted oil and consumed it in the first year of fruiting as the crusing facility had yet to start functioning. This is an evidence of the enterprising spirit of the farmers of Krishna district. As the department of Horticulture failed to

setup the factory by the scheduled time, respondents were restless about the wastage of the fruit and carried on mass meetings to expedite the establishment of oil extration facility.

Cultivation of a rain-fed crop under irrigated conditions would mean total dependence on tube-wells. Long gestation period of five years and dependence on inter-crops for income during the gestation period was another risk factor. This risk was in fact experienced by some marginal and small farmers.

In Pragadavaram village of West Godavari district, respondents could not earn enough income from intercrops . Due to drought, the available sources of water had to be diverted to the immediately income giving intercrop than longterm crop like oil palm. Without adequate water supply, subsidies in the form of fertilizers and pesticides were of no use for the growth of oil palm crop. Therefore, intercrops were removed in the third year and with no yield from oil palm or intercrop the farmers of Pragadavaram found oil palm a liability.

With all the above mentioned attractions, risks and uncertainities associated with the oil palm, the farmers had adopted oil palm technology and as a consequence entered into a network relation with technology. The adopters had their own reasons, which varied from one another, for adopting oil palm technology. The network relation between the adopter and the technology can be established by understanding the reasons given by the adopters for adopting oil palm technology. The respond-

ents were asked to rank their reasons for adopting the technology. The ranking order of reasons is as follows:

(1) Profitability of oil palm compared to other crops; (2) less labour requirement compared to other crops; (3) less investment; (4) subsidy from the government; (5) venture for new crop; (6) achievement satisfaction; and (7) country's self-reliance in edible oils.

The adopters were asked to rank their priorities in adopting technology to get an idea about 'Technology-Adopter Nexus'. Among the various reasons given above, profitability was given the highest rank by 91 respondents (54.8%). Followed by venture for new crop by 29 respondents (17.5%), interesting subsidy by 27 (16.3%), less labour requirement by 11 (6.6%), country's self-reliance in edible oils by 4 (2.4 %), less investment by 3 (1.8%) and achievement satisfaction by 1 respondent (0.6%) (see Fig 5.1).

Fig 5.1 follows on the next page

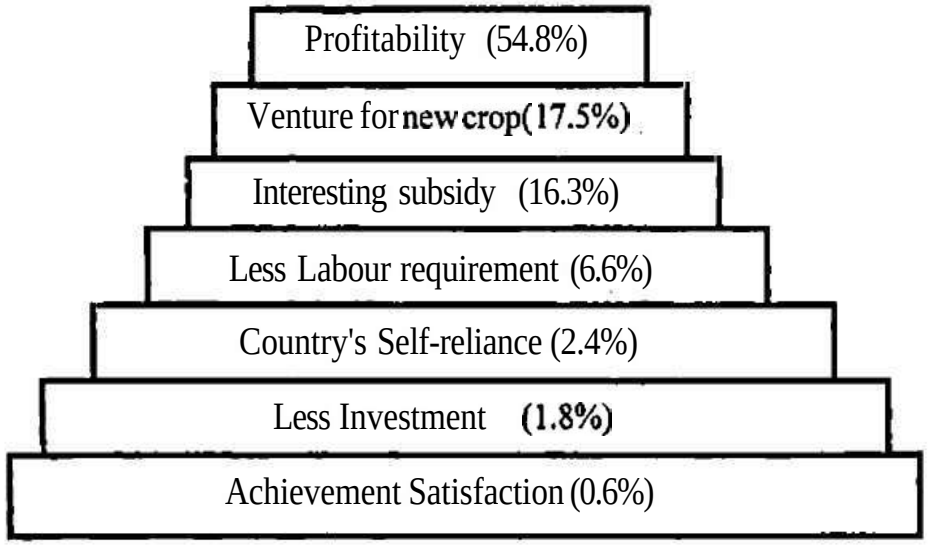


Fig 1 Technology-Adopter Nexus

The network relation between the technology and the adopter may also be ascertained by the performance of the adopter while utilising the technology. The output or yield may be seen as the index of performance.

The output of the technology was considered in terms of the yield in Kilograms per acre. The relationship between performance and social and economic attributes of the farmers are examined in terms of their caste and economic class background.

Among 166 farmers in the sample, 22 (13.3%) obtained no yield and the average yield obtained by the rest 144 farmers was found to be 985.2 Kg per acre.

Among those who obtained yield, in 83 (57.6%) cases the yield was below the average, while in 61 (42.4%) cases it was above average. Among the 83 farmers who obtained below average yield, 70 (84.3%) belonged to forward castes, 4 (4.8%) backward castes and 9 (10.8%) scheduled castes. Among the 61 farmers who obtained above average yield, 57 (93.4%) belonged to forward castes, 2 (3.3%) backward castes and 2 (3.3%) scheduled castes. It is clear that the proportion of farmers belonging to backward and scheduled castes is low. (see Table 5.2).

Table 5.2 follows on the next page

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 hod 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.

The network relation between the technology and the economic status of the adopter through the out put may be seen by means of a contingency analysis. As mentioned above, yield is taken as an indicator of out put of technology and size of land holdings as an indicator of class.

Among the 83 farmers who obtained below average yield, 8 (9.6%) were marginal farmers, 13 (15.7%) small farmers, 22 (26.5%) medium farmers and 40 (48.2%) big farmers. Among the 61 farmers who obtained above average yield, 3 (4.9%) were marginal farmers, 7 (11.5%) small farmers, 11 (18.0%) medium farmers and 40 (65.6%) big farmers (see Table 5.3).

Among those who obtained higher yield, the majority of the adopters had higher size of land holdings, thus suggesting a positive relationship. During the field work, it was observed that those farmers with better economic status, i.e., higher size of land holdings, had the ability to bear risks. They could afford to invest resources to employ labour, use latest methods of irrigation and perform even under adverse conditions like drought.

Table 5.3 follows on the next page

Table 5.3

RELATIONBETWEENYIELDAND ECONOMIC STATUS

Yield (Kg/acre)	Economic Status				Total
	Marginal Farmer	Small Farmer	Medium Farmer	Big Farmer	
Below Average	8 (6.3)	13 (11.5)	22 (19.0)	40 (46.1)	83 (57.6)
Above Average	3 (4.6)	7 (8.4)	11 (13.9)	40 (33.8)	61 (42.4)
Total	11 (7.6)	20 (13.9)	33 (22.9)	80 (55.6)	144 (100.0)

In many cases, very low yield was obtained due to monsoon failure and subsequent drought. Due to failure of tubewells during acute summer, many respondents could barely manage to water their fields. In a few cases, male flowers were produced because of which, there was no scope of yield. A few farmers in West Godavari district, neglected their fields in the first few years by diverting the subsidies meant for oil palm cultivation towards domestic consumption. This resulted in low yield. These heterogeneous elements which account for the differentials in performance of the farmers in the project could be observed with the help of actor-networks.

The small and marginal farmers with few irrigation facilities could not perform well under drought due to failure of tubewells. In spite of adverse conditions the dynamic nature of the actor-network relation between the oil palm technology and the adopters was maintained. This can be seen in the persistence of the adopters with the technology in spite of hardships faced. For instance, in the case of one respondent in Pallerlamudi in Krishna district, oil palm fields got devastated due to failure of tubewells. He could not grow any plants and the Horticulture officials refused to give him the subsidy for the second year. But still he decided to continue oil palm cultivation by getting his tubewell repaired and wanted to adopt oil palm in the post-demonstration phase. Eight farmers in our study belonging to Chinnaboinapalle in Krishna district also had similar experience with tubewells and got no yield. But still they wished to continue oil palm cultivation by rectifying their mistakes. All those respondents in our study in three districts who used subsidies for other

purposes and neglected fields in the first three years, realised their mistake after observing the bountiful production obtained by their fellow adopters and decided to continue oil palm cultivation with more commitment and conviction.

The strength of the network relation between technology and the human element is maintained inspite of aberrations caused due to geological, technological or psychological factors. While the respondents of West Godavari district who were affected by drought, persist with the existing acreage under oil palm and improving their irrigation facilities, the respondents of East Godavari and Krishna districts were gearing up for further expansion in oil palm cultivation.

The relation between the output of technology in terms of yield and labour may be seen by taking into account the degree to which the farmers were directly involved by employing their own labour while using the technology. The degree of involvement may be categorized in to six kinds:

(a) Absentee landlords: who entrusted the cultivation to the annual farm labour and did not spend their own labour. In the present study absentee landlords were reported from Vempadu Agraharam of Krishna district, where lands were bought by entrepreneurs who had their respective business enterprises in nearby cities. Except two cultivators in the village, all others entrusted their cultivation to farm servants and seldom visited their fields.

(b) Supervising land owners; There are two subcategories among this category;

(i) Land owners employing annual farm servants - who employed servants on annual contract to culti-

vate the land while the owners restricted their labour to servants. It was observed that in East Godavari district, big landlords leave their cultivation to able farm servants and supervise them regularly, where as the respondents of Krishna district, how much so ever big they may be, work along with their farm servants in fields.In fact the researcher met most of the respondents in the sample belonging to Krishna district on their fields, where as those of East Godavari district were always available at home.

(ii) Owners employing casual labour - land owners who employed casual labour for all seasonal operations and supervised the work of casual labour. Employing casual labour would mean, being in constant touch with the seasonal operations of the cultivation, trends of the labour market in terms of availability and wages of labour etc.

(c) Owners working with hired labour - land owners who employed labour and also worked with them in the fields. Whether labour is of casual or annual nature, the involvement of the farmer in cultivation is shown in working with labour.

(d) Family Labour - land owners who worked for themselves and also involved their family in oil palm cultivation.

Among the 144 adopters who got yield, majority (52.0%) employed annual farm servants and supervised them regularly. Thirty two per cent worked along with the labour or have worked for themselves and 21.5% involved their family labour (21.5%). Poor performers were absentee land lords, (see Table 5.4).

Table 5.4 follows OB the next page

Table 5.4

Relation between yield and **owner's** labourinvolvement

Yield	owner's labour involvement in production					Total
	Absentee Landlord (1)	owners with annual farmLabour (2)	owners with casual Labour (3)	Working with Labour (4)	Family Labour (5)	(6)
Below average	0 (0.0)	26 (31.3)	3 (3.6)	29 (34.9)	25 (30.1)	83 (57.6)
Above average	2 (3.3)	26 (42.6)	7 (11.5)	18 (29.5)	8 (13.1)	61 (42.4)
Total	2 (1.4)	52 (36.1)	10 (6.9)	47 (32.6)	33 (22.9)	144 (100.0)

The performance in terms of yield and the degree of involvement though related, do not suggest strong linear association because of various other factors which could be understood only with the help of actor-network perspective.

Yield cannot be correlated with any single factor because it depends on many factors. The degree of owner's Involvement in production is expressed through his labour activity. The labour involvement of the farmer is different in different cases depending on one's own economic status and affordability of labour. If the farmer is rich, he would obviously employ labour for production, rather than working on his own. In those cases where, inspite of having affordability, farmers worked along with labour, production was higher. Thus, owner's labour involvement was an indicator of his interest in the production.

Farmer's degree of involvement is also dependent up on the economic status of the respondents. Those who are econimically well-off employ labour and those who cannot afford to employ labour work on their own.In the sample of 166 adopters, none among the absentee landlords are marginal and small farmers and majority are medium (66.6%) and big (33.3%) farmers. Among those who depend on annual farm labour majority are big (85.7%) and medium (14.3%) farmers. Similarly among those who employ casual labour, majority are big (61.5%) and medium (38.5%) farmers. Among those who work along with labour 24.1%, 31.0% and 43.1% are small, medium and big farmers respectively. Among those who work on their own majority are small (27.8%) farmers while minority (19.4%) are big farmers. (see Table 5.5).

Table 55 follows on the next page

TABLE 5.5
RELATION BETWEEN ECONOMIC STATUS AND DEGREE OF LABOUR INVOLVEMENT

Economic Status	owner's labour involvement in production					Total
	Absentee Landlord (1)	owners with annual farmLabour (2)	owners with casual Labour (3)	Working with Labour (4)	Family Labour (5)	(6)
Marginal Farmer	0	0	0	1	10	11 (6.6)
Small Farmer	0	0	0	14	11	25 (15.1)
Medium Farmer	2	8	5	18	8	41 (24,7)
Big Farmer	1	48	8	25	7	89 (53.6)
Total	3 (1.8)	56 (33.7)	13 (7.8)	58 (34.9)	36 (21.7)	166 (100.0)-

Thus the adopters' labour involvement in production depends on the economic status.

It is argued in communication literature that in a development process, sharing of knowledge between receivers and communicators is essential for increased levels of awareness and participation rather than a simple top-down communication. For this to succeed, the receiver has to be receptive to the continuous flow of information. His ability to reflect upon and critically evaluate Information in relation to the context in which he/she is placed are essential to provide feedback. The level of information a farmer has indicates the extent of his involvement in not only learning technical details but also implementing them. In this study it was observed that same information was given by communicators to all the participants of the project. But differences in their comprehension and retention of the information was observed. During the field work, each of the respondents was asked to recount their knowledge of the entire gamut of technical aspects of oil palm cultivation in order to note if there were any differences in their information 'evels. The information levels of the farmers regarding various aspects of oil palm technology were ascertained with the help of a cumulative scale with six items. Each item has a different score value and has various activities ranging from the fundamental details of the operations involved in the cultivation of oil palm technology to the issue of relevance of oil palm cultivation to the country.

For example, item I has five activities which are the basic operations in oil palm cultivation viz., planting, watering, manuring, weeding and cutting. Knowledge about these individual activities is given a weightage of

1 and the total weightage of the item no.1 is 5. Various activities included in item II are given individual weightages of 2 each. Similarly, the rest of the four items are also given weightages. Thus, total score value of the six items is 96. The score is divided into three size-classes i.e., 1 -32, 33-64 and 65-96 indicating low, medium and high levels. The details of the items are given in Chart No.5.1.

The scores of individuals' levels of information indicate the retention capacity of the farmer of the details of various operations in oil palm technology, wider concerns involved in oil palm cultivation in the country and innovativeness in evolving techniques and methods. The minute details about information were collected from the farmers in the sample regarding the technology and duly scored as per the scale. The levels reflect the increasing quantity of information.

Chart 5.1 follows on the next page

Chart 5.1
Levels of information

LEVELS OF INFORMATION	WEIGHTAGE	TOTAL
I. Basic information regarding:		
1) planting	1	
2) watering	1	
3) manuring	1	
4) weeding	1	
5) cuffing	**1**	**5**
II. 1) gradual increase in basing	**2**	
2} regular watering	2	
3) regular manuring	2	
4) inter-crop	2	8
III. 1) knowledge about watering versus producfion	3	
2) manuring versus increase in production	3	
3) choice and knowledge about inter-crop	3	
4) timely realisation of the harvest	3	12
IV 1} regional climatic conditions	4	
2) drip irrigation	4	
3) growth and protection of the plant	4	
4} fruit protection methods	4	**16**
V. 1) oil palm for country's self-reliance	5	
2) (ess labour	5	
3) more profits to private sector	5	
4} low price for consumer	5	
5) Foreign exchange saving	5	25
VI. Ability for innovative methods in		
1) planting	6	
2) watering	6	
3) manuring	6	
4} weeding	6	
5) cutting	6	30
total weightage		**96**

An examination of the relation between the technical elements and the non-technical elements like the social and economic attributes of the adopter gives the nature and extent of the network relation between technical and non-technical actors.

Out of 166 farmers in the sample the majority (36.7%, 34.3% and 13.3% respectively) were in the third, second and fourth stages of information.

Among those who were in the third, fourth and fifth stages majority (49.1%, 59.0% and 72.7% respectively) had education up to school level. Among those who were in the second, third, fourth and fifth stages of information, the majority (36.8%, 63.9%, 59.0% and 92.8% respectively) were big farmers. There were only two adopters who reached the sixth stage of information and both were big farmers. It shows that levels of information are related to size of landholdings i.e., economic class position. (see Table 5.6).

Table 5.6 follows on the next page

Table 5.6
Stage of Information

Stage of Information	Number of cases	Percentage
1	9	5.4
2	57	34.3
3	61	36.7
4	22	13.3
5	14	8.4
6	3	1.8
Total	166	100.0

It shows that access to information is unequally distributed. The scores obtained by the adopters on the scale of levels of information also indicated that the comprehension capacity increases with level of education. Our analysis shows that school level education appears to be critical level.

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. This shows that the level of information depends on one's educational background.(see Table 5.7).

Table 5.7 follows on the next page

Table 5.7
Relation between level of information and education

Information level	Educational background			Total
	No formal Education	School level	College & Professional	
1-32	48	62	8	118 (71,1)
33-64	5	21	7	33 (19.9)
65-96	1	7	7	15 (9.0)
TOTAL	54 (32.5)	90 (54.2)	22 (13.3)	166 (100.0)

Because technology development is essentially an actor-network dynamics involving many heterogeneous factors, there maynot be a strong linear association observed statistically between the above mentioned variables. Therefore, limiting network relations to a few variables and trying to see a statistical association among them at best gives a partial description of the network.

As the OPDP is studied as a network of actors, participation of the adopters in the project indicates their participation in the actor-networks of technology development. In this study, participation of adopters was divided into three levels: high, medium and low. While constructing these levels, all the social, economic and technical factors were considered in such a way that, participation of the adopter as such becomes an indicator of network relations among various actors.

The participation of an individual in a project such as the OPDP is influenced by various factors. Firstly, his eagerness and initiative to learn about new technologies and approach the right person at the right time with a view to take decision whether to participate in it or not. The reasons for opting this new technology as delineated by a given adopter suggest the interests and motives behind participating in a government sponsored project. The frequency of meetings of the adopter with the officials regarding the technological information and the investment made in terms of money and time in involving labour, the attitude towards subsidy per se and usage of subsidy for the given purpose and attempts to give feedback to the promoters regarding the project suggest the extent of involvement of the adopter in the project. The technical elements like out-

put of the technology in terms of yield, technical know-how in terms of information levels suggest the adopter's efficiency in dealing with new technology.

The above mentioned factors seemed to affect participation. Ten characteristic features of participation, which were social, economic and technical in nature, were given different weightages in three levels of participation. The highest weightage was given to the characteristic feature or item if it showed higher degree of involvement of the adopter in using technology. The lowest weightage was given to the characteristic feature if it showed the lowest degree of involvement of the adopter. Thus, each characteristic feature was given a weightage of 9, 6 and 3 in each level of participation - high, medium and low - according to the degree of involvement of the adopter.The total weightage scored by the adopter according to his level of participation would be 96, 60 and 30 at each level.

Thus, adopters were categorised into three groups on the basis of their scores obtained on the level of participation: high, medium and low according to their total weightage scored. The details of the characteristic features in each level of participation and corresponding weightage are given in Chart No.5.2.

Chart 5.2 follows on the next page

Chart 5.2
Levels of participation

	weightage
High:	
1) Meeting officials on ones' own initiative for technology	9
2) Giving priority to the reason 'venture for new crop'	9
3) Giving priority to 'self-reliance in edible oils'	9
4) Giving priority to 'achievement satisfaction*	9
5) Meeting officials regularly and giving feed-back regularly and attending meetings regularly	9
6) With land below 10 acres, working with family labour OR with 10-20 acres working along with employed labour or self labour or with above 20 acres supervising labour	9
7) Using subsidy completely for oil palm cultivation OR apart from the subsidy investing one's own money	9
8} Participating with same enthusiasm even if subsidies are withdrawn	9
9} Obtaining an yield of 3000-6000 kilograms per acre	9
10) Information scores as given in the study ranging between 67 and 96	9
Medium:	
1) Being approached by officials or other farmers for technology adoption	6
2) Giving priority to 'profitability'	6
3} Giving priority to 'less budget'	6
4) Giving priority to ' venture for new crop or self-reliance in edible oils or achievement satisfaction'	6
5) Attending meetings twice or thrice only during the crisis`	6
6)With land between 10-20 acres, supervising labour	6
7)Using subsidy partially for oil palm cultivation and partially for other purposes	6
8) Participating in the project depending on his economic position if subsidies are withdrawn	6
9) Obtaining 500 - 3000 kilograms per acre	6
10) Information levels ranging between 25 and 66`	6
Low:	
1) Adopting technology after a lot of persuasion by the village leaders or officials	3
2) Giving priority to ' interesting subsidy*	3
3) Giving priority to * less budget '	3
4) Giving priority to ' less labour*	3
5) Meeting officials only once or never	3
6) Being an absentee landlord or abandoning one's fields	3
7) Using subsidy completely for other agricul tural and non-agricultural purposes	3
8) Withdrawing from the project if subsidies are withdrawn	3
9) Obtaining below 500 Kilograms or no yield per acre	3
10) Information levels with scores ranging between 5 and 24	3

As per the total weightage scored on the above characteristics, respondents who scored between 31 and 50 are categorised as low level participants, those obtaining between 51 and 70 as medium level participants; and respondents obtaining between 71 and 90 as high level participants.

Out of 166 adopters in the sample, 51 (30.7%) were found to be low level participants, 84 (50.6%) medium level and 31 (18.7%) high level participants.

Among the 145 adopters belonging to forward castes, 24.8% were low level participants, 53.7% medium level, 21,3% high level participants. Among the backward caste adopters, majority (57.1%) were low level participants and 42.8% were medium level, while, none were high level participants.

Among the scheduled caste adopters, majority (78.5%) were low level participants and 21.4% were medium level, while, none were high level participants. (see Table 5.8).

If we look at the variation in participation within the social groups we find that the majority among backward and scheduled castes are low level participants. In the case of forward castes, the majority are medium level participants. Among the backward castes, majority are medium level. There is no one among BCs and SCs at high level of participation. As the majority in the universe belonged to forward castes, the sample too had majority of forward castes. The association between caste and the participation suggests that the majority of the adopters among forward castes are medium level participants.

Table 5.8 follows on the next page

Table 5.8
Relation between participation and social status

Participation	Social status of the respondents			
	Forward Castes	Backward Castes	Scheduled Castes	Total
LOW	36 (24.8)	4 (57.1)	11 (78.6)	51 (30.7)
MEDIUM	78 (53.8)	3 (42.9)	3 (21.4)	84 (50.6)
HIGH	31 (21.4)	0 (0.0)	0 (0.0)	31 (18.7)
TOTAL	145 (100.0)	7 (100.0)	14 (100.0)	166 (100.0)

In rural areas of India, with several constraints for equal access to education, education upto school level can be accepted as a reasonable level of achievement. The non-availability of facilities for higher education in villages is also another reason for lack of higher education among majority of the rural population.

Among the 51 adopters at the low level of participation, majority i.e., 25 (49.0% } have had education upto school level and 24 (47.1%) had no formal education. Among the 84 medium level participants, 57 (67.9%) were educated upto school level education and above and 27 (32.1%) with no formal education. While among the 31 high level participants, majority 28 (90.3%) have had school level education and above . Participation was positively related to level of education. The Chi-square test conducted to test the independence of the variables suggested that, the observed value of Chi-square was 13.387 while the table value was 9.488. Thus the level of participation of the adopters was found to be strongly associated with their educational background. (see Table 5.9).

Table 5.9 follows on the **next** page

Table 5.9

Relation between participation and educational background

Participation	Educational background			Total
	No formal Education	School level	College & Professional	
LOW	24 (47.1)	25 (49.1)	2 (3.1)	51 (100.0)
MEDIUM	27 (32.1)	45 (53.6)	12 (14.3)	84 (100.0)
HIGH	3 (9.7)	20 (64.5)	8 (25.8)	31 (100.0)
TOTAL	54 (32.5)	90 (54.2)	22 (13.3)	166 (100,0)

df = 4, Significance = 0.05, Chi-square - 13.387

(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 rote 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.

Table 5.10
Relation between participation and economic status

Participation	Economic status				total
	Marginal Fanner	Small Farmer	Medium Farmer	Big Farmer	
LOW	5	16	17	13	51
	(9.8)	(31.4)	(33.3)	(25.5)	(100.0)
MEDIUM	3	8	23	50	84
	(3.6)	(9.5)	(27.4)	(59.5)	(100.0)
HIGH	0	1	3	27	31
	(0.0)	(3.2)	(9.7)	(87.1)	(100.0)
TOTAL	8	25	43	90	166
	(4.8)	(15.1)	(25.9)	(54.2)	(100.0)

df = 6, Significance = 0.05, Chi-square = 36.702

There appears to be a strong association between the economic status and the participation level as supported by the Chi-square test of association.

Qualitatively too, the level of participation, was related to the economic status of the adopter. This was infact visualsed by the technocrats right in the beginning in the context of invention. Their main criterion in selecting farmers was the risk bearing capacity of the farmers. They chose specifically those farmers who had the economic as well as the cultural resources to adopt new technologies. The OPDP was meant to demonstrate the technological efficiency and productivity. Its success was crucial, because, unless a demonstration project was successful, the technology would not be accepted by the adopters. Therefore, those farmers who were likely to make the demonstration project successful were selected by the officials while implementing the project. Thus, this study of the context of justification, from the perspective of the actor-networks demonstrated the non-linear nature of technology development which addressed the context of justification right in the inception stage .

As mentioned earlier, in the actor-network perspective the innovators keep in view the necessities and economic position of the adopters of the technology and implications of technology. In the case of the OPDP, as in the case of VEL (Callon, 1989), failure of seeds to give female plants, failure of oil palm plants to give yield due to drought and wastage of fruit due to bureaucratic delays in setting up oil crushing unit happened. The delays gave rise to a social movement and paved the way for the emergence of Oil Palm Growers Association. Later new actors in the form of corporate

houses entered the actor- network of the OPDP by promising services.

A comprehensive understanding of the the OPDP is facilitated by the actor-network perspective which helps in overcoming the limitations of sociology that focuses on relations among only social categories and ignores non-human actors.

For instance, those who got no yield reported a series of reasons like failure of monsoons, drought, male flowering etc. There were farmers with lower economic and educational status, but with enthusiasm to learn new techniques and practice them.

There was one such farmer in our study who belonged to Murari village in East Godavari district. He had only 4 acres of land and education upto high school. But he worked on his own in the fields with no help of labour and achieved the highest yield of 10 tonnes per acre in the district. His enthusiasm was so great that he attended exhibitions organised by the Department of Horticulture, learnt latest techniques like tissue culture and applied them in his fields within the available limited resources and excelled in those techniques. He was rewarded for his highest production in oil palm by the Indian Tobacco Company and in the participation scale developed in the study, he scored the highest weightage.

Another such farmer was found in Seetharampuram of Krishna district who too had only two acres of land, but educated in engineering discipline and worked in Defence services. His enthusiasm went to the extent of using vermiculture in his fields. He brought vermiculture castings from Pune and employed them in oil palm fields. The fruit bunches after crushing were brought back from the factory and were turned into manure

with the help of vermiculture castings. He too achieved the highest yield of 10 tonnes per acre in his district and the highest score in the participation scale.

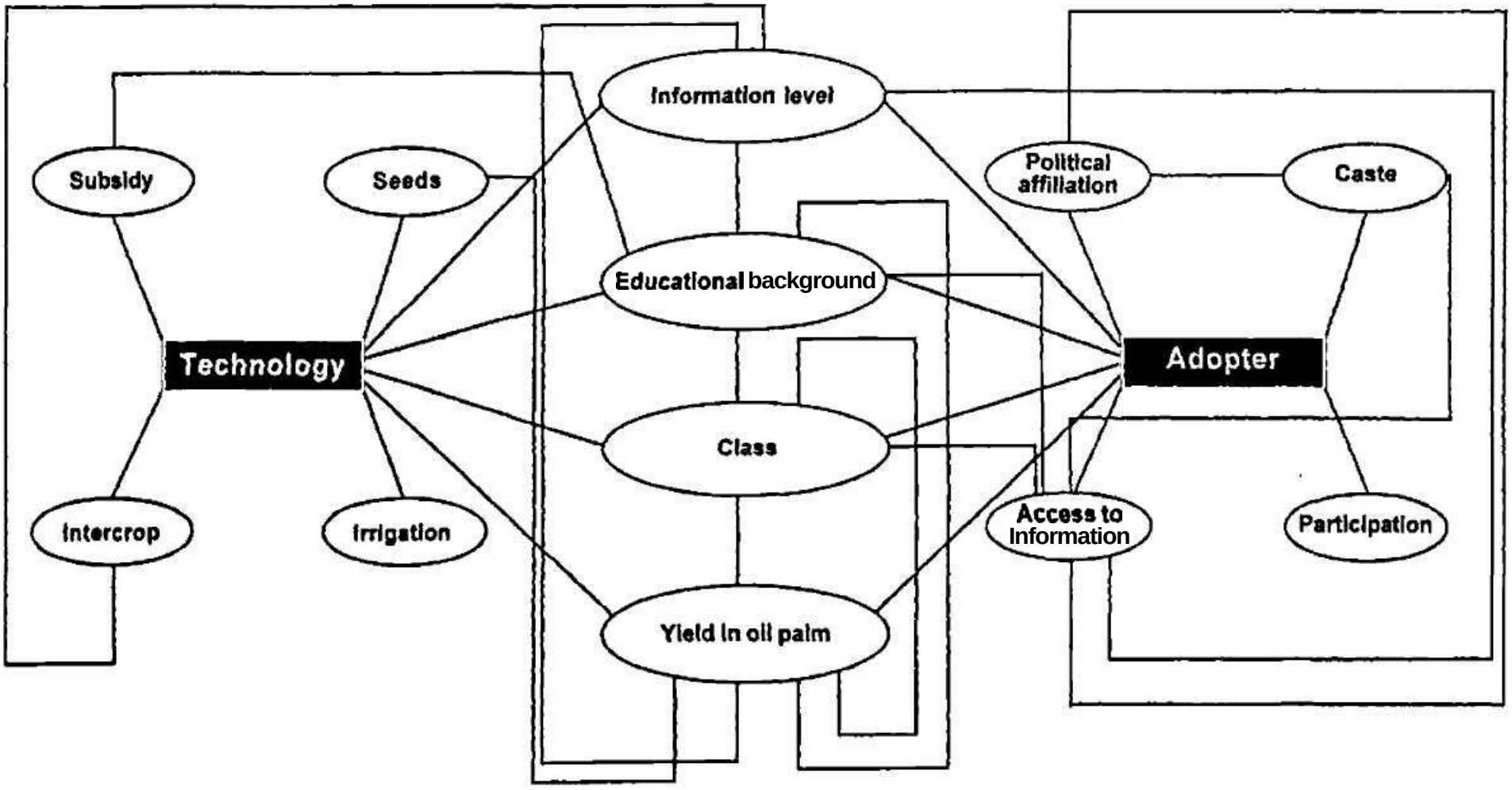
Mere statistical cross-tabulations between participation and economic or educational status would not take into account the dynamic behaviour of human actors as evidenced by their initiative which indicates that farmers are active subjects. This understanding is facilitated by actor-network perspective which helped in giving equal importance to human and non-human elements in technology development.

The reasons for successful performance of a few farmers and unsuccessful performance of few others would not have been brought out through simple statistical analysis of the relationship between yield and social attributes of the actors nor through simple sociological analysis of social categories. Thus, technology development involves complex interactions among heterogeneous elements viz., human, non-human and technical. The interaction doesnot presuppose any hierarchy among the elements.

FIG. II

ACTOR-NETWORKS *IN OIL* PALM DEMONSTRATION PROJECT

CONTEXT OF JUSTIFICATION



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. Callon, 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. Callon 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 heterogenous 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 technolgy. 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 ecor omically 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 io 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 sociolgical 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 homogenety 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-

text-dependent. 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 sociolgically 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 sociolgy 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 ofcourse 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 landowing 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. Therfore, 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 in to 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.

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