PADDY LAND CONVERSION IN KERALA

An inquiry into Ecological and Economic aspects in a Midland Watershed Region

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August 2004

Final Report
Kerala Research Programme on Local Level Development
Centre for Development Studies
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Acknowledgements

We are indebted to a number of individuals and institutions for their timely help, guidance, critical comments, assistance and interest in this study. At the outset, we would like to place on record our sincere gratitude to Dr. K Narayanan Nair and his colleagues especially, Dr. P.R. Gopinathan Nair, Dr. Vineetha Menon, Dr. Cristopher, Prof: T.P Sreedharan for their unstinting support at all stages of the study. Critical comments of Prof. Kanchan Chopra, Achin Chakraborthy, Dr. M.P Parameswaran, Dr N.C. Narayanan and Dr. Rajan Gurukal helped us to sharpen the focus of study. Critical comments of participants of a state-level seminar at Kannur and international seminars at Thiruvananthapuram and Calcutta were useful. Peer group discussions held at the study circle meetings of KRPLLD provided useful insights into various aspects of the issues involved in the study. We are thankful to all of them.

The Principal of NSS College, Pandalam provided all facilities for carrying out this research. Our colleagues in the Departments of Economics and Zoology encouraged our efforts and provided all support. Final M.A (Economics) students helped in conducting semi-structured interviews and focus group discussions in the study region. The elected representatives of Kulanada Block Panchayat and Kulanada and Mezhuveli grama panchayats and the officials of village office and the local bodies helped us by supplying the data, and by discussing with us the various aspects of the study. The local people were very helpful. We gratefully acknowledge the help and service rendered by each and every person in the completion of the study.

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Introduction

Paddy fields in Kerala are typical wetland ecosystems. They provide numerous important ecological and economic functions that benefit people. Landowners using their right to opt for crop of their choice convert paddy fields for other crops and also for non-agricultural purposes. It is argued that economic return from paddy cultivation is not attractive to induce conservation. Landowners, most of them not full-time farmers basically argue for profit maximisation through the freedom of individual choice to shift away from paddy and it seems that they have accepted conversion inevitable to ensure adequate return. The fact that wetland agro-eco-system provides valuable goods and services to society are more often than not, overlooked. Conversion of paddy involves irreversible transformation of the ecosystem. Despite the fact that Kerala ranks top in literacy and environmental awareness, there was a 65 per cent fall in the wetland area under paddy in the last 30 years. Unabated massive conversion still continues and that may result in a total abandonment of rice cultivation in the near future.

The issue of conversion at present is viewed as a choice decision of landowners. Although the State is against land use change, farmers resort to conversion for maximising their economic returns. In their effort to maximise current economic returns, 'farmers' ignore the possible ecological and environmental impacts of conversion. If we look at the issue of conversion from their economic perspective, given the private costs and benefits, rice cultivation is no longer seen as economically viable as it does not provide what is regarded as an adequate return. Moreover, land at present is seen only as a real estate needed for residence and status and it is also considered as the safest and best investment. Therefore economic rationale of the private owners of paddy fields suggests them to convert for non-agricultural purposes. It seems that majority of farmers are not aware of the real long term impact of ecological and environmental imbalances that may result due to transformation of the wetland agro-ecosystems.

If, on the other hand, we look at the issue of conversion from the perspective of the local society, we could see environmental resource depletion impacting directly on the poverty levels and livelihood conditions of the indigent local population dependent on land. Depletion of environmental base may turn them destitute even as the local economy as a whole 'grows'. Environmental problems caused by deforestation, disruption of backwater ecosystems and paddy land conversion have already affected the livelihood conditions of large numbers of the economically backward sections in rural areas. Degradation of environment hurts the poor than the rest of the society (Kadekodi, 2001). Rural folk in several developing countries eke out a living from products obtained from plants and animals in common property resources (Sankar, 2001; Dasgupta, 2001).

Kerala, with the lowest land man ratio among the States in India, is widely known for its peculiar pattern of development characterised by high level of human and social development coupled with relative stagnation of production sectors. The academia is now doubtful about the sustainability of the widely acclaimed Kerala model of development[i] (Kurian, 1995; George, 1998, 1999; Kannan, 1998, 1999; Tharamangalam, 1998). The environmental damage now faced by the state raises the questions on the sustainability of livelihood security of those sections marginalized from the mainstream tendencies of development (Kurian, 1995; Narayanan, 2003). Natural forests and wetland ecosystem are the worst affected resource bases.

It is surprising to note that several parts of the State, which receives an annual rainfall of about 3000 mm and has 41 west-flowing rivers and numerous backwaters and lakes experience acute drinking water scarcity for about six months a year. About two-thirds of the population does not have access to safe drinking water[ii]. Despite the fact that the soil and climate provide ideal conditions for plant growth, landowners resort to massive conversion of paddy fields. The State's deficit in rice, which is the staple food, has increased steadily from 50 to 55 percent during early fifties to mid-seventies to more than 80 per cent of its requirement at present. In fact, Kerala has ceased to be a food grain producing state of any significance (Kannan, 2000). This tendency is likely to have its impact on the food security of the absolutely poor if the public distribution system happens to fail.

Context of the Study

The State's agrarian economy has undergone radical and far-reaching changes. In the name of development, the hills are mined, sacred groves are desecrated and destroyed, and rare medicinal plants exterminated paddy fields in the valley reclaimed and consequently the sources of perennial water streams of Panchayats dried up. Kerala's environmental damage directly threaten the quality of life of its people and both directly and indirectly reduces its economic potential to sustain the relatively high levels social sector development despite bw levels of per capita income and poor performance of productive sectors (Franke & Chasin 1999; Tharamangalam, 1999; M.P.Parameswaran, 1999).

Conversion of paddies means abandoning a highly developed and complex wetland agro-eco-system. It involves irreversible transformation of the ecosystem. While the conversion benefits go exclusively to private owners, the society at large in general and those who depend on land for their livelihood in particular bear the brunt of disruption of the fragile ecological and environmental balance of the ecosystem. It is feared that the recently promulgated government order permitting reclamation of paddy fields for construction purposes may augment the process of conversion, which may result in vanishing of the remaining paddy in the near future[iii].

Though the State is against conversion of paddy fields, the landowners with the connivance of corrupt bureaucracy resort to large-scale conversion. Agricultural labour unions were against conversion. Owing to fear of loosing farm employment the labour unions with the support of leftist political parties organised agitations and destroyed crops in converted lands in several parts of the state in the late 1990s. However, the unions at present remain silent for reasons best known to them.

Civil society and academia argue for continuance of rice cultivation for reasons of conservation of the fragile wetland ecosystem and food security. Though, they have been exerting pressure for the protection of the ecology and environment and also for the conservation of natural capital, little efforts have been made for the conservation of paddy fields.

So the issue of paddy conversion in Kerala is complex and it involves economic, ecological, socio-cultural, structural and class dimensions. The real costs and benefits of conservation and development to stakeholders are difficult to comprehend unless we consider a specific context in terms of time and space. The present study is therefore, based on a specific local context: a small watershed region in the midland of south Kerala. In this micro level study, an attempt is made to examine the issue of resource depletion due to paddy conversion from the perspective of the rural poor, who happens to be, in most cases, landless labourers. It tries to bring out the enormity of resource depletion caused by paddy conversion and its impact on the livelihood conditions of the people who eke out a living from land resources.

It is also important to understand the major functions, the agents and users of wetland paddy ecosystems. Paddy conversion is not an isolated, independent activity. It is a part of social process and the result of the development goal that the society pursue. So the dynamics of the social process that led to the large-scale conversion of paddy has to be probed. Economic dimensions of the issues involved are also important. We hope that estimates on the economic value of major economic and ecological functions lost due to paddy conversions would help to convince the stakeholders about the need for conservation. It is hoped that the study would provide key inputs to strengthen the efforts of the civil organisations at local levels. It would also provide critical inputs to policy makers to frame appropriate policies to strike a balance between conservation and development. Following are the specific goals of the study:

Study Goals

The primary objective of the study is to bring out the enormity of resource depletion caused by paddy conversion and its impact on the livelihood conditions of the rural poor. The other goals are:

To understand the major functions, the agents and users of wetland paddy ecosystems;

To delve into the social process that led to the large-scale conversion of paddy; and

To highlight the economic value of major economic and ecological functions lost due to paddy land conversions.

Study Region

Conversions of paddy fields in Kerala have been extensive. Area under rice cultivation, which stood at about 32 per cent of the total cropped area in 1974-75, has declined to about 12 per cent in 1999-2000. Out of the four major physiographic zones in the state - highlands, middle zone, lowland plain and coastal plain, a sample micro watershed, Ullannor, a midland area in the southern part of Kerala is selected for the study. It spread over two grama panchayts of Mezhuveli and Kulanada. This watershed was one among the 12 micro watersheds identified by the Centre for Earth Science Studies, Thiruvananthapuram for the purpose of local-level watershed-based, development planning. It has an area of 745 hectares and covers 2150 households spread over the two panchayats. It is bounded by hills on three sides and Achenkovil River on the south. It is a typical midland ribbon valley system, which has undergone drastic transitions in the past two decades due to anthropogenic activities.

Large-scale conversion of paddy fields and enclosure of the adjoining common property and common access resources denied the local people their access to free grass, fish, medicinal plants and wild vegetables and fruits. Till the massive reclamation of paddy fields since the mid-eighties, nobody in the region experienced acute drinking water scarcity. But the situation at present is different. Acute drinking water scarcity is experienced in hill areas for about six months a year. Inhabitants of the hill areas travel long distance to fetch water during summer. Farm workers, especially the women bear the brunt of the paddy conversion, for it has affected their livelihood conditions.

Theoretical ideas underlying the study

Worldwide, commercialisation of agriculture and the march towards globalisation have resulted in a massive loss of biodiversity and that in turn has affected the livelihood conditions of those living at the margins. Various dimensions of biological diversity and the resultant colossal economic loss are evident in series of recent publications (Myers, 1988, 1990; Pearce and Moran, 1994; Sengupta, 2001). Globalisation seems to have improved the living standards and quality of life of the rich and the powerful. The middle class is comfortable with the mainstream

tendencies of development. The rest, the poorest, most discriminated against and the powerless are faced with poverty, insecurity, unemployment and a decline in livelihood security.

The decline in the area under rice cultivation in Kerala has been a hotly debated issue for many years. The debate centres around the right of farmers on the choice of crop in lands they own. However, despite the Land Utilisation Order of 1967[iv] insisting continuance of food crops in lands traditionally so used, unabated paddy conversion continued. Agricultural labourers organised under strong trade unions demanded continuance of rice cultivation. Their main concern is livelihood security. Farmers and their organisations argued for conversions due to problems such as low profitability, scarcity of labour and high wages for rice cultivation. They refuse to accept the fact that paddy fields do have unique ecological and environmental features. Academia also has diverse responses on the scientific and social aspects of paddy conversion (Narayanan, 2003). Apart from the arguments in the farmer and labour perspectives no body has attempted to highlight the economic value of major economic and ecological functions lost due to paddy conversions.

One can look at the issue of economic benefits from two diverse perspectives – individual's and societal. The decision to change the land use at present is purely a subjective decision of the owner, guided by his/her private returns. The negative externalities in the form of damaging the ecosystem, which the present as well as the future generations are entitled to take benefit of, does not figure in this subjective decision of the owner. From the individual's standpoint, given the socio-economic and cultural conditions of the locality, economic rationality suggests the owner to develop for non-agricultural purposes. Because the net present value and hence profit from conversion or development (R convert) is far higher than the present and expected returns from conservation and sustained rice cultivation (R conserve).

$$R(\text{convert}) > R(\text{conserve}), \text{ hence the decision to convert is rational}$$

If we look at the problem from the societal standpoint the answer may be different. From the societal point of view midland paddy fields are wetland ecosystems that

provides several economic, ecological and environmental functions. When it is converted or developed the functions are lost forever. Therefore the present and future value from conservation (TEV conserve) or sustained rice cultivation will be far in excess of total economic value of conversion or development (TEV convert).

TEV (convert) < TEV (conserve)

The expression for cost benefit rule is that conservation will be preferred if;

$$TEV\ (conserve) - TEV\ (convert) > 0$$

TEV (conserve) is the sum of expected return from the use and non-use values for a long time period T. It is the opportunity cost of forgone development values. If the forgone conservation values calculated for several years to come is less than the present benefit from conversion TEV (convert) there is no harm in land conversion. Otherwise it should not.

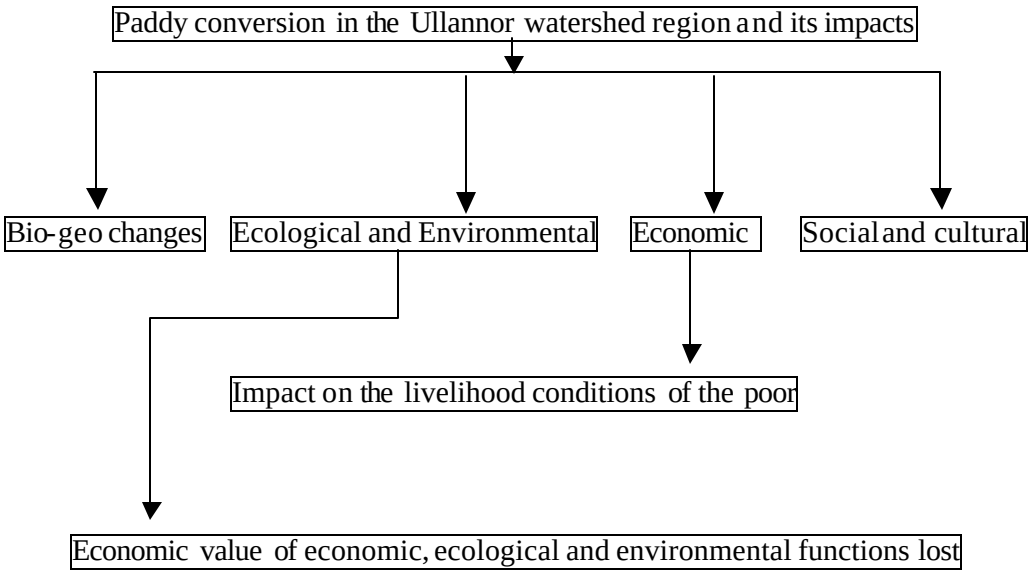
Research design

The theoretical framework demands a close examination of the diverse dimensions of paddy conversion and their inter-connections in the local context. It is important to look at the ecological, economic, social, cultural and institutional dimensions of the issue of land use. Given the complexities of the problems involved, a phased approach is needed to study the entire gamut of the problem. The present study is therefore, planned in three phases or steps. The first step was preparation of an overview of the studies on the subject to understand the broad dimensions and nature of paddy conversion, social process and economic factors that led to conversion. It was essential to understand the changes that have taken place in the study region in its proper perspective. Participatory research methods were applied to get broad dimensions about the economic and environmental changes and its impacts in the study region.

Based on the broad picture derived from participatory methods we identified issues that require detailed enquiry. It is also found that some aspects require participatory

observation for a relatively long period to get a clear picture. Seasonal data was required for measuring a few ecological and environmental aspects such as the flow of water in canals bordering paddy fields and also to estimate the extend and magnitude of fall in water levels in the wells near the converted paddy fields. A yearlong participatory observation was made in selected households to get a clear idea about the nature of work, actual days of employment, income and living conditions of whose farm workers who depend primarily on farm work for their livelihood. Comparison of bio-geo changes and changes in biotic forms in normal and converted paddy fields in the watershed also necessitated a yearlong observation and monitoring.

The third step was household surveys in the sample region. Information on several aspects like drinking water scarcity, problems of grass, fish and other common access resources, difficulties, experienced in the cultivation of rice in holdings close to converted plots, market for wetland and several other related issues and aspects were captured through household surveys. Purposive samples of appropriate sizes were selected for the purpose. The issues to be studied are summarised below:



Data and methods

Since the issues involved are complex and multi-faceted, a trans-disciplinary approach combining the research methods of life science, social science and ecological economics is employed for the study. Research methods of life sciences were used for understanding the changes in the ecology and environment of the region. Social science research methods were employed for studying the social processes underlying the factors that led to large-scale conversion and its impact on various sections, particularly the poor sections of the society. Both secondary and primary sources of data are used. Secondary data are collected from published and unpublished sources including institutions and agencies ranging from local to national levels. Participatory research methods are used to elicit information from knowledgeable persons in the locality. Primary data are drawn from household surveys.

Ecological economic methods were employed for measuring the economic value of economic and ecological functions lost in conversion of paddy. We have used a mix of methods for measuring benefits forgone - Opportunity Costs, Multi-Criteria Analysis, Cost Benefit Analysis and Shadow Prices – by the various stakeholders of the wetland ecosystem. Measurements are made from an ecological economic perspective.

Chapter Scheme

Our observations and findings of the study are presented in this report. The plan of the report is as follows: In the next chapter a brief discussion of the functions of the wetland and agents involved in the use of paddy fields are presented. Chapter III highlights the social processes and economic factors that led to large-scale decline of wetland in the region. A brief discussion of the cost of rice cultivation in holdings close to converted plots is also presented in this chapter. Ecological and environmental imbalances that occurred in the region are briefly discussed in chapter IV. The next chapter takes up the impact of environmental degradation on the livelihood conditions of the rural poor. We take up in chapter VI the economic

valuation of wetland functions lost as a result of conversion of the ecosystem. The final chapter summarises the discussion with a few policy suggestions.

Notes:

[i] Social scientists and development economists allover the world hailed the remarkable progress in the material quality of life, high social sector development and relative equity achieved in a low-income State (Dreze and Sen 1997; Ramachandran 1997; Franke and Chasin 1990, 1993, 1997). The achievements were made possible by public policies in response to social and political movements and mobilizations several of which began prior to the formation of the State (Varghese, 1970; Herring 1983; Oommen 1985; Kannan 1988; Parameswaran 1998; Tornquist 1999).

[ii] Normal annual rainfall in the State is 3107 mm against the national average of 1190mm. Rainfall varies not only temporally but also spatially. On an average, the number of rainy days in Kerala is in the range of 120 – 140 in a year. In 70 out of 125 days the quantum of precipitation is as low as 2.5mm or less (GOK, Economic review 2000). The heavy downpour concentrated over a limited number of days and that too for an average duration of less than two hours rain causes heavy floods during the monsoon periods and at the same time exposes the remaining part of the year to severe drought. Though the state has 44 rivers, several freshwater and brackish water lakes, a few man-made reservoirs, numerous small and large ponds, extensive paddy fields and a multitude of dug wells, it experiences acute drinking water scarcity during summer season. The environmental and ecological crisis that the Kerala state faces is so acute that about two-third of the total population do not have access to safe drinking water (KRPLLD Report 2000).

[iii] The order issued by C.S Srinivasan, Secretary (Agriculture), on the basis of the "Proceedings of the Council of Ministers of February 5, and the Government letter No.47165\NCA\3\97AD of December 17,1997 (restricting conversion).

[iv] The Kerala Land Utilisation Order of 1967 (issued under the Essential Commodities Act, 1955) empowers the government to direct every holder of land not to leave any land fallow, not to cultivate any other crop than grown during three years immediately before commencement of this order or attempt to convert such land for any other purpose.

Chapter 2

Geographical and Ecological Profile of Ullannoor Watershed

Wetlands form the heart of the watersheds[v]. Paddy fields in the midland physiographic zones in Kerala are wetland ecosystems[vi]. Rice was the major wetland crop. There was a 65 percent fall in the area under rice in the last thirty years. Since rice has become the least rewarding of the various economic land use options, landowners resorted to large-scale conversions. The State has been witnessing unprecedented growth in building construction in general and housing in particular, roads and other infrastructure since the early 1980s. A section of the population could spend much more than others on housing and luxury goods. Increase in investment pushed up the prices of all factors of production. Land has become a saleable commodity and its price has shoot up within a span of a short period (Gopikuttan, 2002). Wetlands were filled and converted to house plots on a massive scale. It seems that the rapid pace of growth has resulted in an ecological havoc manifested in the form of drinking water shortage, desertification, flooding, and species loss. This general tendency is very well observed in Ullannor watershed region.

Ullanoor watershed in Kulanada Block Panchayat of Pathanamthitta district consists of hills, valleys and extensive wetland paddy fields. The land lies at a height of 20-120 metres from the sea level. The side slope of the valley is moderate (5^{o}-18^{o}). Wetland accounted for about 30 per cent of the total land area. Till the mid-1980s more than 90 per cent of the wetlands was under rice cultivation. Rice is the only grain crop cultivated in the region. As has been the case with the rest of the State, the area under rice declined from 34 percent of the net-cropped area in mid-seventies to about 15 percent in 2000 (Table 2. 1). Bunds bordering paddy fields, canals and streams were full of grass, medicinal plants, wild vegetables and other useful plant species. Wild plants and animal species in and around paddy fields were considered as common access resources.

Table 2.1: Distribution of Area under Major Crops in Ullanoor Watershed in 1955, 1975 and 2000 (Area in Hectares)

Crop	Five year period ending			Percentage change since 1975
	1955	1975	2000	
Rice	180 (30.8)	210 (33.6)	90 (15.8)	(-) 57.1
Coconut	212 (36.2)	200 (32.0)	185 (32.4)	(-) 7.5
Tapioca	65 (11.1)	42 (6.7)	38 (6.6)	(-) 9.5
Rubber	0	80 (12.8)	165 (28.9)	(+) 106.3
Other tree crops	30 (5.1)	25 (4.0)	28 (4.9)	(+) 12
Banana	22 (3.8)	20 (3.2)	30 (5.3)	(+) 50
Other crops	76 (13.0)	48 (7.7)	34 (6.0)	(-) 29.0
All crops	585 (100.0)	625 (100.0)	570 (100.0)	

Figures in brackets show percentages

Source: Computed from data given in Office records of Krishi Bhavan, Panchayat Office, Rubber Producer's Society, Kera Vikasana Samithi and data obtained through field enquires.

Cultivable dry land used to be under garden crops, coconuts, banana, plantain, vegetables and tree crops. Wetland on the other hand was used mainly for rice cultivation. Thick bushes and scrubs existed on common lands on the hill slopes and along side wetlands and canals. Lush green grass, medicinal plants and several other useful plant species grew on bunds bordering rice fields and canals. People in the locality had free access to all such common property resources (CPRs) and common access resources (CARs).

The wetland soil provides ideal conditions for rice cultivation. Rice cultivation is an activity which does not alter the ecological characteristics of the valleys; the essential nature of the landform unit is maintained. But the economic compulsions of landowners inspired them to maximise returns from land by conversion to more productive uses. Table 2.2 shows the broad changes in the land use of Ullanoor.

The area under crops, though increased during the period up to mid-seventies, declined by about 9 per cent since then. The tendency to keep cultivable land fallow has been increasing, particularly among households that draw their main income from sources other than agriculture. Roads, lanes and buildings recorded more than 90 per cent growth since the mid-seventies. Roads and buildings occupy about one-sixth

(125 hectares) of the total land area in the year 2000. Several roads ran through paddy fields and a few were constructed converting the bunds bordering wetlands.

Table 2.2: Land Use in Ullanoor Watershed region

(Area in Hectares)

Land use	Five year period ending			Percentage change since 1975
	1955	1975	2000	
Area under crops	585 (79.6)	625 (85.0)	570 (77.6)	(-) 8.8
Roads and lanes	10 (1.4)	35 (4.8)	60 (8.2)	(+) 71.4
Buildings	20 (2.7)	40 (5.4)	65 (8.8)	(+) 62.5
Groves, shrubs and other CPRs and CARs	80 (10.9)	20 (2.7)	10 (1.4)	(-) 50.0
Others including cultivable fallow	40 (5.4)	15 (2.0)	30 (4.1)	(+) 100.0
Total land	735 (100.0)	735 (100.0)	735 (100.0)	

Figures in brackets show percentages

Source: Computed from data given in Office records of Krishi Bhavan, Panchayat Office, Rubber Producer's Society, Kera Vikasana Samithi and data obtained through field enquires.

Ecologically valuable wetland fauna and flora have disappeared due to paddy conversion; the biological food chain is also disrupted. Groundwater in the region has receded and acute water scarcity is being experienced during summer. Though the people have started experiencing the evil effects, they are not aware that they are due mainly to paddy conversion.

Functions of wetland paddy fields

Wetland paddy fields perform numerous important ecological processes that benefit humans. Many of these functions provide goods and services, which are important to human society and such functions, produces value. The functions and value of a wetland depends upon the location of the wetland, its adjacent environment, water source and quality, its biological diversity and a host of other characteristics (Kanchan Chopra 1997). Major functions of the Ullannoor wetland paddy fields are summarised below:

- Maintenance of fertility and productivity
    - Biogiochemical cycling
    - Biosphere stability
    - Primary production
    - Biodiversity
- Hydrological function
    - Ground water recharge
    - Ground water discharge
    - Absorption and control of floodwater
- Water purification function
- Habitat of plants, predators and micro-organisms
- Economic services to human utilisation
    - Production of fish
    - Medicinal plants
    - Grass and green leaves for livestock population
    - Recreation facilities

Though the environmental resources are under private control, several stakeholders are involved in their use. People in the locality consider them an open access property for collecting grass/fodder, catching fish, gathering medicinal plants and collecting wild vegetables for consumption and materials (like reed, cane and wild grass) for housing and handicrafts (See Table 2.3).

Table 2.3. Agents and Uses of Wetland Paddy fields

Agents	Uses of wetland paddy fields
Land owners	Cultivation of paddy, returns from cultivation
Farm workers	Employment and income
Residents of the valleys	Assured supply of safe drinking water
Poor people living on the valleys	Access to common access resources like grass/fodder, firewood, medicinal plants, vegetables, reed, cane and other resources for employment and housing
Children	Space for recreation
Government	Control of flood and water logging

Since large numbers of people belonging to different agency statuses are involved in the land use, the costs and benefits of conversion also vary widely among the agents.

Landowners may use the converted piece of land for purposes of their choice depending on the location. Though a few farm workers may get employment opportunities, poor people in the locality lose access to CPR when the converted land gets enclosed. Residents of the valley irrespective of their economic status lose access to fresh water flowing through springs and side canals of paddy fields. Children in the rural areas lose open space for recreation. Since it is the duty of a welfare government to assure safe drinking water to all, the financial burden of the government will rise during the summer months. So the society at large, except the direct beneficiaries of land conversion, namely the landowners or legal custodians of environmental resources, becomes the loser. Table 2 .4 summarises the costs and benefits to premier agents.

Table 2.4: Agents, Costs and Benefits of Wetland Paddy field Conversion

Agents	Costs	Benefits
Land owners	Cost of reclamation	High profit/rent
Farm workers	Loss of employment, Denial of access to open access resources, Drinking water scarcity, Loss of grass and medicinal plants	Nil
Residents of valleys	Fall in ground water level, Drinking water shortage, Flood, loss of access to common access resources	Improved road access
Owners of rice fields close to the converted fields	Difficulty in getting and draining water, Pest infestation, Increased use of pesticides and insecticides, High cost of cultivation, Problems due to high frequency of flood and water logging	Nil
Children	Loss of space for recreation	Roads
Government	High cost of supply of drinking water during summer, Increased expenditure on public health, flood relief etc,	Farm roads, Village roads
Non-farm workers	Drinking water scarcity during summer	Employment in the non-farm sector
Transport workers	Drinking water scarcity during summer	Employment in the transport of soil
Real estate business	Water scarcity	High profit

Large-scale conversion of paddy in Ullanoor was mainly due to penetration of market forces. Scrutiny of the data available with the local village office[vii] shows that since 1980 the intensity of land transactions was quite high for small plots, both dry and

wet, on both sides of motorable roads. More than 90 percent of the wetland plots located near motorable roads and purchased/sold since 1980 have been shifted to other uses, either for construction of buildings or for cultivation of dry land crops.

Relatively rich farmers have already converted their rice fields on both sides of 'farm roads' for non-agricultural purposes. Natural springs and side canals are filled and converted into roads and lanes. A new road induces further conversion of paddy. It is found that there was a five times growth in the length of tar roads in the watershed region since 1975.

Free flow of water is now obstructed. While waterlogging affects farming operations in a few wetland stretches known as *yelas*, water scarcity is the problem faced in some other locations. However, the problems have not been comprehended in their ecological or environmental dimensions and as a grave crisis, due to the fact that the rural poor, a minority at present, are their real victims.

Before looking into the details of the ecological and environmental dimensions and their impacts let us now turn to the major social and economic processes that led to massive paddy reclamation.

Notes:

[v] Watershed, by definition, is an area above a specific point, through which all the incoming water in that area drains out. All watersheds have the basic function of converting precipitation into stream flow. The watershed is part of a hierarchy of hydrological/ecological units, which constitute a water resource region. In ecological terms it is an ecosystem consisting of both terrestrial and aquatic habitats. At present watershed has been recognised as a unit of planning and development. Each watershed forms a unique ecosystem. An *ecosystem* is a functional unit of environment formed by mutually dependent and regularly interacting *abiotic* (non-living) and *biotic* (living) components or factors. Biotic components are the living organisms such as plants, animals, man and microbe which are collectively called *biotic community* or *community*. All the organisms in the community are related functionally.

[vi] The organisms of an ecosystem or community belong to two main groups: *food producers* or *autotrophs* (self nourishing) and *consumers* or *heterotrophs*. Green plants are the producers, which can fix light energy and synthesize food from simple inorganic substances. Animals are consumers feeding either directly or indirectly on the autotrophs. Animals and plants are linked through food relationship or food chain. A *food chain* is a series of different organisms through which energy is passed. The transfer of energy from the autotrophs to the herbivores (plant eaters) and through several levels of carnivores (flesh eaters) makes a trophic pattern. Energy of the sun received by plant flows through each level, such as producers, herbivores, carnivores, etc. These are called *trophic levels*. The

heterotrophs may eat the autotrophs as well as other heterotrophs, or several carnivores at different trophic levels may eat the herbivore. These inter-linked food chains are known as *food web*.

The green plants upon the earth serve as a bridge in the transfer of energy from the sun to the other living forms. Hence they are called the *primary producers*. Rest of the living world, except the chemosynthetic bacteria, depend upon the production of green plants and hence designated as *consumers*. The consumers of the first order are the herbivores (*primary consumers*), which draw energy directly from the producers. Then comes the *secondary consumers* which live upon the herbivores and in turn, are consumed by others called *tertiary consumers*. The dead organisms provide energy to scavengers like vulture and decomposers like bacteria. The decomposed matter ultimately finds its way into the soil and water upon earth. The material cycle is therefore complete. The abiotic portion of an ecosystem consists of three components: inorganic substances, organic substances, and physical factors like light, temperature, rainfall, humidity, etc. The inorganic substances are involved in material cycles of the ecosystem.

[vii].To understand the nature and extent of reclamation the watershed region was divided into three zones based on topography and relief features: (i). Central or core zone of wetlands and drainage canals lying in the valley floor, (ii). Peripheral zone which is the inner dry land zone bordering the wetlands; and (iii) Outer zone consisting of hilltops and hill slopes. At the heart lie the wetland paddy and the canals. The paddy fields are again divided into three categories based on road access. They are (i) those without road access, (ii) Those on the side of developed roads and (iii) those on the side of developing roads. It is found that the intensity of reclamation and development is high in fields on the side of developed roads followed by those on the side of developing roads. More than 90 percent of the holdings in survey blocks V and VI, which do have access to developed roads, have been developed and are under either dry land crops or used for non-agricultural purposes.

We scanned the village office records particularly the *pokkuvaravu* register that records all the transactions in the village to understand the relationship between market for wetland and the intensity of reclamation. We could not find any significant relationship between change of ownership right and land development. Number of transactions or change of ownership in survey blocks V and VII by market sale during the period from 1951 to 2000 was less by 49 per cent than the change of ownership by inheritance. In survey block VI on the other hand, change of ownership by purchase/sale was 43 per cent higher than that of by inheritance. Notwithstanding differences in the nature of change of ownership, significant differences were not seen in the intensity of reclamation and development of paddy fields. Majority of those who own paddy fields close to motorable roads are looking forward to develop at the earliest. The only constraining factor, they said, was financial resources. At present they find it difficult to fill or reclaim water logged inner core of the wetland. Otherwise the owners would have done it.

Chapter 3

Social Processes and Economic Factors of Extensive Paddy Conversion

High input cost, low product price, non-availability of labourers in peak seasons, inadequate and inappropriate techniques to handle high yielding variety (HYV) seeds, high susceptibility of HYVs to pests and diseases, inadequate institutional support, non-availability of inputs in time and lack of credit are reported to be the major reasons for the decline of paddy cultivation in the State [viii]. From the landowner's cost-benefit perspective, economic rewards from rice cultivation may not be high enough to induce them to continue with rice farming. Farmers seeking 'economic benefits' prefer crops other than rice. Besides economic reasons several social and political forces that unleashed the state since mid-seventies too had their impacts in the land use pattern of this watershed.

Demographic factors and settlement pattern

Population growth, nuclear families, unique settlement pattern and preference for independent houses exerted pressure on land in the watershed, as is the case with the rest of the State. The annual average growth of population in the region has been a little more than 2 per cent during the past three decades. The growth of residential houses during the period exceeded the average annual growth of population.

High density of population and the urge for independent garden houses[ix] led to great demand for house plots. The richer sections found it convenient and economical to develop paddy fields near motorable roads and development them as house plots. In the process, natural springs and canals were filled up and roads and lanes built on them. Extension of existing roads and opening of new roads, construction of buildings for commercial uses and provision and improvement of infrastructural facilities necessitated conversion of more areas of paddy land. At present buildings alone occupy about 8.5 per cent of the total land area and the share of former wetlands occupied by buildings is 2.3 percent. The trend continues unabated.

Development of Infrastructure

There has been a five times increase in the length of tar roads in the watershed region since 1975[x]. Road length within the watershed, which was only 3 kms in 1975, increased to 15.5 kms in 2000. Area under roads, which was only 1.3 per cent of the total land area in mid-fifties, has increased to 8 per cent in 2000. Roads are virtually eating up the paddy fields. About 5 per cent of wetland has already been converted to roads.

Phenomenal increase is observed in education, health and infrastructural facilities. Healthcare facilities in the region in 1975 were limited to one primary health centre, one Homeo and one Ayurveda pharmacy. At present there are 10 hospitals including 2 private allopathic hospitals with all modern facilities. Similarly 4 coconut-oil-extracting units, two rice mills and a hollow bricks factory have come up in the region since 1975. Some of these establishments are set up in reclaimed paddy fields.

Development of Land Market

Like in other parts in rural Kerala, land in Ullannoor has become a marketable commodity and a real estate. It is well reflected in the transfer of ownership (*pokkuvaravu*) since 1950. Frequency of transaction was high during the period from 1970 to 1985. About 90 per cent of wetland plots transacted since 1980 have been converted either for non-agricultural purposes or for non-paddy crops.

Field enquiries[xi] revealed 75 percent of the buyers draw their main income from sources other than agriculture and more than 60 percent sellers were marginal farmers. All the sample buyers except the one who happened to be a marginal farmer with poor income, either converted or have plans to convert wetland plots for non-agricultural purposes. In terms of area 95 per cent of the purchase was for the purpose of conversion. Sellers on the other hand reported economic compulsion as the major reason for disposing off paddy fields.

Economic reasons

Over the past three decades, rice growers have been experiencing a difficult situation in which cost of cultivation has been increasing without any commensurate increase in the price of rice[xii]. Several farmers reported that at the present rates paddy cultivation is not at all economically viable. Though there are several public and institutional agencies and state departments committed to the promotion of rice cultivation in the locality, none of them seems to have succeeded in persuading landowners to retain rice cultivation.

Political factors

Laws and regulations restricting land use changes are in vogue in the state. However, agencies and institutions at the local levels like *Krishibhavan* and Village office are not exercising their powers to prevent indiscriminate filling and levelling of paddy fields, canals and springs. Corrupt officials in collusion with self-seeking local leaders of political parties of all hues often collude with the rich and the influential landowners in their effort to convert their lands for other uses and to encroach upon and usurp common property resources.

Agricultural workers in the region are highly organised on political lines. The relationship between farmers and labours, particularly dalit labourers, in the region were of patron-client type. The farmers appropriated the benefits of social capital[xiii] derived from the co-operation of workers. Although the system was exploitative, livelihood security of a few dependent workers was ensured. Liberated from the clutches of the patron-client relationship and attached labour, the rural workers are at present free to take up the jobs they like. None of them, irrespective of the levels of their skill and efficiency, would accept wages below the going rate. Job opportunities in the farm sector dwindled. It is a paradox, however, that though the workers are highly organised on political lines, they have not put up any strong resistance against the on-going process of paddy land conversion.

Cultural factors

A large number of 'sacred' groves and ponds existed in different parts of the watershed till recently. People especially the poor, worshiped their gods at the sacred groves. Since the grove trees were considered the abode of hill gods, nobody ventures to cutting trees and destroying the groves and ponds; on the contrary, every effort has been made to conserve and preserve these sacred lands. However, extensive cultivation of plantation crops and the contemptuous attitude of the *nouveaux* riches towards all forms of paganism particularly since the mid-1970s have resulted in the destruction of groves and ponds. That in turn resulted in the drying up of several springs, which were sources of perennial water supply in the canals and the paddy fields. In the absence of perennial water supply paddy, the practice of three crops a year – during autumn (Virippu), winter (Mundakan) and summer (Punja) – followed in some polders in the watershed was abandoned.

Lack of environmental awareness

The environment is literally the entity on which all subsist and on which our entire agricultural and industrial developments depend. No organism is ever totally independent of the environment. Conversely, there is no environment which is unaffected by the organisms that it supports. In fact, many farmers are not aware of the environmental and ecological functions of the wetlands. Most think only in terms of their short-term, individual, economic costs and benefits, not about the societal loss.

Attitudinal changes

At present, all job-seekers aspire to get government jobs. Like in other parts of the state almost all of them are averse to hard physical work in mud and slurry[xiv]. Land owing younger generations became "absentee landlords". They prefer to keep land fallow to making investment in rice cultivation[xv]. Attitudes of the agricultural labourers also have undergone drastic change. Several academic studies have noted that young workers are not coming to the sector [xvi]. Labour unions consider the owners of land inheritors of an exploitative system.

Employment in the farm sector is seasonal. Demand for labour peaks up during busy seasons to levels far beyond supply. Farmers vie with one another for workers. They offer higher wages and other benefits. The highest bidders among the farmers get the workers. Once paid, the highest wage becomes the norm, the information will soon be passed on to other workers in the locality by word of mouth and without the direct interference of unions the new high wage will come to be the baseline wages in the next season. Though this practice began in the 1980s, the pace of wage increase picked up only since the turn of the nineties. The wage share in the total cost, in rice cultivation has increased several folds since the 1950s. But in some activities such as harvesting which follow output-sharing practice; worker incomes have not increased much. Therefore, workers are most unwilling to undertake harvesting job.

Informal tenancy

It is observed that a practice of informal tenancy is gaining momentum in the watershed region. Landless agricultural labourers interested in cultivation of crops such as banana, beetle leaves and vegetables through an informa l agreement take on wetland on rent. Usually the land is lent for a period of two years. Though the land is not filled, crops are cultivated on clay bunds prepared for easy drainage. After two years the owner himself continue cultivation of crops like tapioca for one or two years. Again it is given for rent. Eventually the leased lands are permanently converted to non-rice crops.

Conversion leads to further conversion

Midland ribbon valley wetlands (polders or *yelas*) are a continuous wetland ecosystem. Generally they began from uplands and end up with river basins or sides of other water bodies. Conversion of an upland plot affects water supply in plots in the down land. Similarly filling and levelling of down land plots obstructs drainage of uplands. Filling and levelling of plots in a polder would affect the water holding-capacity of neighbouring plots. That in turn would affect water charging and discharging functions of wetlands. Moreover cultivation in holdings adjacent to converted plots would become difficult and expensive.

With a view to understanding the externalities of paddy conversion we compared the average cost of cultivation in a normal plot (NP) with that in plots lying adjacent to converted plots (ACP). We took a sample of 10 plots in each category. Cost differences in each item of activity were compared. We found that differences do not exist in some major items of inputs (See Appendix Table). Cost differences involved in rice cultivation per hectare of NP and ACP for winter crop in 2000 are summarised in Table 3.1.

Table 3.1: Cost of Rice Cultivation in NP and ACP of Ullanoor Watershed in 2000

Name of items	Cost per hectare for winter crop (in Rs.)		
	NP	ACP	Difference
Ploughing/tilling	5500	7000	1500
Chemical fertilisers	3750	4500	750
Artificial irrigation	Nil	2500	2500
Weeding	2800	3640	840
Total	12050	17640	5590

Source: Field survey

The average cost of cultivation in ACP was 46 per cent higher than in NP. All the 10 sample ACP farmers reported their difficulty in continuing rice cultivation in such holdings. Therefore it is sure that they would also shift either to other dry land crops or convert land for non-agricultural purposes in the immediate future. However, all these farmers reported that they are willing to continue paddy cultivation if all other farmers in the local wetlands system co-operate. It is question of assurance game. Who will assure that no body would defect? Is it possible to ensure that all would co-operate in the pursuit of sustained rice cultivation? Given that 70 percent of the NP and ACP owner cultivators draw their main income from non-agricultural sources, the institutional mechanism in vogue in the state may not be sufficient to induce them to conserve wetland paddy.

Appendix 1

Table: 3.A1. Manpower required and Cost of Items involved in Rice Cultivation in NP and ACP Holdings in the Sample Watershed in 2000

Items	*NP*		*ACP*	
	Quantity/Man power required	Cost	Quantity/Man power required	Cost
Tilling	40 hours	Rs. 4500	50 hours	Rs. 6000
Bunding	42 male labourers	Rs. 6300	42 male labourers	Rs.6300
Planting	85 female labourers	Rs. 5950	85 female labourers	Rs. 5950
Weeding	40 female labourers	Rs. 2800	52 female labourers	Rs. 3640
Manuring	6 males	Rs. 900	6 males	Rs. 900
Spraying of pesticides	6 males	Rs. 900	6 males	Rs. 900
Irrigation work	-	-	20 males	Rs. 2500
Seed	125 kg	Rs. 1250	125 kg	Rs. 1250
Fertilizer	500 kg	Rs. 3750	600 kg	Rs. 4500
Pesticide	1 litre	Rs. 500	1 litre	Rs. 500
Transportation cost	16 head load workers Tempo charge	Rs. 3200 Rs. 1200	16 head load workers Tempo charge	Rs. 3200 Rs. 1200
Total cost		Rs. **31250**		Rs. **36840**
Additional cost of production in the paddy field close to converted area				Rs. **5590**

Source: Field survey

Notes:

[1] Treatises on agriculture, environment and ecology of Kerala are replete with causes and consequences of land degradation and the consequent damages that inflicted up on the natural capital of the region. Large number of studies describing the factors and forces that led to large-scale conversion of wetland paddy fields are available. The table below summarises the major findings of these studies.

Table 3 N. Summary Results of the Studies on Paddy Cultivation in Kerala

Reasons for paddy conversion	**Description**
Demographic	High population pressure, Family formation and growth of nuclear families
Institutional	Land reforms, demand for independent house, housing boom, emergence and growth of land market

Economic	High cost of cultivation and relatively low price of the paddy (High and rising input cost and relatively low returns)
Social and cultural	Near about total literacy, unwillingness of educated people to work in wetlands, shortage of workers for harvesting
Government policies	Rice, the staple food, is available in plenty (imported from other states) at affordable prices through state run FDS, Maveli stores and State Civil Supplies Corporation.

[viii] Wide disparity in the quality of housing was observed. Pucca houses accounts for about 49 percent of the stock. The proportions of semi-pucca and kutcha houses are 27.4 and 23.7 per cent respectively. It is also noted that the housing and living condition of poor sections like scheduled castes did not improve compared to the living standards of the richer sections. For insistence, only 5 percent of the 210 scheduled caste households live in pucca houses and more than 50 per cent among them live in poor quality kutcha houses.

[ix] The late 1970s was a turning point in the development history of the state (Mridul 1994). Remittances from gulf emigrants, price hike of plantation crops, housing boom, emergence and growth of land market and several institutional factors have resulted in an overall improvement of the level of living of all sections of society. Large number of new buildings, new roads, health centres and educational institutions came since then. Several farm roads came up across and along the bunds (embankments) bordering paddy fields. Many of them were across the paddy lands making obstructions to free flow of water. Roads were constructed along the valleys and hills also. New roads built by cutting the hills have drained out water from the slopes and that has aggravated drinking water problem during summer. However the roads pushed up the market value of the land and facilitated massive filling and levelling (development) of paddy lands.

[x] To understand the issue in detail we selected a random sample of 8 plots from among the 31 wetland paddy plots sold/purchased in the three survey divisions since 1995. These 8 transactions together involved a total area of less than 2 hectares. Semi-structured interviews with the heads of buyer and seller households to understand their socio-economic profile and the purpose of transaction were conducted.

[xi] Majority of farmers feels that sustained rice cultivation in the region is not at all economically viable. In monetary terms, labour cost of production (wage) has increased 28 fold, while the value of the produce has increased only 7 fold during the period from 1970-71 to 1997-98. In real terms, one could hire one-man day of labour with money equivalent of 5.59 kg of paddy in 1970-71. But it has increased to the money equivalent of about 25 kg in 1997-98. Besides the rise in real and wage, cost of agricultural inputs like fertilisers and pesticides have increased much.

[xi] Social capital refers to cost efficiency, which could be achieved through collective efforts. Coleman (1990) described it as 'the structure of relations between actors and among actors' that encourage productive activities.

[xiii] Aspirations for government jobs are high since these are 'regular, remunerative and socially superior. The social value system also accords a higher status to government jobs (Prakash, 1994). Mukherjee and Isaac (1994) confirm that the educated unemployed in Kerala prefer to wait for a job in government service.

[xiv] A recent study commented that '70 percent of the farmers below the age of 40 was ready to give away their rice lands for a reasonable price. Only 2 per cent had the courage to say they will cultivate on their own' *Report of the People's Expert Committee* (1998), Centre for Environment and Development, Thiruvananthapuram, Quoted in Narayanan 2003.

[xv] Though the absolute number of job seekers has increased, the farm sector experiences acute shortage of workers all over the state. Several studies, both at micro and macro level, points to the acute labour shortage in the paddy sector. (Jose, 1991; Shaji, 1991; Vijayam, 1994; Mridul, 1994, Joseph, 1994). With the emergence and growth of new jobs in the non-farm sector, farmer-labourer relations increasingly became formal, impersonal and contractual (Kannan, 1995; Olle Toinquist and Tharakan, 1996). The refusal to adhere to patron-client relations, the sense of dignity manifested in personal hygiene, and the changed life styles seem to have prevented the young workers from taking up work in slurry for rice cultivation. Besides rise in literacy, which raises income/job/status aspirations of the young job seekers, sharp increases in wage rates of non-agricultural work, were also considered to be the major reason for the steep fall in the availability of farm labour.

Chapter 4

Ecological Impacts of Paddy Conversion

The wetlands of Ullanoor watershed consist of a heterogeneous assemblage of diverse aquatic habitats such as ponds, pools, canals, paddy fields (polders) and swamps (marshy places). They support immense variety of aquatic plants and animals. During summer all these sub systems become isolated and become standing water systems. But by the onset of monsoon they establish contacts by the overflowing water and become a common running water system. In the microhabitats of the watershed we identified 6 species of cyanobacteria (blue-green algae), 28 species of algae, 19 species of rooted and floating hydrophytes,) and 46 species of zooplanktons, neustons and invertebrate nektons.

Decline in species populations in the converted area

Significant differences were found in the number and density of organisms[xvii] present in the water bodies located in the converted and non-converted regions. However, significant differences in the number and density of organisms in pools and pond near the NP were not found[xviii] (See Appendix Tables). During the monsoon season there is migration and shuffling of organisms between different microhabitats within the wetland eco-system. Paddy conversion obstructs the free flow of water and hence, it is also found that distribution and density of smaller organisms and tadpole of frog were significantly low in the water bodies near the converted area. Larger organisms like fishes were also absent. A significant difference in the distribution of phytoplankton was observed as between pond and pools near converted area (See Appendix Tables).

Ponds near the converted area may not have plant envelope as they have been cleared in the process of conversion. Vegetation helps to add organic contents to the water, which is essential for the growth of bacteria. Nutrients required for the growth of phytoplanktons are released by bacterial decomposition of organic matter. Similarly, the stumps of paddy remaining in the field after harvest decompose during monsoon

favour the growth of cyanobacteria and other phytoplanktons. That in turn helps the multiplication of zooplanktons.

Water bodies in the converted area contain more silt and sediments than those near NP. Generally, water in ponds and pools near converted areas may be turbid. Turbidity prevents penetration of sunlight and affects photosynthetic process of phytoplanktons and algae. That in turn affects the links between trophic levels or food chains and food webs. When the populations of phytoplanktons decline populations of zooplanktons also would decline. Since the number of smaller organisms decline larger organisms like fishes, which live feeding upon them, cannot survive. Similarly, decline of phytoplanktons limits the availability of dissolved oxygen. That also affects life of fishes. A significant decline in the planktonic populations and macrofauna in the water bodies located near the converted areas was observed.

Loss of fish and frog

Usually, at the time of monsoon freshwater algae and planktons multiply and spread in the wetlands. Paddy conversion uninterrupted the free flow of water in the eco-system and hence the growth of 'seeding' of organisms. Planktonic organisms form the food of fishes and frog tadpoles. Such food chains and food webs have been shattered due to massive conversion of wetlands.

Growth of mosquito population

Aplocheilus melastigma, Panchax lineatus, Panchax panchax,Colisa fasciata, Anabas testudineus, and Macropodes cupanaus, are the common larvivorous fishes seen in freshwater bodies. They feed especially on the larvae of mosquitoes. Mosquitoes can breed in small ditches containing some stagnant water. But fishes on the other hand require comparatively larger pure water bodies to live and breed. Conversion of wetlands dismantled the feeding and breeding place for fishes. In the absence of predator fish, mosquito population has increased at an alarming rate in the watershed region. Decline of secondary consumers among zooplanktons has also contributed to the rise in mosquito population.

Large numbers of birds[xix] living in association with wetland paddy fields were found in the study region. Majority of them are predators and many of them help to control insect pests. The decrease in natural enemies of pests increases the incidence of pest attack necessitating increased use of pesticides.

Fall in water table

There were 17 ponds, 13 springs, 1 reservoir channel and 9 drainage canals in the region. They were perennial sources of water prior to large-scale conversion; water percolated into the paddy fields and that facilitated cultivation three crops a year. Groundwater recharging function occurs when water moves from the wetland down into the underground aquifer. By the time it reaches the aquifer, the water is usually cleaner than when it began to filter down from the wetland. Once in the aquifer, it may be drawn for human consumption, or it may flow laterally underground until it rises to the surface in another wetland as groundwater discharge. Recharge is also beneficial for flood storage-because the run off is temporarily stored underground, rather than moving swiftly down stream and overflowing. This natural balancing act is now disrupted due to wetland conversion.

Laterite soil from hilltops is usually used to fill the paddy fields. Since the water retention capacity of that soil is poor, the converted fields become harder, which leads to the growth of more amphibious grass and other weeds through community succession. Growth of mat like vegetation seen in dry or fallowing fields enhances loss of water by transpiration of water coming up by capillary action and that in turn make the field dry (Elton, 1966). Ultimately, decrease in water in the wetland leads to succession of terrestrial plant communities.

Appendix Tables

Table 4. 1: Seasonal value and Population Density of Phytoplanktons per Litre of Water in Pools near Non- converted (NC) and Converted (C) areas

Name of species	Season (Mean value)						Population density	
	Pre-monsoon		Monsoon		Post-monsoon			
	NC	C	NC	C	NC	C	NC	C
Pinnularia	10	5	18	11	35	14	21	10
Cosmarium	14	5	27	15	43	19	28	13
Spirogyra	18	6	38	12	60	18	39	12
Ulothrix	13	5	28	12	55	20	32	12
Oedogonium	15	7	32	14	57	18	35	13
Cladophora	14	6	35	11	50	25	33	14
Chlamydomonas	25	6	40	16	45	23	37	15
Pandorina	20	4	35	12	52	17	36	11
Volvox	28	6	40	13	70	20	46	13
Euglena	30	5	50	14	60	23	47	14

Source: Field study

Table 4. 2: Seasonal value and Population Density of Phytoplanktons per Litre of Water in Ponds near Non- converted (NC) and Converted (C) areas

Name of species	Season (Mean value)						Population density	
	Pre-monsoon		Monsoon		Post-monsoon			
	NC	C	NC	C	NC	C	NC	C
Pinnularia	15	6	25	13	40	18	27	12
Cosmarium	16	5	30	12	44	19	30	12
Spirogyra	19	7	28	13	70	22	39	14
Ulothrix	15	5	32	17	60	24	36	15
Oedogonium	16	4	35	15	65	26	39	15
Cladophora	14	7	42	16	47	28	34	17
Chlamydomonas	30	12	45	18	60	25	45	18
Pandorina	25	8	40	12	55	20	40	13
Volvox	27	10	35	24	90	28	51	21
Euglena	28	9	53	20	65	25	49	18

Source: Field study

Table 4. 3: Seasonal value, Population Density and Relative Abundance of Zooplanktons per Litre of Water in Ponds near Non converted and Converted areas

Name of species	Season (Mean value)						Population density		Relative abundance (%)	
	Pre-monsoon		Monsoon		Post-monsoon					
	NC	C	NC	C	NC	C	NC	C	NC	C
Daphnia	5	4	14	7	25	12	15	8	11.62	10.81
Cyclops	5	3	12	8	22	16	13	9	10.07	12.16
Harpacticoid	8	4	19	7	35	18	21	10	16.27	13.51
Rotifer	8	5	21	20	28	23	19	16	14.72	21.62
Ostracod	6	3	18	8	25	13	16	8	12.40	10.81
Mayfly larva	5	3	20	10	26	14	17	9	13.17	12.16
Paramecium	12	6	30	17	42	20	28	14	21.70	18.91

Source: Field study

Table 4. 4: Seasonal value, Population Density and Relative Abundance of Zooplanktons per Litre of Water in Pools near Non converted and Converted areas

Name of species	Season (Mean value)						Population density		Relative abundance (%)	
	Pre-monsoon		Monsoon		Post-monsoon					
	NC	C	NC	C	NC	C	NC	C	NC	C
Daphnia	6	3	12	5	21	10	13	6	11.60	12.24
Cyclops	4	2	10	5	16	5	10	4	8.92	8.16
Harpacticoid	8	3	18	5	32	7	19	5	16.96	10.20
Rotifer	7	4	20	12	25	20	17	12	15.17	24.48
Ostracod	5	3	16	6	20	9	14	6	12.5	12.24
Mayfly larva	4	2	15	4	22	9	14	5	18.18	10.20
Paramecium	15	3	25	4	35	16	25	11	22.32	22.44

Source: Field study

Table 4. 5: Seasonal Mean, Annual Mean and Relative Abundance of Planktons and Nektons in Ponds near Non-converted (NC) and Converted (C) areas

Name of species	Season (Mean value)						Annual Mean		Relative abundance (%)	
	Pre-monsoon		Monsoon		Post-monsoon					
	NC	C	NC	C	NC	C	NC	C	NC	C
Gerris	5	4	12	7	19	19	12	10	12.76	14.08
Notonecta	4	1	7	4	10	10	7	5	7.44	7.04
Belostoma	1	0	2	0	3	0	2	0	2.12	0
Laccorephes	5	0	14	3	20	8	13	4	13.82	5.63
Ranatra	3	1	5	5	10	8	6	5	6.38	7.04
Corixa	3	2	12	6	18	13	11	7	11.70	9.85
Dysticus	4	2	10	6	22	11	12	6	12.76	8.45
Odonata nymph	2	1	7	4	18	9	8	5	8.51	7.04
Mosquito wriggler	5	25	4	11	15	45	8	27	8.51	38.02
Fish fry	0	0	25	05	5	0	10	0	10.63	0
Tadpole	0	0	12	5	3	1	5	2	5.31	2.81

Source: Field study based on per Hour of Catch

Table 4. 6: Results of ANOVA carried out on Population Distribution of groups of Organisms in Habitats in Non-converted and Converted areas

Type of population	Type of habitats compared	Calculated F value	Table value F	Significance at 5 % level
Phytoplanktons	Ponds in NC and C areas	95.75	4.10	Significant
	Pond in NC and pools in C areas	54.69	4.10	Significant
	Pond in NC and pools in NC area	1.092	4.10	Not significant
	Pond in C and pools in C area	7.12	4.10	Significant
Zooplanktons	Pond in NC and pond in C area	301	4.74	Significant
	Pools in NC and pools in C areas	16.64	4.74	Significant
	Pond in C and pools in C areas	4.4	4.74	Not significant
	Pond in NC and pools in NC area	0.082	4.74	Not significant
Nektons	Pond in NC pond in C area	7.27	3.49	Significant

Source: Field study

NC = Non-converted paddy field C = Converted paddy field

Table 4.7: Historical Time Line of the Presence of Predators in the Watershed

Group	Name	Presence of Predators in the Decade ending				
		1960	1970	1980	1990	2000
Insecta	Dragon flies (Odonata)	A	A	LA	LA	R
	Preying mantis (*Mantis religiosa)*	LA	LA	R	R	VR
	Lace wings, Earwig *(Forficula)*	A	LA	LA	R	R
	Antlion, Ladybird beetle (*Coccinella*) Stinging wasps	A	A	LA	LA	R
	Giant waterbug *(Belostoma indica*)	A	A	LA	R	VR
Arachnida	Spiders	A	A	A	LA	LA
Pisces	*Aplocheilus, Macropoduscupanatus Anabas testudineus*	A	A	LA	R	R
Amphibia	Frog (*Rana hexadactyla, Rana tigrina*)	A	A	LA	LA	R
	Toad (*Bufo melanostictus*)	A	A	LA	R	R
	Chunam frog (*Rhacophorus maculates) Ixalus*	A	A	LA	R	VR
Reptilia	Garden lizard (*Calotes versicolor) Mabuya carinata*	A	A	LA	R	R
	Flying dragon (*Draco)* Indian monitor (*Varanus), Chamaeleon zealanicus*	LA	LA	R	R	Lt
	Rat snake (*Ptyas)*	A	LA	LA	R	R
Aves	Insectivorous birds	A	A	LA	R	R
	Barn owl	A	A	LA	R	VR

Source: Field study
A = Abundant, LA = Less abundant, R = Rare, VR = Very rare, Lt = Lost

Table 4.8: Historical Time-Line of the Relative Availability of Green Manure Plants on the Bunds Bordering Polders and Canals

Name of plants	Relative density in the decade ending				
	1960	1970	1980	1990	2000
Pullanji *(Calycopteris floribunda*)	A	A	LA	LA	R
Kasavu (*Memyxylon eduli*)	A	A	LA	R	Lt
Panal(*Glycosmis pentaphylla*	A	A	LA	R	R
Vatta (*Macaranga indica*)	A	A	LA	R	R
Kureel	A	A	LA	R	Lt

Source: Field study
A = Abundant, LA = Less abundant, R = Rare, VR = Very rare, Lt = Lost

List of cyanobacteria and algae in the paddy field

Cyanobacteria (Blue-green algae)

(Nitrogen fixing forms)

1. Nostoc
2. Oscillatoria
3. Scytonema
4. Rivularia
5. Anabaena
6. Aulosira

Algae

7. Pinnularia (Diatom, Bacillariophyta)
8. Navicula
9. Fragilaria
10. Nitzschia
11. Cosmarium (Unicellular Desmid, Chlorophyceae)
12. Closterium (Unicellular Desmid)
13. Spirogyra (Filamentous Chlorophyceae)
14. Ulothrix
15. Zygnema
16. Oedogonium
17. Cladophora
18. Scenedesmus
19. Coelastrum
20. Chlamydomonas(Unicellular)
21. Volvox (Colonial free-floating)
22. Keratella
23. Cyclotella
24. Microcystis
25. Gloeotricha
26. Pandorina
27. Pleodorina
28. Eudorina
29. Euglena (dinoflagellate)
30. Chara (rooted algae)
31. Chlorella
32. Nitella
33. Richterilla
34. Asterionella

List of rooted and floating plants seen in the water bodies of paddy field

Rooted hydrophytes

1. Typha(Cat tails)
2. Sagitaria
3. Nymphaea
4. Nilumbium (Water lilies)
5. Lymnophylla hydrophyla
6. Potamogeton
7. Ceratophylum
8. Hydrilla
9. Vallisneria

10. Elodia
11. Trapa bispinosa (Water chestnut)
12. Isoetes

Free floating forms

13. Azolla
14. Lemna(duck weed)
15. Wolffia
16. Pistia (Water lettuce)
17. Salvinia
18. Eichhornia crassipes (Water hyacinth)
19. Utricularia

List of Zooplanktons, Nektons and Neustons collected from different habitats in the paddy field

1. Amoeba proteus
2. Paramecium
3. Hydra
4. Rotifer
5. sponge sp
6. planaria
7. Amphipod
8. Daphnia(Water flea)
9. Cyclops(Copepoda)
10. Harpacticoid sp.(Copepoda)
11. Ostracod sp
12. Whirlgig beetles (Gyrinidae)
13. Large water striders(Gerridae)
14. Smaller broad-shouldered water striders(Veliidae)
15. Dragon fly nymphs(Odonata)
16. Isopod sp
17. Mayfly nymphs (Ephemeroptera)
18. Damselfly nymphs
19. Mosquito larva (Diptera)
20. Chironomid larva
21. Hemiptera adult
22. Caddis fly larvae
23. Stimulium larvae
24. Bleparocera larvae
25. Stone fly nymphs
26. Notonecta(backswimmer)
27. Belostoma (giant water bug)
28. Laccotrephes(=Nepa)(water scorpion)
29. Ranatra (waterscorpion)
30. Dysticus larva
31. Dysticus adult
32. Corixa (water boatman)
33. Planorbis(pondsnail)
34. Limnaea (pond snail)
35. Pila globosa(apple snail)
36. Fishes

37. Rana hexa dactyla(frog)
38. Rana tigrina(frog)
39. Toad tadpole
40. Cybister larva
41. Natrix(water snake)
42. Emyda (Tortoise)
43. Leech (Hirudinaria)
44. Paratelphusa (freshwater crab)
45. Macrobrachium (prawn)
46. White breasted water hen (Amaurornis Phoenicurus)

Birds living in and around paddy field

1. Streaked fantail warbler (Cisticola *juncidis)*
2. Spotted munia (*Uroloncha striata*)
3. Weaver bird (*Ploccus philippinus)*
4. Indian myna (Acridotheres tristis)
5. Malay pipit(*Anthus Richard malayensisi)*
6. Large pied wagtail (*Motocilla madraspatensis)*
7. Gray backed shrika (*Lanius schach)*
8. Blossom headed parakeet (*Psittacula cyanocephala)*
9. Blue winged parakeet *(P. columboides)*
10. Rose ringed parakeet (*(P.krameri)*
11. Pied kingfisher (*Cyrile rudis)*
12. Spotted dove (*Streptopelia chinensis)*
13. Nilagiri wren-warbler (*Prinia inornata)*
14. Black bellied finch lark (*Eremopterix grisea)*
15. Little egret (*Egretta garzetta)*
16. Smaller egret (*Egretta intermedia)*
17. Cattle egret (*Bubucus ibis)*
18. Large egret (*Egretta alba)*
19. Grey heron (*Ardea cineria)*
20. White breasted water hen (*Amaurornis phoenicurus)*
21. Black drongo or king crow (*Dicurus adsimillis)*
22. Tailor bird (*Orthotomus sutorius)*
23. Black headed oriole (*(Oriolus xanthornus)*
24. Indian oriole (*Oriolus oriolus)*
25. Crow-pheasant (*Centropus sinensis*)
26. Small blue king fisher (*Alcedo atthis)*
27. Pied kingfisher *(Cyeyle rudis)*
28. Brown fish owl (*Bubo zeylonensis)*
29. Barn owl (*Tyto alba)*
30. Indian myna (*Acridotheres tristis*)
31. Paradise flycatcher (T*erpsiphone paradisi)*
32. Fantail flycatcher (*Ripidura oriola)*
33. Small green barbet (*Megalomania viridis)*
34. Redvented bulbul (*Pycnonotus cafer)*
35. Red whiskered bulbul (*Pycnonotus jocosus)*
36. Purple sunbird (*Nectarinia asiatica)*
37. Magpie-Robin *(Copsychus saularis)*
38. Crested lark (*Galerida cristata*)

39. White wagtail (*Motacilla alba*)
40. Baya weaver bird (*Ploceus philippinus)*
41. Tailor bird (*Orthotomus sutorius)*
42. Common Pariah kite (*Mivus migrans)*
43. The Brahminy kite (*Haliasfur Indus*)
44. Darter (Snake bird) (*Anhinga rufa)*
45. Cotton Teal (*Nettapus coromandelianus)*

List of Weeds and Pests in the paddy field

Weeds

1. Monochoris vaginalis
2. Echinochlora crusgalli
3. Leptochlora chinensis

Pests

1. Rice stem borer (Scripophaga *inceratulus*)
2. Dark-headed borer *(Chilo polychrysa*)
3. Gall fly, Gall midge(*Pachydiplosis oryzae*)
4. Rice bug (*Leptocorisa acuta*)
5. Rice swarming caterpillar(*Spodoptera mauritia*)
6. Rice case worm (*Nymphula depunctalis)*
7. *Stenchaetothrips biformis* (Thrips*)*
8. *Dieladispa armigera* (Rice hispa-beetles)
9. *Pelopidas mathias (* Rice skipper)

Plant hoppers & leaf hoppers

10. Nilaparvata lugens (Brown pla nt hopper)
11. Cicadella spectra
12. Racilia dorsalis
13. Nephotettix virescens
14. Hieroglyphus banian
15. Oxya hitidula

Predators living in and around paddy field

Arthopoda

1. Dragon flies(Odonata)
2. Preying mantis(*Mantis religiosa)*
3. Lace wings
4. Earwig *(Forficula)*
5. Antlions
6. Lady-bird beetles (Cocinella)
7. Stinging wasps
8. Long-horned grass hopper (*Conocephalus longipennis*)
9. Water striders(*Gerris*)
10. Notonecta
11. Belostoma
12. Laccotrephes
13. Ranatra
14. Corixa
15. *Dysticus*
16. Centipede *(Scolopendra)*
17. Spiders
18. Scorpion

Fishes

19. Aplocheilus melastigma

20. Panchax

21. Anabas testudineus

22. Macropodes

Amphibia

23. Frog (*Rana hexa dactyla*)

24. Rana tigrina

25. Rhacophorus

26. Ixallus

27. Frog (*Bufo melanosticus)*

Reptilia

28. Garden lizard*(Calotes)*

29. Mabuya

30. Rat snake (*Ptyas*)

Birds

31. Fan tail warbler (Cysticola juncidis*)*

32. Weaver bird *(Ploccus philippinus*)

33. Mala y pipit *(Anthus richardi malayensis)*

34. Large pied wagtail *(Motacilla maderaspatensis)*

35. Gray backed shrike (*Lanius schach*)

36. Cattle egret (*Bubulcus ibis*)

37. Nilgiri wren-warbler (*Prinia inornata)*

38. Black bellied finch-lark (*Eremopterix grisea*)

39. Barn-owl (*Tyto alba)*

40. Indian Myna (*Acridotherus tristis)*

41. Tailor bird (*Orthotomus sutoris*)

42. Pond heron (*Ardeola grayi)*

43. Crow-pheasant (*Centropis sinensis)*

Notes:

[xvi] We observed and identified 15 species of fishes, 4 species of amphibians, 7 species of reptiles and 45 species of birds in paddy fields and its borders. Borders of paddy fields are the abode of a number of predators. We recorded 15 species of pests of paddy and 43 species of predators belonging to various groups of animals. Several varieties of plants of economic importance were also found in the boarders of non-converted paddy fields. Most important among them were 5 species of fodder grasses, 5 species green manuring plants, 5 species of leafy vegetables, 6 species of wild fruits, 34 species of medicinal plants and 6 species of fibre yielding plants.

[xvii] To study the wetland communities associated with paddy fields, monthly samples of water with animals, plants and detritus were collected from selected ponds, pools, polders and canals both in converted and non-converted paddy fields regularly for one year. The samples were analysed in the research laboratory of NSS College, Pandalam to identify organisms. They were segregated into different trophic levels and recorded the name and number of each species. Their feeding habits and food web relations were traced through field observations and gut content analysis. The data on biodiversity of the converted area was compared with that of the non-converted area.

Care was taken to include all species of plaktonic organisms inhabiting in the collection site within the water sample collected. One litre of water was filtered through plankton net to separate planktons from water. Adding 20-ml water a plankton concentrate was prepared. From this, five samples of 1 ml each were taken in a counting chamber. Specimens were identified and counted under a microscope. Then recorded the number of individuals belonging to each species and calculated density per litre of water. The monthly data for three seasons were collected and analysed: Pre-monsoon (February-May), Monsoon (June-September) and Post-monsoon (October-January). From the seasonal mean numbers annual density of each species was calculated. In order to find out the level of significance in the

differences in distribution and density of species in habitats in converted and non-converted areas analysis of variance (ANOVA) was employed.

Relative abundance (relative density) was analysed to understand how ecosystem changes affected the pattern of dominance of the species. Nektons are swiftly moving organisms. Hence when water sample is collected most of them will escape. They were collected monthly from the pond by towing a plakton net on the surface water for one hour. The annual mean number of each species thus collected was calculated which was taken as an indication of its density.

[xviii] There are number of birds living in association with wetland paddy fields. Destruction of the bushes bordering wetlands affected the populations of Streaked fan tail warbler(*Cisticola juncidis*), Spotted Munia(*Uroloncha striata*) , Weaver bird(*Ploccus philippinus*), Common king fisher (Alcedo atthis), Malay pipit (*Anthus richardi malayensis*,(Large pied wagtail (*Motacilla maderaspatensis*), Gray backed shrika (*Lanius schach*), Blossom headed parakeet (*Psittacula cyanocephala*), Blue winged parakeet(*P. columboides*), Rose ringed parakeet (P. krameri), Pied kingfisher (*Ceryle rudis*), Spotted dove (*Streptopelia chinensis*), Nilagiri Wren-warbler (*Prinia inornata*) and Black bellied Finch-lark (*Eremopterix grisea*). Seemingly, there is an increase in the presence of birds like Little egret (*Egretta garzetta*), Smaller egret *(Egretta intermedia*),Cattle egret(*Bubulcus ibis*), Large egret (*Egreta alba*) and Grey heron (*Ardea cineria*). At present White breasted water hen (*Amaurornis phoenicurus*) and snakebird (*Anhinga melanogaste*r) are rarely seen. Birds like doves, weaver bird, parrots etc peck on grains while crow, stork, kite etc feed on insects, worms, fishes, frogs etc. Notwithstanding the fact that some birds sometimes behave like pest of crops, generally they are predators and many of them help to control insect pests.

Chapter 5

Impacts on the Livelihood Conditions of the Rural Poor

Large-scale conversion of paddy land and privatisation and enclosure of common lands denied the poor people access to several CPRs. The poor had free access to several resources such as grass, fish, firewood, wild grass (for thatch), reeds, medicinal plants, wild leafy vegetables, wild fruits and building materials. Enclosure, privatisation and the consequent denial of access to CPR have affected their livelihood conditions. Besides losing access to CPR, agricultural labourers lost employment opportunities too in the farm sector. People living in the hill areas have lost access to drinking water during summer months. Denial of access to grass has affected the capacity of the poor to maintain their homestead cows.

Employment loss

Traditionally, the majority of agricultural workers in the region belonged to scheduled caste (SCs). With a view to understanding their present employment status we selected 50 sample households from the population of 210 scheduled caste (SC) households in the watershed. The sample selection was purposive to include only those households which had their main earning member employed as agricultural labour. Besides household surveys and semi-structured interviews, close observation and monitoring was also followed. The employment, income and livelihood conditions of all the earning members in these households for a period of one year from first January 2000 were recorded.

The living and housing condition of SC households were poorer than those of the general population in the area. More than 90 per cent of the work force (members in the age group 20-60 who are willing and able to work) consisted of casual labourers. These households had very little assets of value. Average size of their holdings was less than 10 cents. Their housing condition was also relatively poor. While more than 50 per cent of the households in the watershed region live in good quality Terraced houses the corresponding proportion for SC households was only about 5 per cent.

One out of every two SC households lived in low quality *kutcha* houses. They had poor savings and more than 90 per cent of their earnings were spent for food.

The average family size of the sample households was about 5, a little more than that of the families in the region in general. Out of the total 244 members in the sample households 40 percent was below 20 years old and another 4 per cent, above 60 years. Age-wise distribution of household members is shown in Table 5.1.

Table 5.1: Age-wise Distribution of members of the Sample Households

Age group	Male	Female	Total
Below 20	46	51	97
20-30	22	20	42
30-40	15	18	33
40-50	28	20	48
50-60	8	6	14
60-70	4	3	7
Above 70	Nil	3	3
Total	123	121	244

Source: Field survey

Among the total workforce consisting of 137 members (73 male and 64 females), only 11 (7 male and 4 female) depended exclusively on non-farm jobs their livelihood. Others were farm workers. They were unskilled and untrained to take up any non-farm works, which require specialised skills or training. However, a few among them got jobs in the house construction sector as helpers. During the whole one-year period of study 55 workers (20 males and 35 females) got jobs exclusively in the agricultural sector. Others got jobs in the farm and non-farm sectors. Days of work for these casual workers were few and far between. Out of the 365 days the male workers got employment for an average 55 days (37 farm and 18 non-farm works) and female workers got only 31 days work (17 farm and 14 non-farm jobs).

Through several rounds of informal discussions with family members we elicited information about approximate number of days of employment in a year during the mid-eighties when paddy conversion had not become extensive in the region. It is learned that male workers had received an average of 181 days of work (164 farm 17 non-farm jobs) and females 125 days (112 farm and 13 non-farm jobs). It is likely that the number of days of works reported may not be accurate because there could have been cases of memory lapse. However, in the absence of any other dependable

sources of data to find out the actual days of employment for farm workers during the pre-conversion days, we take the reported numbers for purposes of comparison. Compared to mid-1980s a male and a female worker lost work for 126 and 94 days respectively by the year 2000 (see Table 5.2). Employment opportunities for male casual workers in mid-eighties were higher by about three times the average days of employment in the year 2000. In the case of a female casual worker, the loss was still higher, by about 4 times. Elderly workers constituted the worst affected group.

Table 5.2: Age and Gender-wise Comparison of Average days of Employment in mid-eighties and 2000

Age group of workers	Approximate number of days of employment in a year							
	In mid-eighties				Year 2000			
	Farm sector work		Non-farm work		Farm sector work		Non-farm work	
	Male	Female	Male	Female	Male	Female	Male	Female
20-30	150	110	17	13	14	12	23	20
30-40	160	115	20	12	40	17	20	18
40-50	175	112	19	14	46	18	18	13
50-60	171	110	12	13	48	11	11	5
Total	164	112	17	13	37	17	18	14

Source: Field survey

We took this sample statistic for estimating the total employment loss in the farm sector of the watershed. At one per cent level of significance the loss of employment since mid-eighties per male agricultural worker was between 114 and 138 working days and that of women was between 86 and 102 working days, per year. Approximately there were 2150 households and 9675 persons in the watershed region in the year 2000. Assuming that the proportion of farm workers in the watershed region is same as that of Kulanada panchayat[xx] we found that there were 871 farm workers who depend primary sector employment for their livelihood. On the assumption that the ratio of male to female workers is 1:1, we find the total number of working days lost per year for men was between 49,704 and 60,160 and for women between 37,496 and 44,472, compared to the employment opportunities in mid-eighties.

Admittedly, the entire employment loss may not be due to wetland conversion alone. Other changes in the land use pattern and crop pattern also might have played major role in the labour absorption capacity in the area. For instance, rice used to be grown during three seasons a year - autumn (Virippu), winter (Mundakan) and summer

(Punja) till the early `eighties. But at present summer crop is abandoned and autumn crop is not grown in the majority of rice-growing area. Moreover, the cropping pattern in dry lands has also changed in favour of less labour absorbing crops. Labour requirement for *mundakan* crop was on the average 100 males and 127 females per hectare. Total loss due to conversion of 110 hectares of paddy lands since 1975 therefore accounts for 11,000 male and 13,970 female days in one season and 22,000 man-days and 27,940 women days a year. It accounts for about 40 percent of total loss of employment for men and 68.3 per cent for women. Therefore, the total days of employment loss for male workers due to wetland conversion was between 19,882 and 24064 man-days and women workers 25,610 and 30374[xxi].

Decline in nutrient rich cheap food items

Small and medium size fishes were available in plenty in the side canals and *chiras*. Since the canals were perennial sources of water flow, a wide variety of fishes and frogs were available in the watershed region till the early seventies. The common medium-sized food fishes seen in the region were snake-head (*Ophiocephalus*), cat fishes (*Saccobranchus, Clarias), Hemiramphus*, Pearl spot (*Etroplus maculatus*), Eel, Climbing perch (*Anabas*), and *Mastacembalus.* People, especially from SC community used to capture them from the canals, channels, ponds and marshy places in the wetlands. They applied different indigenous techniques and gears for capturing fishes. Now, in the absence of perennial sources of water flow, no body in the watershed keeps any gears for fishing. Large-scale conversion of wetlands has led to conspicuous changes in physical conditions of biotopes and a drastic decline in aquatic fauna (Appendix Table 5. A1 shows the historical time line of the relative availability of some of the important edible animals in the wetland).

A wide variety of leafy vegetables was available on the bunds bordering paddy fields. The most important among them were *Thazuthama, Ponnariveeran, Puthina, Thakara and Madantha.* Children from poor families gathered wild fruits from the bushes bordering canals and wetlands for consumption. Their parents could not afford the price of fruits available in the market. When the bushes were destroyed the children lost access to nutritious wild fruits. (A historical time line of relative availability of wild fruits in the watershed is shown in Appendix Table 5.A2).

Loss of medicinal plants

Different varieties of medicinal plants such as *naruneendi, menthonni, vayampu, karimkurinji, amrithu, palmuthakku, orila, moovila, chakkarakkolli, kattupaval, kattupadavalam, avanakku, kurumthotti, kacholam, and chitharutha* had been available on the bunds and bushes bordering paddy fields (A historical time line of relative availability of medicinal plants in the watershed is shown in Appendix Table 5. A3). People used these plants for curing ailments simple and acute. Many of these plants have by now disappeared. Through semi-structured interviews we collected information on the average medical expenses of the households who use herbal medicines[xxii]. The average medical expense of these families, except for major diseases, during a period of six months from June 2000 came to Rs. 450 per household. Thus an estimated expenditure of Rs. 900 per household can be taken as the true opportunity cost of locally available medicinal plants.

Loss of fibre yielding plants

Women workers used to collect, during their leisure time, reeds (*Ochlandra travencorica, O.rheedi*), *rattan* or cane (*Calamus rotang, C. thwaitesii*), *Kaitha* (*Pandanus furcatus*) and different twiners like Kareelanchi (*Smilax aspera*) from the bushes bordering canals and paddy fields. They made different types of baskets, chairs and mats for sale. This type of work gave them auxiliary job and income to supplement their main earnings from farm work. Though the bushes had existed mostly in private lands, they were treated as common access resources. Large-scale conversion of paddy lands and canals and the consequent emergence of enclosure have resulted in the total loss of these fibre-yielding plants. In the absence of wage employment, women workers are at present forced to while away their time[xxiii].

Decline of grazing lands and forage plants

Grass on the bunds of paddy fields and canals were used to be CPRs. Women workers, especially from agricultural labour families, used to collect grass for sale in the market. When they did not get wage employment they could meet their basic

needs from the sale proceeds. This opportunity is now lost due to conversion of paddy fields.

Paddy fields after harvest, had served as common grazing land since the next sowing season began. In the absence of such facilities, it has now become difficult for the poor households to graze their cattle to earn an income from sale of milk and to give nutritious food to their children in the form of milk and butter.

We conducted a quick survey in 100 households in different parts of the watershed to take the stock of cows and buffaloes in the region. Among the surveyed households only 19 had any livestock (cow, buffalo or goat). There were only 42 cows and/or buffaloes in all these houses together. Applying this sample result (of 42 cows per 100 households) for the entire watershed region, the total cattle population would be about 900. The approximate number of cows and buffaloes in the year 1996 was 1300[xxiv]. There are documented sources of evidence to show that livestock population in the study region has declined drastically during the 10-year period from 1987. It is also learned that about two-third households lost access to free grass due to enclosure and privatisation of common land. Now they purchase cattle feed from the market. The rural poor with meagre income often find it difficult to maintain cattle during their dry period.

Drinking Water shortage

Till the late' seventies, most of the canals, springs and ponds of the watershed had water throughout the year (See Table 5.3). Water shortage during summer was experienced only at the hilltops, that too not for more than a couple of months a year. During these months, residents of the hill areas took bath and washed their cloths in nearby ponds and streams down hill. Now the situation has undergone drastic change. Canals, ponds and springs in the downhill also dry up during summer months. General water level in the wells and ponds has gone down considerably in all areas of the watershed. As the water level receded, high and middle-income group households either deepened their wells or constructed bore wells to extract ground water.

Table 5. 3: Months and Intensity of Water Flow in Canals bordering Paddy fields: 1970, 1980, 1990 and 2000

Relative flow	Period of flow (in months) in the decade ending			
	1970	1980	1990	2000
Strong Average	6 4	5 4	3 4	2 3
Weak	2	3	4	3
No flow	0	0	1	4

Source: PRA & field survey

To understand how the inhabitants of hills and valleys facing acute drinking water problem during summer manage to get water we identified and interviewed 30 such households during the summer of 2000. It is learned that they experience acute water scarcity for about four to five months a year. Every year the scarcity period gets longer. It is also learned that water level in the surface wells in the region fell, on an average, by 4 to 6 feet during the past ten years. One-third households deepened their surface wells more than twice during the past 10 year period. Richer sections managed the situation either by deepening wells or constructing bore wells. Economically weaker sections were the worst affected people. During summer, they travel an average distance of 700 metres to fetch water.

The economic value of economic functions and ecological services lost in wetland conversion is taken up in the next chapter.

Appendix

Table 5. A1: Historical Time Line of the Relative Availability of Edible Animals in the Watershed

Name of species	Relative availability of species in the decade ending				
	1960	1970	1980	1990	2000
Freshwater-crab *(Paratelphusa hydrodromous)*	A	LA	R	R	Lt
Prawn (*Palaemon*)	A	LA	Lt	Lt	
Climbing perch (*Anabas testudineus*	A	A	R	Lt	
Snake-heads *(Channa orientalis, Ophiocephalus striatus*	A	LA	R	Lt	
Wallago attu	LA	LA	R	Lt	
Stinging cat fish *(Heteropneustes fossilis*)	A	A	R	R	Lt
Spotted cat fish *Clarias brachysoma*	A	A	R	Lt	

Etroplus maculates	A	LA	R	Lt	
Mastacembalus	A	LA	R	Lt	
Hemirampus	A	LA	R	Lt	
Eel	LA	R	Lt		
Kuruva Paral	A	LA	R	Lt	
Muthuppila	A	LA	R	Lt	

Source: Field study

A = Abundant, LA = Less Abundant, R = Rare and Lt = Lost

Table 5. A2: Historical Time Line of Relative Availability of Wild Fruits in the Bushes Bordering Canals and Wetlands

Name of wild fruits	Relative availability during the decade ending				
	1960	1970	1980	1990	2000
Ponkorandi (*Antidesma zeylanica*	A	LA	LA	R	Lt
Mulli *(Carissa caranda)*	A	A	LA	R	R
Odal	LA	LA	R	Lt	
Kotta (*Grewia microcos)*	A	A	LA	R	R
Vedinjotta	A	A	LA	R	Lt
Thetti (Ixora)	A	A	LA	R	R

Source: PRA & field study

A = Abundant, LA = Less Abundant, R = Rare and Lt = Lost

Table 5.A3: Historical Time Line of the Relative Availability of Medicinal Plants in the Watershed region since 1960

Name	Relative availability during the decade ending				
	1960	1970	1980	1990	2000
Naruneendi (*Hemidesmus indicus*)	A	LA	LA	R	R
Vayampu *(Accerus calamus*)	A	LA	R	R	Lt
Karimkurinji *(Strobilanthus kunthianus*)	A	LA	R	R	Lt
Venkurinji *(Strobilanthus sp)*	A	LA	R	R	Lt
Palmuthakku (*Ipomea mauritiana)*	A	LA	R	R	Lt
Amrith (*Tinospora Cordifolia)*	A	A	LA	R	Lt
Orila (*Desmodium giganticum*)	A	A	LA	R	R
Moovila (*Pseudarthria biscidia)*	A	A	LA	R	R
Chakkarakolli *(Symnema sylvestre)*	LA	LA	R	R	Lt
Velutha avanakku *(Ricinus communis*)	A	A	LA	R	Lt
Kurumthotti (*Sida rhombifolia)*	A	A	LA	R	R
Chittarutha *(Alpinia galanga)*	A	A	R	R	Lt
Brahmi *(Bacopa moneri)*	A	A	R	R	Lt
Keezharnelli *(Phyllanthus neruri*)	A	A	LA	R	Lt
Chunda *(Solanum sp.)*	A	A	LA	R	R
Pushkara mulla *(Coffea travancorica)*	A	A	LA	R	Lt
Kudukkamooli *(Aristalochia indica*)	A	A	LA	R	Lt

Kattuthetti *(Ixora coccinia)*	A	A	LA	R	R
Pachotti *(Symplocus racemosa)*	A	A	LA	R	Lt
Sathaveri *(Asparagus racemosus*)	A	A	LA	R	Lt
Poovamkurumthal *(Vernonia cineria*)	A	A	LA	R	R
Mukkutti *(Biophytum sensitivum*)	A	A	A	A	LA
Kattupadavalam *(Trichosanthes cucumeriana*	A	A	LA	R	Lt
Kattupayar *(Centrocema sp.)*	A	A	LA	R	Lt
Kayyonni *(Eclipta alba)*	A	A	LA	R	Lt
Changalam paranda *(Cissus quadrangularis*	A	A	LA	R	Lt
Padakkizhangu *(Cyclea peltata)*	A	A	LA	R	Lt
Uzhinja *(Cardiospermum halicacabum*)	A	A	LA	R	R
Kodithuva (*Tragia involucarata*	A	A	LA	R	Lt
Anachuvadi (*Elephentopus scaber)*	A	A	LA	R	R
Incha *(Accacia incia)*	A	A	LA	R	Lt
Kozhuppa*(Portulaca sp)*	A	A	LA	R	Lt
Njonganamthumpa (*Oldenlantia umbellata)*	A	A	LA	R	R
Vallikanjiram (*Strychnos cordifolia)*	A	A	LA	LA	R

Source: Field study

A = Abundant, LA = Less Abundant, R = Rare and Lt = Lost

Notes:

[xix] The proportion of farm workers in Kulanada Panchayat according to the Panchayat Vikasana Rekha (1996) was 9 per cent of its total population.

[xx] Though the actual days of employment were few and far between, the sample households answered in the affirmative for our question about whether their livelihood conditions are better than the levels in mid-eighties. We presume that it may be because of the relatively high wages during the days of work, social security and welfare strategy of the governments. However, all the sample households are looking forward to governments – national, sub-national and local - support for meeting their basic needs.

[xxi] Our survey in SC households indicated that the majority of the young members are not familiar with medicinal plants and their uses. They prefer modern medicines for all types of illness. Given the changes in the attitudes and preferences of the people, even if medicinal plants were available not more than 10 per cent of the sample households would not have used them for treatment.

[xxii] Even if local materials are available the majority of the young women even from poor families in the watershed region do not have the skill and training to produce traditional products like mats, chairs and baskets.

[xxiii] Kulanada panchayat form a major part of the ullannnor watershed. According to livestock census in 1987 there were 1753 Cows, 5211 Buffaloes and 1282 Goats in the panchayat. Another estimate in 1996 shows that the number of cows has increased to 3246 and the number of Buffaloes declined to an abysmal low of 49 and the number of goats remained at 1218. Total cattle population, which was 8246 in 1987, declined to 4513. The geographical area of Ullannor watershed region being equal to 40 per cent of the Kulanada panchayat, it is assumed that cattle population in the region is 40 percent of the total, that is 1805. Among them 27 per cent (487) are goats. Approximate number of cows and buffaloes in the sample region was therefore not less than 1300 in the year 1996.

Chapter 6

Economic Value of loss

An economic value cannot be put on all functions of wetland ecosystems. However, a few important functions can be valued using economic tools. Environmental good, in general, process three important features, namely irreversibility, uncertainty and uniqueness (Banerjee 2001)[xxv]. Total Economic Value (TEV) of an environmental good, according to Pearce and Moran (1994), is the sum of use value (UV) and non-use value (NUV)

Use value consists of three components – direct use value, indirect use value and option value. The direct use value is the value of environmental goods such as fodder, fish etc as well as services such as recreation, aesthetic experiences etc. Indirect use value refers to the ecological functions that are performed by the ecosystem. These are essential for the survival and maintenance of the ecological system within which the economic system is located. For instance water charging and recharging, watershed protection and nutrient cycling are examples of ecological functions. Option value is the value that individuals attach to the option of preserving it for possible use in the future.

Important elements of non-use value are bequest value and existence value. Even if a resource is neither used currently nor considered usable with current level of information, its option value may be positive and significant (Santhakumar and Chakraborty, 2000). Kruttilla, (1967) was the first to refer to the notion of non-use value. Bequest value refers to what an individual will be willing to pay in order to ensure that bio-diversity is saved for future generations. The existence value is another form of non-use value, which is based on the fact that people may derive utility simply from knowing that a particular species exists. The existence value often springs out of the religious beliefs of individuals regarding the right to live of their life forms.

There are two distinct views of value of environment – utilitarian and non-utilitarian. The basic approach that people derive benefits from mere existence of the environment, even though they make no use of it, stems from utilitarian approach. This is clearly different from the non-utilitarian approach that non-human species are intrinsically valuable, independent of any use they may have on human beings (Callicott, 1986). The different notions of value imply alternative views on the sources of utility for individuals. The source and nature of utility need not be same for all individuals, hence the notion of value also differs. However, market based valuation[xxvi] is possible for actual use value of environmental goods.

Studies attempting to value benefits of intangible or non-marketed goods need alternate methodologies of valuation. The available valuation methods can be categorised as price based valuation, surrogate market valuation and artificial or constructed market valuation methods. Market price reflects the economic value of a resource as measured by exchange value. It need not be reflective of the true economic value in cases of market failure. Then we have to consider the full opportunity cost of resource use to society. The opportunity cost is useful for valuing non-marketed goods and measures trade-offs between preservation and other marketed goods and services. Similarly the loss of earnings approach is based on prices in the labour market. The surrogate market valuation approach uses information relating to a marketed good to infer the value of an associated non-marketed good.

All the above neo-classical methods do have obvious limitations when applied to specific situations. Because of its obvious limitations, the neo-classical approach alone is insufficient to value the 'preservation' benefits and loss in development of a complex ecosystem like wetland paddy fields. Therefore the tools of ecological economics, a relatively new discipline, which shares certain points of commonality with traditional environmental and resource economics seems to be more appropriate for valuation of environmental goods and services of wetland ecosystem.

However, ecological economic methods of valuation become difficult in problems where multiple actors and users are involved. In fact, several actors are involved in the use of wetland ecosystem of the watershed. A comparison of aggregate benefits and costs of all the stakeholders involved would not reflect the actual value of

environmental goods and biodiversity lost in conversion. For instance, if we take the current and future accounting costs and benefits of those landowners who converted paddy land for the purpose of house construction, conversion is found to be highly rewarding[xxvii]. The benefit of conversion goes exclusively to the landowners. Poor people who have the benefits of CPR and environmental goods would be the real losers. Therefore, the general practice of a full-fledged social cost benefit analysis to estimate the net benefit of change would not reflect the real loss due to conversion.

Given the complex methodological issues of valuation[xxviii], what is attempted here is to highlight the economic value of major economic and ecological functions lost due to paddy conversions from the perspective of the rural poor, who happens to be, in most cases landless labourers. For the present purpose we take an attempt to measure only the direct and indirect use value of a few important functions lost by the year 2000. value of functions and ecological services is measured at current prices using ecological economic methods.

Table 6. 1: Functions Measured and Methods

Functions Measured	Method(s)
Employment	The loss of earning approach (benefits forgone)
Grass	Opportunity cost
Medicinal plants	Opportunity cost
Fish, wild vegetables and wild fruits	Opportunity cost
Fall in ground water level and scarcity of drinking water	Shadow price (both opportunity cost and willingness to pay)
Bio-diversity	Multi Criteria Analysis

Employment

We have noted that male agricultural workers in the watershed lost between 19,882 and 24064 of employment days a year due to conversion of paddy lands. The corresponding figures for women workers were a little higher, between 25,610 and 30374 days of work a year. The wage rate for farm workers in the region during the year 2000 was Rs. 125 per day for males and Rs. 70 per day for females. The cost of loss of employment per day is earnings loss, Rs. 125 for male and Rs. 70 for female workers. Total earnings loss of all the agricultural workers in the study region at one per cent level of significance, is estimated to lie between Rs. 42,77,900 and Rs.

51,34,180 in the year 2000. It is a measure of the economic value of direct employment.

Besides the loss of direct employment, women workers in the region lost opportunities for several auxiliary occupations due mainly to the loss of bushes bordering wetlands and canals and also to the enclosure and privatisation of CPRs and CARs. In the absence of relevant data on the loss of raw materials and the market value of products, we could not attempt to its economic valuation.

Grass

It is found that the total livestock population in the watershed region was about 900 in the year 2000. To understand the effect of loss of access to free grass on the cost of maintaining cattle population we selected a sample of 10 households having at least one milking cow from different locations of the watershed. It is learned that inhabitants, particularly economically backward households, near the non-converted paddy purchase relatively less quantity of cattle feeds from the market. They spend an average amount of Rs. 12 per day per cattle for the market purchase. Inhabitants near the *yelas* where massive reclamation took place spend an average of Rs. 34 per day to purchase cattle feed and dry straw for milking cows and Rs. 21 for non-milking cows. Taking the average of the two, they spend an amount of Rs. 27.5 per day for each cattle. Differences in the cost of market purchase per cattle in the two locations lie between Rs. 15 and 18 per day. This difference can be taken as the full opportunity cost of loss of access to grass.

About two-third of the cattle farming households in the study region lost access to free grass due to the wide spread enclosure of CPRs and CARs and filling and levelling of paddy fields. Opportunity cost of grass lost measured in terms of price of additional expenditure on cattle feed per day for the 600 cattle population in the region is an amount between Rs 9,000 and Rs 10,800 per day. Annual value of grass lost therefore, ranges between Rs. 32,85,000 and Rs. 39,42,000. Besides grass for own cattle, we have seen elsewhere that few women agricultural workers when they did not get wage employment used to cut grass from the *yelas* to sell in the market. Since

the total earnings from such sales are minimal we are not considering it for economic valuation.

Water

It is learned from semi-structured interviews with the heads and members of the 30 sample households facing acute drinking water shortage during summer that the elder members of these families spend an average time of 60 minutes for collecting water from an average distance of 700 metres from home. Their children in the school-going age also spend an average time of 30 minutes a day for collecting water. This they continue on all days in the summer, that is, for about 4 to 5 months a year. The opportunity cost of the time spent (measured in terms of income they would have earned if employed as rural casual labour) by all members in an average household for collecting drinking water per day was estimated to be about Rs. 45. Considering the fact that all members will not get wage employment and earnings on all days, we take a realistic estimate. A minimum amount of Rs.15 and a maximum of Rs. 25 per day are taken as the full opportunity cost of time spent by each household for the collection of water for domestic use.

It is learned that at least 25 per cent of the 2150 households in the sample region experience acute water scarcity for not less than four months a year. Based on the above estimates the opportunity cost of water collection by the affected households in summer season comes to between Rs. 8070 and Rs. 13450 per day. This figure may be taken as the economic value of the loss of drinking water sources. Applying this figure for the 120 days of acute water scarcity, the total value of the loss of drinking water in the watershed is found to be between Rs. 9,68,400 and Rs. 16,14,000 a year. In the case of water scarcity also we cannot attribute the entire blame on wetland conversion. But, it did definitely play a major role in environmental and ecological degradation, which in turn contributed to the acute water scarcity.

We also made an enquiry into the amount of money each household is willing to spend if safe drinking water supply were assured at home during summer. Each sample household in the region was willing to spend an average amount of Rs. 10 per day for the purpose. Applying this sample statistic we calculated the willingness to

pay of all households experiencing water scarcity as Rs. 6,45,600 a year. Obviously, most of these households do not have the capacity to pay Rs. 10 per day during all days in summer for drinking water.

Medicinal plants

Though we prepared a list of popular medicinal plants in the watershed and documented their relative availability since 1960, we could not collect relevant information about the uses of each. Theoretically speaking, the direct use values of medicinal plants are measurable in monetary terms. However, in the absence of information on the rate of current extraction and true economic value of each it is difficult to estimate the true opportunity costs of resources lost. For the present purpose we depend on the estimate of cost of modern medicines for curing simple ailments that could have been cured using indigenous herbal medicines.

Our survey and close monitoring in 50 scheduled caste agricultural labour households has brought out the fact that about 10 per cent of them would have used medicinal plants for treatment of simple ailments of its members. Mainly because of the non-availability of medicinal plants each family had to spend an average amount of Rs. 900 a year on modern medicines. Even if we assume that 10 per cent SC households alone would have made use of medicinal plants, they could have saved an amount of Rs. 18,900 in the year 2000. This amount is taken as the full opportunity cost of medicinal plants lost from the study region mainly due to changes in land use pattern.

Fish, leafy vegetables and wild fruits

Wide variety of fish, vegetable and fruits had been available in the watershed till the land conversions on a large scale began. The majority of the rural people depended on home grown vegetables. Agricultural worker households used several wild-growing leafy vegetables available on the bunds of paddy fields and canals. They rarely purchased fruits from market for household use. However, they used to purchase fish regularly. We cannot compare fish lost in the region with their market purchase. In the absence of relevant data we apply a rule of thumb to arrive at a potential loss of fish

of Rs. 10,000 per year (a rather moderate figure by any standard). The amount is supposedly inclusive of the value of leafy vegetables and wild fruits lost.

Bio-diversity

It is difficult to estimate the extent and rate of biodiversity loss since the number of species, which had existed in the area at any point in time in the past, are not known. However, the species loss has steadily been accelerating due to the destruction and modification of their habitat. The number of species dependent on a wetland habitat is a factor 10 times the number of habitat lost. It is assumed that 50 per cent of species would be lost if 90 per cent of the habitats are gone (Sengupta, 2001). Conversion of land in the natural system to less productive uses reduces its net primary production (NPP). It is estimated that such conversions would reduce the potential NPP by about 13 per cent a year and that the human share in unreduced potential NPP of a year goes up to 40 per cent (Sengupta, 2001).

The extinction of species and organisms would have its primary impact on human society through the impairment of ecosystem services. Destruction of insect species may cause decline in pollination and affect the pest control services by ecosystem resulting in pest outbreaks. Power of resilience of the system may be affected too. Sustainable development depends on environmental quality and long-term productivity of the natural system. Like environmental quality, biodiversity needs to be recognised as a service that possess economic value. Though direct use values get reflected in market values, the value of goods and services produced by biodiversity cannot be measured directly. Considering the difficulty in measurement, a thumb rule, which assumes that loss of annual service per hectare will be Rs. 200, is assumed for valuation. On this thumb rule, the total loss due to conversion of the entire 110 hectares in the study region works up to Rs. 22,000 per year.

Sum of annual value

The annual value of important economic functions and biodiversity lost mainly due to paddy conversion in the watershed region is summarised in Table 6.2.

Table 6.2: Annual Loss (functions and biodiversity) due to Paddy land Conversion in Ullannoor Watershed region

Serial number	Functions Measured	Value in Rs. (at 2000 prices)	
		Minimum value	Maximum value
1	Employment	42,77,900	51,34,180
2	Grass	32,85,000	39,42,000
3	Medicinal plants	18,900	18,900
4	Fish, wild vegetables and fruits	10,000	10,000
5	Water	9,68,400	16,14,000
6	Bio-diversity	22,000	22,000
	Total loss	85,82,200	1,07,41,080

Out of the total economic value of the wetland ecosystem, we considered only a few important functions lost due mainly to conversion. The current economic value of the loss ranges between Rs. 78020 and Rs. 97646 per hectare per year. The total benefit is the sum of annual benefits that would accrue as long as the quality of the watershed remains unchanged. Once it is converted or developed the damage done to the system becomes irreversible, and the wetland ecosystem functions disappear forever.

Conversions may give high economic returns to the landowners concerned. A few workers may get employment in the process of conversion and in the 'development' activities that follow. If the landowner does not resort to conversion the maximum return that he could expect for the conservation of environmental resources is the sale vale of the land. The average market value of paddy fields in the region is not more than Rs.0.25 million per hectare. Given the magnitude of huge (imputed) economic loss that conversion would entail for the local society, the collective wisdom of the society could not permit conversion of wetland paddy field.

Notes:

[xxiv] The decision to use up environmental goods is generally an irreversible decision, as the environment cannot be regenerated according to our wish and will. Uncertainties arise from our limited knowledge of the ecological balance and the likely waste/loss due to use. It is unique in the sense that nature's scenic beauty is not replicable; neither can we bring back extinct species. Because of its unique features the environment has direct user-value and non-user benefit (existence value). User values or benefit that one derives is referred to as functional value. Functional value consists of actual present value and its option value.

[xxv] Neo-classical economics, the dominant paradigm in economics today, has looked at the problem of biodiversity and loss in terms of the following three approaches:

(a) an optimising approach (focus could be on a particular species or on a particular area)
(b) a social cost benefit approach
(c) a statistical approach

In most practical applications, one finds a mix of the conservation versus development approach and a social benefit cost approach applied to specific areas or species (Kanchan Chopra 1997). Economists have been concerned with the trade-off between conservation and development. Krutilla and Fisher (1974) introduced the concept of 'preservation benefits' – the benefits that accrue to human beings from natural areas, which are lost when the area is developed. The loss of these preservation benefits, therefore, represents the hidden cost of development. The conservation versus development approach has been the basis of a number of empirical studies in the cost-benefit (CBA) framework.

[xxvi] The market value of paddy field increased 10 times from Rs 5000 per 0.01 hectare to Rs 50000 when the owner spent Rs 20000 for filling and leveling. He constructed a building in the converted land at a cost of Rs 2 lakh and now he is getting an annual rent not less than Rs 24000. This is a typical case pointing to the real benefits to the landowners from paddy conversion. Given the cost and economic return from rice cultivation, economic rationality suggests profit-seeking landowners to convert paddy land for purposes other than rice cultivation.

[xxvii] Any attempt to understand the value of economic functions of a wetland ecosystem requires scientific data on three aspects: (i) genes and species in the system and their roles/functions that benefit humans directly and indirectly; (ii) the role that wetlands plays in maintaining the stability and dynamics of the system; and (iii) direct and indirect human benefits/losses due to conservation/development. Total benefit is the benefits accrued to all stakeholders at any point in time. Such a comparison of costs and benefits to all sections of the society is not attempted in the present study.

Chapter 7

Summary and conclusion

Several social and cultural changes and economic forces have led to massive conversion of wetland paddy lands. Although the paddy fields in Kerala are typical wetland ecosystems that provide numerous useful functions, there was a 65 percent fall in the area under rice cultivation since the past 30 years. The present study is based on a specific local context. The study region, Ullanoor watershed has an area of 745 hectares and covers 2150 households spread over two *grama* panchayats. Wetlands accounted for about 30 percent of the land area. Till the mid-1980s more than 90 per cent of the wetlands was under rice cultivation. As has been the case with rest of Kerala, the area under rice declined from about 34 per cent of the net cropped area in mid-seventies to about 15 percent in the year 2000. In absolute terms the area under rice has declined from 210 hectares in 1975 to 90 hectares in the year 2000.

High density of population and rising need for construction of buildings and roads are some of the major factors accelerating conversion. Roads and buildings occupy about 16.5 per cent (125 hectares) of the land area of the watershed. Buildings now occupy about 2.3 per cent of the watershed in the study region. About 5 per cent of the wetland has already been converted into roads.

The majority of landowners feel that sustained rice cultivation in the region is not economically viable. Lack of political will and a general apathy of the state in the implementation of rules and regulations of the land have aggravated the problem of conversion. Law-enforcing agencies and institutions are not exercising their powers to arrest the trend.

Paddy land conversions have led to an overall ecological degradation in the watershed from hilltop down to the riverside of the watershed. Reduction in humus formation and intensification of soil erosion have affected the fertility of the soil. Because of the quick surface runoff rainwater does not percolate deep into the soil to create springs. Perennial streams which had their origins in the upper reaches of the watershed, have

disappeared. Water level in the surface wells receded by about 4 to 6 feet during the past ten years. All these changes affected the livelihood conditions of the rural poor.

Conversion of paddy lands led to loss of employment to farm workers. Besides loss of direct employment in the farm sector, women workers have lost work opportunities in subsidiary occupations too mainly because of the loss of fibre-yielding plants which had grown abundantly on the borders of paddy fields. The poor people have lost access to several nutrient-rich low-cost, food articles, which had been available in and around the fields. Many households used to collect grass from the bunds bordering paddy fields. About two-thirds of the households have lost access to free grass due to enclosure and privatisation of common property resources. The rural poor also experience acute water scarcity for about four to five months a year.

The current economic value of functions and services lost in the region due to paddy land conversion is estimated to be between Rs. 78020 and Rs. 97646 per hectare in the year 2000. From the social perspective, we find that the expected benefit from conservation would last as long as the intrinsic quality of the ecosystem is conserved. The ecosystem loses its quality forever once conversion takes place. Conversion may look beneficial to the landowners who control environmental resources. The ecological and environmental loss is, however, enormous and the entire society is the loser.

At present it seems that the stakeholders are not fully aware of the true value of the loss of resource depletion and its impacts on the livelihood conditions of the poor. It appears that the state government has not become alive to the gravity of the problem[xxix]. The labour institutions, though they argue for continuance of rice cultivation, are not putting up strong resistance against paddy conversion. The amorphous group of subsistence farmers, farm workers and others who bear the full brunt of conversion cannot come together as a pressure group because of the complex political, socio-cultural and institutional structure of the Kerala society.

The attitudes and preferences of the people also raise questions about the sustainability of rice cultivation. Landowners aspire to shift to more remunerative options. Aversion to manual work in mud and slurry keeps the labour away from rice

fields. The economic analysis may not prove rice cultivation attractive. But, the ecological economic analysis proved that paddy fields, being the most productive zones of the watershed, needs to be conserved for future generations. Paddy being an amphibious crop can be cultivated along with maintenance of the ecological functions of wetland. Therefore, paddy cultivation needs to be preserved for the wider interest of the society.

Notes:

[xxviii] Though the state is against paddy conversion, widespread conversion continues unabated. A recent state government order (Rt No.157\2002\AD) issued on February 5, 2002, allowing large-scale conversion of food crop and reclamation of paddy fields for construction purposes would speed up the process. It is likely that the remaining paddy fields would be vanished in the near future. (The Hindu Daily dated 1 March 2002).

REFERENCES :

Banerjee Sharmila (2001). "Economic Valuation of Environmental Benefits and Costs" in R. N. Bhattacharya (ed), *Environmental Economics: An Indian Perspective*, Oxford University Press, New Delhi.

Callicott, J.B (1986). 'On the Intrinsic value of Nonhuman Species' in B.G Norton (ed) *The preservation of Species: The value of Biological diversity*, Princeton: Princeton University Press.

Chopra Kanchan (1997). *Economic Valuation of Biodiversity*, Study Report, IEG, New Delhi.

Colman, J.S (1990). *Foundations of Social Theory*, The Belknap Press of Harward University Press, Cambridge.

Dasgupta, Partha (2001). 'Poverty and the Environmental Resource Base' in Sankar, U (Ed) *Environmental Economics*, Oxford University Press, New Delhi.

Dreze, Jean and Amartya Sen (1997). Indian Development: Selected Regional Perspectives. UNU/WIDER Studies in Development Economics, Oxford University Press, New Delhi.

Elton, C. S (1966). The Pattern of Animal Communities, Metheun and Co. Ltd,.

Francis, Shaji. K (1991). *Dynamics of Rural Labour Market : An analysiss of Emerging Agricultural Labour Shortage in a Kerala Region*, M.Phill Dissertation submitted to JNU, CDS, Trivandrum (unpublished).

Franke, R.W. and B.H Chasin (1990). Development Without Growth: The Kerala Experience. *Technology Review*, No. 93.

Franke, R.W. and B.H Chasin (1993). *Life is a Little Better: Redistribution as a Development Strategy in Nadur Village Kerala*. Boulder & Co: Westview Press.

Franke, R.W. and B.H Chasin (1997). Power to Malayalee People. *Economic and Political Weekly*, Vol. 32, No.48.

Franke, R. W and B.H Chasin (1999). 'Is the Kerala Model Sustainable? Lessons from the Past: Prospects for the Future' in Oomman. M.A (ed), *Rethinking Development: Kerala Development Experience* Vol. I, Institute of Social Sciences, New Delhi.

George P.S (1998). "Dilemma of Cost of Cultivation in Kerala" in *Economic and Political Weekly*, Vol. XXIII, No. 39, September.

George, K.K. (1999 Revised edition). *Limits to Kerala Model of Development*, Centre for Development Studies, Thiruvananthapuram.

Gopikuttan, G (2002). *Public Housing Schemes for Rural Poor in Kera la: A critical study of their suitability*, Discussion Paper No. 49, Kerala Research Programme on Local Level Development, Centre for Development Studies, Thiruvananthapuram.

Herring, J. Ronald (1983). Land to the Tiller: *The Political Economy of Agrarian Reform in South Asia*, Yale University Press, New Haven and London.

Jose, Sunny (1991). *Group Farming in Kerala: An illustrative study*, M.Phil Dissertation submitted to JNU, CDS, Trivandrum (unpublished).

Joseph, George (1994): *Impact of Infrastructure Development on Paddy Cultivation in Kuttanad*, M.Phil Dissertation submitted to Kerala University (unpublished).

Joseph, Vijayam (1994). *Land Market in Kerala: A Comparative Study of an Agriculture Dominant Rural Area with an Urban Periphery*, M.Phil Dissertation submitted to Kerala University (Unpublished).

Kadekodi Gopal K. (2001). "Environment and Development" in R N Bhattacharya (ed), *Environmental Economics: An Indian Perspective*, Oxford University Press, New Delhi.

Kannan K.P (1995). Levelling up or Levelling Down? Labour Institutions and Economic Development in India, *Economic and Polictical Weekly*, July 23.

Kannan, K.P (1999). Rural Labour Relations and Development Dilemmas in Kerala: Reflections on the Dilemmas of a Socially Transforming Labour Force in a Slowly Growing Economy. In Byres, T.J, Karin Kapadia and Jeus Lerche (ed) *Special Issue on Rural Labour Relations in India, Journal of Peasant Studies*, Vol. 26, No. 2/3, January-April.

Kannan. K.P & Pushpangadhan.K (1998)."*Agricultural Stagnation and Economic growth in Kerala: An Exploratory Analysis*". Working Paper No.227. Centre for Development Studies, Trivandrum.

Kerala Research Programme on Local Level Development, *Annual Report* 4, 1999-2000, Centre for Development Studies, Thiruvanthapuram, Kerala

Krutilla, J.V (1967). Conservation reconsidered, *American Economic Review*, Vol 57 (4).

Krutilla, J.V. & A.C. Fisher (1974). Valuing long-run ecological consequences and irreversibilities, *Journal of Environmental Economics and Management*, Vol 1 (2).

Kurian, John (1995). The Kerala Model: Its Central Tendency and the Outlier, *Social Scientiest*, Vol. 23, Nos. 1-3 January-March.

Mridul Eapen (1994). "Rural Non- Agricultural Employment in Kerala – Some Emerging Tendencies", *Economic and Political Weekly*, May 21.

Mukherjee, C and Tomas Isaac, T.M (1994). *Nine Observations on Educated Unemployed in Kerala*. International Congress on Kerala Studies, Abstracts, Vol. 2: 66-68, AKG Centre for Research Studies, Thiruvananthapuram.

Nair, Janardhanan, M (1981). *Report of the one man Commission on the Problems of Paddy Cultivators in Kerala*, Govt. of Kerala.

Narayanan, N.C (2003). *Against the Grain: The political ecology of land use in a Kerala region, India*, Shaker Publishing, The Netherlands.

Oommen, T.K. (1985). From Mobilisation to Institutionalisation – The Dynamics of Agrarian Movement in Twentieth Century Kerala, Popular Prakashan, Bombay.

Parameswaran, M. P (1999). 'Kerala Model Prospects and Problems' in Oomman. M.A (ed), *Rethinking Development: Kerala Development Experience*, Institute of Social Sciences, New Delhi.

Parameswaran, M.P (1998). Kerala 'Model' – What Does It Signify? Bulletin of Concerned Asian Scholars, Vol. 30, No.4.

Pearce, David and Dominic Moran (1994). *The Economic value of Biodiversity*, Earthscan Publications Ltd,.

Prakash, B.A. (1994). Kerala's Economy: An Overview. In Prakash, B.A (ed), *Kerala's Economy: Performance, Problems and Prospects*. Sage, New Delhi.

Ramachandran, V.K (1997). On Kerala's Development Achievements. In Jean Dreze and Amartya Sen (ed) *Indian Development – Selected Regional Perspectives.* Oxford University Press, New Delhi.

Sankar, U (2001). Introduction. In Sankar U (ed) *Environmental Economics*. Oxford University Press, New Delhi.

Shaji. K, Fransis (1991). *Dynamics of Rural Labour Market: An alaysis of Emerging Agricultural Labour shortage in a Kerala Region,* M.Phil Dissertation submitted to JNU, CDS, Trivandrum (unpublished).

Santhakumar V and Achin Chakraborty (2000). 'Environmental Valuation and its Implications on the Costs and Benefits of a Hydroelectric Project in Kerala, India, *Working Paper No. 309*, Centre for Development Studies Thiruvananthapuram.

Sengupta Ramprasad (2001). *Ecology and Economics: An approach to Sustainable Development*, Oxford University Press

Tharamangalam, Joseph (1999). 'The Social Roots of Kerala's Development Debacle', in Oomman. M.A (ed), *Rethinking Development: Kerala Development Experience*, Institute of Social Sciences, New Delhi.

Toinquist, Olle and Micheal Tharakan P. K (1996). "Democratization and Attempts to Renew the Radical Political Development Project: case of Kerala", *Economic and Political Weekly*, July 13, 20 and 27.

Tornquist, Olle (1999). *Politics and Democratisation: A Critical Introduction.* Sage, New Delhi.

Varghese, T.C. (1970). *Agrarian Change and Economic Consequences: Land Tenures in Kerala 1850-1950.* Allied Publishers, New Delhi.

[i] Social scientists and development economists allover the world hailed the remarkable progress in the material quality of life, high social sector development and relative equity achieved in a low-income State (Dreze and Sen 1997; Ramachandran 1997; Franke and Chasin 1990, 1993, 1997). The achievements were made possible by public policies in response to social and political movements and mobilizations several of which began prior to the formation of the State (Varghese, 1970; Herring 1983; Oommen 1985; Kannan 1988; Parameswaran 1998; Tornquist 1999).

[ii] Normal annual rainfall in the State is 3107 mm against the national average of 1190mm. Rainfall varies not only temporally but also spatially. On an average, the number of rainy days in Kerala is in the range of 120 – 140 in a year. In 70 out of 125 days the quantum of precipitation is as low as 2.5mm or less (GOK, Economic review 2000). The heavy downpour concentrated over a limited number of days and that too for an average duration of less than two hours rain causes heavy floods during the monsoon periods and at the same time exposes the remaining part of the year to severe drought. Though the state has 44 rivers, several freshwater and brackish water lakes, a few man-made reservoirs, numerous small and large ponds, extensive paddy fields and a multitude of dug wells, it experiences acute drinking water scarcity during summer season. The environmental and ecological crisis that the Kerala state faces is so acute that about two-third of the total population do not have access to safe drinking water (KRPLLD Report 2000).

[iii] The order issued by C.S Srinivasan, Secretary (Agriculture), on the basis of the "Proceedings of the Council of Ministers of February 5, and the Government letter No.47165\NCA\3\97AD of December 17,1997 (restricting conversion).

[iv] The Kerala Land Utilisation Order of 1967 (issued under the Essential Commodities Act, 1955) empowers the government to direct every holder of land not to leave any land fallow, not to cultivate any other crop than grown during three years immediately before commencement of this order or attempt to convert such land for any other purpose.

[v] Watershed, by definition, is an area above a specific point, through which all the incoming water in that area drains out. All watersheds have the basic function of converting precipitation into stream flow. The watershed is part of a hierarchy of hydrological/ecological units, which constitute a water resource region. In ecological terms it is an ecosystem consisting of both terrestrial and aquatic habitats. At present watershed has been recognised as a unit of planning and development. Each watershed forms a unique ecosystem. An *ecosystem* is a functional unit of environment formed by mutually dependent and regularly interacting *abiotic* (non-living) and *biotic* (living) components or factors. Biotic components are the living organisms such as plants, animals, man and microbe which are collectively called *biotic community* or *community.* All the organisms in the community are related functionally.

[vi] The organisms of an ecosystem or community belong to two main groups: *food producers* or *autotrophs* (self nourishing) and *consumers* or *heterotrophs*. Green plants are the producers, which can fix light energy and synthesize food from simple inorganic substances. Animals are consumers feeding either directly or indirectly on the autotrophs. Animals and plants are linked through food relationship or food chain. A *food chain* is a series of different organisms through which energy is passed. The transfer of energy from the autotrophs to the herbivores (plant eaters) and through several levels of carnivores (flesh eaters) makes a trophic pattern. Energy of the sun received by plant flows through each level, such as producers, herbivores, carnivores, etc. These are called *trophic levels.* The heterotrophs may eat the autotrophs as well as other heterotrophs, or several carnivores at different trophic levels may eat the herbivore. These inter-linked food chains are known as *food web.*

The green plants upon the earth serve as a bridge in the transfer of energy from the sun to the other living forms. Hence they are called the *primary producers*. Rest of the living world, except the chemosynthetic bacteria, depend upon the production of green plants and hence designated as *consumers*. The consumers of the first order are the herbivores (*primary consumers*), which draw energy directly from the producers. Then comes the *secondary consumers* which live upon the herbivores and in turn, are consumed by others called *tertiary consumers*. The dead organisms provide energy to scavengers like vulture and decomposers like bacteria. The decomposed matter ultimately finds its way into the soil and water upon earth. The material cycle is therefore complete. The abiotic portion of an ecosystem consists of three components: inorganic substances, organic substances, and

physical factors like light, temperature, rainfall, humidity, etc. The inorganic substances are involved in material cycles of the ecosystem.

[vii] To understand the nature and extent of reclamation the watershed region was divided into three zones based on topography and relief features: (i). Central or core zone of wetlands and drainage canals lying in the valley floor, (ii). Peripheral zone which is the inner dry land zone bordering the wetlands; and (iii) Outer zone consisting of hilltops and hill slopes. At the heart lie the wetland paddy and the canals. The paddy fields are again divided into three categories based on road access. They are (i) those without road access, (ii) Those on the side of developed roads and (iii) those on the side of developing roads. It is found that the intensity of reclamation and development is high in fields on the side of developed roads followed by those on the side of developing roads. More than 90 percent of the holdings in survey blocks V and VI, which do have access to developed roads, have been developed and are under either dry land crops or used for non-agricultural purposes.

We scanned the village office records particularly the *pokkuvaravu* register that records all the transactions in the village to understand the relationship between market for wetland and the intensity of reclamation. We could not find any significant relationship between change of ownership right and land development. Number of transactions or change of ownership in survey blocks V and VII by market sale during the period from 1951 to 2000 was less by 49 per cent than the change of ownership by inheritance. In survey block VI on the other hand, change of ownership by purchase/sale was 43 per cent higher than that of by inheritance. Notwithstanding differences in the nature of change of ownership, significant differences were not seen in the intensity of reclamation and development of paddy fields. Majority of those who own paddy fields close to motorable roads are looking forward to develop at the earliest. The only constraining factor, they said, was financial resources. At present they find it difficult to fill or reclaim water logged inner core of the wetland. Otherwise the owners would have done it.

[viii] Treatises on agriculture, environment and ecology of Kerala are replete with causes and consequences of land degradation and the consequent damages that inflicted up on the natural capital of the region. Large number of studies describing the factors and forces that led to large-scale conversion of wetland paddy fields are available. The table below summarises the major findings of these studies.

Table 3 N. Summary Results of the Studies on Paddy Cultivation in Kerala

Reasons for paddy conversion	Description
Demographic	High population pressure, Family formation and growth of nuclear families
Institutional	Land reforms, demand for independent house, housing boom, emergence and growth of land market
Economic	High cost of cultivation and relatively low price of the paddy (High and rising input cost and relatively low returns)
Social and cultural	Near about total literacy, unwillingness of educated people to work in wetlands, shortage of workers for harvesting
Government policies	Rice, the staple food, is available in plenty (imported from other states) at affordable prices through state run FDS, Maveli stores and State Civil Supplies Corporation.

[ix] Wide disparity in the quality of housing was observed. Pucca houses accounts for about 49 percent of the stock. The proportions of semi-pucca and kutcha houses are 27.4 and 23.7 per cent respectively. It is also noted that the housing and living condition of poor sections like scheduled castes did not improve compared to the living standards of the richer sections. For insistence, only 5 percent of the 210 scheduled caste households live in pucca houses and more than 50 per cent among them live in poor quality kutcha houses.

[x] The late 1970s was a turning point in the development history of the state (Mridul 1994). Remittances from gulf emigrants, price hike of plantation crops, housing boom, emergence and growth of land

market and several institutional factors have resulted in an overall improvement of the level of living of all sections of society. Large number of new buildings, new roads, health centres and educational institutions came since then. Several farm roads came up across and along the bunds (embankments) bordering paddy fields. Many of them were across the paddy lands making obstructions to free flow of water. Roads were constructed along the valleys and hills also. New roads built by cutting the hills have drained out water from the slopes and that has aggravated drinking water problem during summer. However the roads pushed up the market value of the land and facilitated massive filling and levelling (development) of paddy lands.

[xi] To understand the issue in detail we selected a random sample of 8 plots from among the 31 wetland paddy plots sold/purchased in the three survey divisions since 1995. These 8 transactions together involved a total area of less than 2 hectares. Semi-structured interviews with the heads of buyer and seller households to understand their socio-economic profile and the purpose of transaction were conducted.

[xii] Majority of farmers feels that sustained rice cultivation in the region is not at all economically viable. In monetary terms, labour cost of production (wage) has increased 28 fold, while the value of the produce has increased only 7 fold during the period from 1970-71 to 1997-98. In real terms, one could hire one-man day of labour with money equivalent of 5.59 kg of paddy in 1970-71. But it has increased to the money equivalent of about 25 kg in 1997-98. Besides the rise in real and wage, cost of agricultural inputs like fertilisers and pesticides have increased much.

[xiii] Social capital refers to cost efficiency, which could be achieved through collective efforts. Coleman (1990) described it as 'the structure of relations between actors and among actors' that encourage productive activities.

[xiv] Aspirations for government jobs are high since these are 'regular, remunerative and socially superior. The social value system also accords a higher status to government jobs (Prakash, 1994). Mukherjee and Isaac (1994) confirm that the educated unemployed in Kerala prefer to wait for a job in government service.

[xv] A recent study commented that '70 percent of the farmers below the age of 40 was ready to give away their rice lands for a reasonable price. Only 2 per cent had the courage to say they will cultivate on their own' *Report of the People's Expert Committee* (1998), Centre for Environment and Development, Thiruvananthapuram, Quoted in Narayanan 2003.

[xvi] Though the absolute number of job seekers has increased, the farm sector experiences acute shortage of workers all over the state. Several studies, both at micro and macro level, points to the acute labour shortage in the paddy sector. (Jose, 1991; Shaji, 1991; Vijayam, 1994; Mridul, 1994, Joseph, 1994). With the emergence and growth of new jobs in the non-farm sector, farmer-labourer relations increasingly became formal, impersonal and contractual (Kannan, 1995; Olle Toinquist and Tharakan, 1996). The refusal to adhere to patron-client relations, the sense of dignity manifested in personal hygiene, and the changed life styles seem to have prevented the young workers from taking up work in slurry for rice cultivation. Besides rise in literacy, which raises income/job/status aspirations of the young job seekers, sharp increases in wage rates of non-agricultural work, were also considered to be the major reason for the steep fall in the availability of farm labour.

[xvii] We observed and identified 15 species of fishes, 4 species of amphibians, 7 species of reptiles and 45 species of birds in paddy fields and its borders. Borders of paddy fields are the abode of a number of predators. We recorded 15 species of pests of paddy and 43 species of predators belonging to various groups of animals. Several varieties of plants of economic importance were also found in the boarders of non-converted paddy fields. Most important among them were 5 species of fodder grasses, 5 species green manuring plants, 5 species of leafy vegetables, 6 species of wild fruits, 34 species of medicinal plants and 6 species of fibre yielding plants.

[xviii] To study the wetland communities associated with paddy fields, monthly samples of water with animals, plants and detritus were collected from selected ponds, pools, polders and canals both in converted and non-converted paddy fields regularly for one year. The samples were analysed in the research laboratory of NSS College, Pandalam to identify organisms. They were segregated into different trophic levels and recorded the name and number of each species. Their feeding habits and food web relations were traced through field observations and gut content analysis. The data on biodiversity of the converted area was compared with that of the non-converted area.

Care was taken to include all species of plaktonic organisms inhabiting in the collection site within the water sample collected. One litre of water was filtered through plankton net to separate planktons from water. Adding 20-ml water a plankton concentrate was prepared. From this, five samples of 1 ml each were taken in a counting chamber. Specimens were identified and counted under a microscope. Then recorded the number of individuals belonging to each species and calculated density per litre of water. The monthly data for three seasons were collected and analysed: Pre-monsoon (February-May), Monsoon (June-September) and Post-monsoon (October-January). From the seasonal mean numbers annual density of each species was calculated. In order to find out the level of significance in the differences in distribution and density of species in habitats in converted and non-converted areas analysis of variance (ANOVA) was employed.

Relative abundance (relative density) was analysed to understand how ecosystem changes affected the pattern of dominance of the species. Nektons are swiftly moving organisms. Hence when water sample is collected most of them will escape. They were collected monthly from the pond by towing a plakton net on the surface water for one hour. The annual mean number of each species thus collected was calculated which was taken as an indication of its density.

[xix] There are number of birds living in association with wetland paddy fields. Destruction of the bushes bordering wetlands affected the populations of Streaked fan tail warbler(*Cisticola juncidis*), Spotted Munia(*Uroloncha striata*), Weaver bird(*Ploccus philippinus*), Common king fisher (Alcedo atthis), Malay pipit (*Anthus richardi malayensis*,(Large pied wagtail (*Motacilla maderaspatensis*), Gray backed shrika (*Lanius schach*), Blossom headed parakeet (*Psittacula cyanocephala*), Blue winged parakeet(*P. columboides*), Rose ringed parakeet (P. krameri), Pied kingfisher (*Ceryle rudis*), Spotted dove (*Streptopelia chinensis*), Nilagiri Wren-warbler (*Prinia inornata*) and Black bellied Finch-lark (*Eremopterix grisea*). Seemingly, there is an increase in the presence of birds like Little egret (*Egretta garzetta*), Smaller egret *(Egretta intermedia*),Cattle egret(*Bubulcus ibis*), Large egret (*Egreta alba*) and Grey heron (*Ardea cineria*). At present White breasted water hen (*Amaurornis phoenicurus*) and snakebird (*Anhinga melanogaster*) are rarely seen. Birds like doves, weaver bird, parrots etc peck on grains while crow, stork, kite etc feed on insects, worms, fis hes, frogs etc. Notwithstanding the fact that some birds sometimes behave like pest of crops, generally they are predators and many of them help to control insect pests.

[xx] The proportion of farm workers in Kulanada Panchayat according to the Panchayat Vikasana Rekha (1996) was 9 per cent of its total population.

[xxi] Though the actual days of employment were few and far between, the sample households answered in the affirmative for our question about whether their livelihood conditions are better than the levels in mid-eighties. We presume that it may be because of the relatively high wages during the days of work, social security and welfare strategy of the governments. However, all the sample households are looking forward to governments – national, sub-national and local - support for meeting their basic needs.

[xxii] Our survey in SC households indicated that the majority of the young members are not familiar with medicinal plants and their uses. They prefer modern medicines for all types of illness. Given the changes in the attitudes and preferences of the people, even if medicinal plants were available not more than 10 per cent of the sample households would not have used them for treatment.

[xxiii] Even if local materials are available the majority of the young women even from poor families in the watershed region do not have the skill and training to produce traditional products like mats, chairs and baskets.

[xxiv] Kulanada panchayat form a major part of the ullannnor watershed. According to livestock census in 1987 there were 1753 Cows, 5211 Buffaloes and 1282 Goats in the panchayat. Another estimate in 1996 shows that the number of cows has increased to 3246 and the number of Buffaloes declined to an abysmal low of 49 and the number of goats remained at 1218. Total cattle population, which was 8246 in 1987, declined to 4513. The geographical area of Ullannor watershed region being equal to 40 per cent of the Kulanada panchayat, it is assumed that cattle population in the region is 40 percent of the total, that is 1805. Among them 27 per cent (487) are goats. Approximate number of cows and buffaloes in the sample region was therefore not less than 1300 in the year 1996.

[xxv] The decision to use up environmental goods is generally an irreversible decision, as the environment cannot be regenerated according to our wish and will. Uncertainties arise from our limited

knowledge of the ecological balance and the likely waste/loss due to use. It is unique in the sense that nature's scenic beauty is not replicable; neither can we bring back extinct species. Because of its unique features the environment has direct user-value and non-user benefit (existence value). User values or benefit that one derives is referred to as functional value. Functional value consists of actual present value and its option value.

[xxvi] Neo-classical economics, the dominant paradigm in economics today, has looked at the problem of biodiversity and loss in terms of the following three approaches:

(a) an optimising approach (focus could be on a particular species or on a particular area)
(b) a social cost benefit approach
(c) a statistical approach

In most practical applications, one finds a mix of the conservation versus development approach and a social benefit cost approach applied to specific areas or species (Kanchan Chopra 1997). Economists have been concerned with the trade-off between conservation and development. Krutilla and Fisher (1974) introduced the concept of 'preservation benefits' – the benefits that accrue to human beings from natural areas, which are lost when the area is developed. The loss of these preservation benefits, therefore, represents the hidden cost of development. The conservation versus development approach has been the basis of a number of empirical studies in the cost-benefit (CBA) framework.

[xxvii] The market value of paddy field increased 10 times from Rs 5000 per 0.01 hectare to Rs 50000 when the owner spent Rs 20000 for filling and leveling. He constructed a building in the converted land at a cost of Rs 2 lakh and now he is getting an annual rent not less than Rs 24000. This is a typical case pointing to the real benefits to the landowners from paddy conversion. Given the cost and economic return from rice cultivation, economic rationality suggests profit-seeking landowners to convert paddy land for purposes other than rice cultivation.

[xxviii] Any attempt to understand the value of economic functions of a wetland ecosystem requires scientific data on three aspects: (i) genes and species in the system and their roles/functions that benefit humans directly and indirectly; (ii) the role that wetlands plays in maintaining the stability and dynamics of the system; and (iii) direct and indirect human benefits/losses due to conservation/development. Total benefit is the benefits accrued to all stakeholders at any point in time. Such a comparison of costs and benefits to all sections of the society is not attempted in the present study.

[xxix] Though the state is against paddy conversion, widespread conversion continues unabated. A recent state government order (Rt No.157\2002\AD) issued on February 5, 2002, allowing large-scale conversion of food crop and reclamation of paddy fields for construction purposes would speed up the process. It is likely that the remaining paddy fields would be vanished in the near future. (The Hindu Daily dated 1 March 2002).