Peri-Urban Interface Production System Research
Natural Resources Systems Programme

Baseline Study and Introductory Workshop for Hubli-Dharwad City-region, Karnataka, India

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EXECUTIVE SUMMARY

BACKGROUND

This report details the activities and findings of the project entitled `Baseline Study and Introductory Workshop for the Hubli-Dharwad city-region, Karnataka, India", undertaken between January and September 1997. The project is part of an inter-disciplinary, collaborative, demand-led research programme supported by the UK Department for International Development (DFID), focusing on the "peri-urban interface".

The overall objective of the DFID research programme is to increase the productivity of the peri-urban interface production system, with a particular focus on farming systems, energy, waste and environmental management, to be achieved over 8 years. The objectives of this phase of the programme in Hubli-Dharwad being reported here were to:

- create a baseline database of natural resource information;
- develop an understanding of the peri-urban interface as a system; and
- identify research problems and priorities in as participatory way as possible.

These objectives have been achieved, though it is recognised that this project is the first phase of a longer programme of research. The next stages will continue the process of understanding the peri-urban interface production system and of identifying key themes and issues.

THE PERI-URBAN INTERFACE

Within this research project, the peri-urban interface has been perceived as a system of interactions between urban and rural areas which is most intense in the peri-urban region. It may be composed of flows of capital, commodities, natural resources, people and pollution between urban and rural economies. It is a field of dynamic socio-economic, institutional and environmental change. Because of this, new situations and problems are continually developing which may require research to help generate optimal patterns of resource use.

Research organisations have neglected the peri-urban interface. This programme is designed to help fill that gap. Two medium sized cities, Kumasi (Ghana) and Hubli-Dharwad (India) have been chosen as case study sites for the programme. In Hubli-Dharwad, staff from the University of Agricultural Sciences (UAS), Karnatak University and other local colleges collaborated with the Universities of Birmingham, Wales at Bangor and Nottingham in this project.

RESEARCH ACTIVITIES

The research was conducted in a number of phases which allowed the team to take stock of the data being collected and to assess the significance of the initial findings. The first phase involved a rapid, broad-brush survey of 25 villages or locations in the city-region, representing different production systems. The surveys produced both baseline information on natural resource issues and enabled the team to select issues and communities for further study. Census data for 1981 and 1991 was extensively analysed for the 25 villages.

Some of the key issues were pursued through sector studies, focusing on farming systems, energy, waste and socio-economic, institutional and landuse change. Data was collected through key informant interviews with government departments, the private sector and with community members, and through small surveys. Further, more participatory, studies were then carried out in four villages. The results of these studies formed the basis for a workshop held in Dharwad in July, bringing together local, national and international expertise to consider the information collected and the problems and research priorities identified. This report is based on all of this material.

KEY THEMES

Socio-economic characteristics

Average village size varied in 1991 from 1,394 (Kalghatgi) to 2,772 (Navalgund), with the larger villages in the black cotton soil irrigated areas. However, these villages tend to have lost population through out-migration over the 1980s, while villages in the wetter, red soil areas north and east of the city, Dharwad taluk in particular has a concentration of villages (c 70%) which have grown by attracting in-migrants. In Hubli and Kalghatgi taluks, villages growing at more than the average natural rate of increase have tended to be close to the city; villages further away have tended to lose population.

Growth in population may be explained by the increase in non-farm employment opportunities in the three taluks closest to Hubli-Dharwad: Hubli, Dharwad and Kalghatgi. The increase in non-farm employment was particularly marked for men. 101 villages in the five taluks had experienced a decline in non-farm employment, suggesting both a concentration of such employment and an inability to compete with city enterprises.

Participation in the labour force as a whole has increased particularly rapidly for women in the three taluks nearest the city. Given that female non-farm workers increased much more slowly than male, most women were finding work in the lower paid farm sector. Poverty in the peri-urban areas thus has a strong gender dimension.

Literacy levels were studied, as an indicator of wellbeing/poverty. In general male rates (around the 50% mark) were more than double female in 1981 and almost double in 1991. There was significant variation by taluk, with the best rates in the wealthiest and more agrarian areas east of the city, and the lowest rates in the forest fringe areas. The three more dynamic taluks are probably absorbing unskilled, uneducated migrant labour.

Overall, we can say that the pattern of growth and change is dynamic and complex to the west and north of the city, but rather stagnant and more purely agrarian elsewhere. This difference may be explained by several factors. There may be varied degrees of land pressure, new opportunities presented by irrigation and changing cropping patterns, new opportunities for employment providing goods and services to the city, and possibilities for commuting.

Changes in land use and farming systems

The picture is of generally increasing pressure on land throughout the city region, with the possible exception of Kundgol taluk, where there appears to have been an increase in land available per cultivator. However, there is a high degree of variation in hectares/household in the more dynamic taluks, compared to greater equality in the less dynamic taluks. Land pressure was not found to be strongly correlated with proximity to the city - it is caused by more complex factors, suggesting again that the flows and linkages PUI model may have more explanatory power than the spatial model. Land values have increased dramatically in the more rapidly developing areas northwest and southwest of the city-region, where population and non-farm employment increases have occurred.

At district level, the statistics show significant increases, but gradual, in both area cultivated for all the major crops except cotton, and variable increases in yields over the 1970s and 1980s. There has been a trend toward mechanisation, with a concomitant reduction in plough animals. Traditional dairy breeds have also been replaced to some extent by hybrids, and numbers reduced. Overall there has been a reduction in farmyard manure as a result. This has not yet been studied or quantified.

At peri-urban level the picture is more varied, but statistically less complete. At the margins, there has been a substantial degree of crop diversification, which usually covers a small proportion of land cultivated. Diversification has been achieved on a stable cropping pattern base - with cotton, chilli, rice, groundnut and sorghum being the major crops, and cotton-chilli, sorghum-pigeonpea being the major intercrops. The more participatory studies showed strong patterns of diversification in a variety of villages - into horticulture, fruit trees, horticulture-arable intercrops and maize, particularly since the 1970s. Change was seen by farmers as being principally due to increased irrigation and the relative profitability of different crops.

Changing profitability is partly explained by the development of commodity markets. These are diverse, and specialised markets are located throughout the region, with some concentration in Hubli and Dharwad. There would appear to be a distinction between local (city-region) and wider markets, with bigger producers slotted into the wider regional market networks and smaller producers serving the local market. The local market would appear to be less organised; transaction costs may be higher, with consequences for the poorer producer and consumer households who depend on them. This difference seems to be especially marked in the rapidly developing horticultural markets. This is at the level of a hypothesis, to be tested in further research, along with an exploration of why local markets should be less smoothly functioning - is it a

question of the scale of trading enterprise and access to working capital, storage facilities, physical infrastructure?

A further important dimension of change in farming systems centres around the labour market. These changes are complex and not yet researched. There are contradictory pieces of information: in the more rapidly growing peri-urban areas, wages are generally lower than elsewhere, and considerably lower than in the city. This may be due to the rapidly growing participation of women in the labour force in these areas. At the same time, farmers in these areas report shortages of agricultural labour, which is not consistent with the low wage rates being paid, unless other factors are involved (e.g. skill level, seasonal availability etc.). One of the responses is to develop mango orchards, which involve less permanent labour inputs, and where labour operations are increasingly being let to contractors. On the other hand, in the areas which are more agrarian and prosperous (due to canal irrigation) wages are higher, but there has been a significant reduction in the proportion of the population engaged as farm labour, indicating a substantial degree of mechanisation.

As villages are absorbed into the administrative boundaries of the city, the policy framework changes. Access to subsidies (e.g. subsidised credit through IRDP) is not available. It is not clear how this may affect farming systems, but it is a symptom of the institutional vacuum which incorporated villages experience.

Renewable energy

Hubli-Dharwad is very representative of medium-sized cities in South Asia whose growth is severely constrained by power and water shortages. The impact of structural adjustment has been felt more heavily in the power sector than anywhere else in the Indian economy, in the shape of constraints on capital investment for new projects. At the same time, the constraints on private sector involvement have not been removed, so the private sector also finds investment in power difficult.

A number of studies were undertaken in the Hubli-Dharwad city-region to generate baseline information on energy sources and consumption patterns. The shortages in electricity are severe in the Hubli-Dharwad city-region, as in many other parts of India. This has constrained development in the peri-urban interface. Distributing and using electricity efficiently and making use of renewable sources of energy present avenues to address the power problems. The case for the increasing utilisation of decentralised energy generation technology is strong in the light of continuing deficiencies in electricity generation.

A number of characteristics of energy consumption patterns were observed, including differences in types of fuel used between the urban and rural areas, and between households of different income levels. There have been no substantial changes over the 1987-1997 decade in types of fuel used (both rural and urban), though use of liquified petroleum gas is increasing. Agricultural waste, particularly cotton stalks, offers a cheap source of fuel for many households in rural and peri-urban areas. The time taken to collect agricultural waste, firewood and twigs and branches does present problems when many members of households take up employment other than

farming. This may have implications for fuel use in the future as the trend of taking up urban employment increases.

Waste and pollution

There has been a tradition of selling waste from the municipal dumpsites to farmers, either through auctions, in Dharwad, or by tractor-loads, taken by the farmers for a certain price. The market for municipal waste has declined since the construction of the underground sewerage system in parts of the cities and the changing composition of solid waste. In recent years, the garbage has not been as suitable for use on fields as it used to be and so, the auction system is not as effective as it was in the past. The increase in waste over the coming years will create problems in terms of its' handling and disposal. There is also the possibility that ground water is being polluted due to infiltration near the dumpsites.

The waste generated by the agro-industries is generally used in agriculture. Dung produced in the urban dairies is used either by the dairies themselves (particularly large dairies), or sold as dung cakes for fuel. There does not appear to be a market in selling dung for use on land. Poultry waste is either used on land belonging to the owners or is sold to large farmers. The use of waste from pigs is yet to be utilised in a systematic way as the pigs roam freely in the city. Waste from rice and saw mills does appear to be sold efficiently. However, the potential for the utilisation of distillery waste, both as sludge as well as spent wash, is yet to be investigated.

Urban wastewater is used for irrigation of horticultural crops, but is creating (minor) health hazards, as well as leading to more weeds and insect pests within the crops. This, in turn, leads to greater use of pesticides. Finally, pollution sources and effects associated with the peri-urban interface have not been systematically examined. However, there have been a number of pollution incidents, such as that pursued by an NGO, and the waste created by the industrial estates has been a cause for concern.

Water

There are a number of public sector organisations involved in water resource management activities, which means that there are many information sources, leading to fragmented collection of data. However, it is clear that there is information available on the amount of water going into the urban areas, but insufficient information has been collected on the distribution of water to the peri-urban and rural areas.

The information collected to date provides a rough picture of the issues, including the inadequate supply of water to the urban areas, in part due to the unreliable power supplies, the brackish nature of much of the groundwater in the rural areas and the insufficient availability of water for small irrigation schemes.

Government planning

Planning in the Hubli-Dharwad area is currently divided between the Hubli-Dharwad Urban Development Authority (HDUDA) and the Dharwad Zilla Panchayat (DZP). However, each operates under a different interpretation of planning. The HDUDA is concerned with physical or town and country planning; its priority is to engage in forward planning, leaving the Hubli-Dharwad Municipal Corporation responsible for the implementation of these plans. The emphasis is on accommodating urban growth rather than making specific land use decisions as part of an environmental management plan or strategy. Scope exists for greater integration of environmental concerns into the current comprehensive development planning approach.

In contrast, the Zilla Panchayat is concerned with socio-economic planning and has virtually no concern with land-use decision-making or physical planning. The various Gram Panchayats within the district make requests for funding, and the DZP allocates resources to each department in accordance with Central and State plans. The Village Development Committees of the Gram Panchayat are also concerned with socio-economic planning and the allocation of resources to specific projects. There appears to be little attempt to engage in physical or land-use planning. Consequently there is a danger that land-use conflicts may emerge in the future when environmental issues are neglected.

The present planning systems lack effective means of co-ordination. Problems arise from the limited inter-institutional co-ordination between the urban-based, long-term, physical planning approach of the HDUDA and the rural-based, short-term, socio-economic and non-spatial planning approach of the DZP. This has been recognised by the State Government which has set up a (not fully accountable) District Planning Board with representation from all the local planning authorities.

One of the key issues which planning authorities will have to deal with in future is their relationships with the many small communities which make up the peri-urban interface. Until now the relationship has been based on absorption and domination, rather than sustainable development.

RESEARCHABLE THEMES

Researchable themes have been identified through the participatory exercises in the four villages and through the theme paper studies.

The researchable issues arising from the village-level studies include:

- addressing problems relating to the use of wastewater from the urban areas for irrigating crops;
- assessing the development of institutional arrangements within a dynamic peri-urban system;
- the potential for addressing electricity shortages through the development of more decentralised production; and,

• the need to gain a greater understanding of changes in labour and commodity markets, the implications of them and potential responses.

A number of researchable themes were also identified at the July 1997 Workshop in Dharwad, after presentation and discussion of the workshop papers. The following table highlights some of the research priorities identified.

Field	*Priorities identified* *
Farming Systems	Reported low soil fertility Moisture conservation, including use of waste water Weeds and pests in wastewater systems Poorly articulated labour market (high wage disparities, labour scarcities) Local marketing of key products e.g. mango, milk, vegetables
Energy	Survey scarce waste material available for decentralised power generation Scope for community biogas for power generation
Waste	Health and environmental problems (weed and pest incidence) due to waste water use for vegetable Alternative uses of urban waste (including pig manure human septic tank nightsoil) (characterisation of wastes, identification of demand) Decline of municipal compost auction system
Environmental Management	Peri-urban institutional vacuum

*Not in any order of priority

There is a clear overlap here between the farming systems identification of soil fertility as a researchable issue and the availability of underused urban waste. The basic energy issues are either dependent on change in subsidy policy, or capable of being included in a farming systems study.

CONCLUSION

Preliminary analysis of the information collected during 1997 suggests that there are researchable problems with a short pay-off period. The most obvious of these is the question of whether alternative systems and techniques for processing urban wastes can be harnessed to reduce the soil fertility constraint identified in peri-urban agriculture. Other short term farming system improvements which may be researched include the management problems of peri-urban farming using untreated sewage water, and the "problem" of urban piggeries.

It may be that the most significant research will be done in the medium-longer term on issues which are at present not clearly enough perceived: the rapid and seemingly irreversible erosion of knowledge about natural resource management; the substitution of integrated pest management for toxic agro-chemicals in field horticulture; the development of new peri-urban institutional arrangements for managing development and natural resources; the development of strategies which permit higher wages and the conservation of small scale peasant farming; and, the search for appropriate modalities for *local* market development. Although researchers will initially be addressing issues with shorter time horizons, the short term research should as far as possible retain space for consideration of these significant and specifically peri-urban issues.

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ABBREVIATIONS

AEH	All electric homes
APMC	Agrircultural Products Marketing Corporation
DFID	Department for International Development
DZP	Dharwad Zilla Panchayat
GIS	Geographical Information Systems
HDMC	Hubli-Dharwad Municipal Corporation
HDUDA	Hubli-Dharwad Urban Development Authority
ISRO	Indian Space Research Organisation
JVS	Janapara Vignana-Tantragnana Samsthe (A People-Oriented Science-Technology Institute)
KEB	Karnataka Electricity Board
KMF	Karnataka Milk Federation
KSPCB	Karnataka State Pollution Control Board
KSFIC	Karnataka State Forests Industries Corporation
KSRSTUC	Karnataka State Remote Sensing Technology Utilisation Centre (Bangalore)
KUWSDB	Karnataka Urban Water Supply and Drainage Board
LPG	Liquid Petroleum Gas
MRBC	Malaprabha Right Bank Canal
NGO	Non-Governmental Organisation
NIC	National Informatics Centre
NRDMS	Natural Resource Data Management Centre (Dharwad)
NRSP	Natural Resources Systems Programme
PUI	Peri-Urban Interface
SPS	Samaj Parivartana Samudaya
UAS	University of Agricultural Sciences (Dharwad)
WALMI	Water and Land Management Institute (Dharwad)

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Specific contributions

Dr C. S. Hunshal co-ordinated the project in Hubli-Dharwad, including organising meetings, surveyors and surveys.

Dr. S. R. Shambhulingaiah organised and conducted the health checkup for the sewage-irrigation study, with the assistance of Dr. V. R. Desai Dermatologist, Dr. A. K. Handigol President of IMA Dharwad, Dr. Suresh Halsangimath and Dr. V. G. Narasapur Physician.

The list of papers in the Workshop proceedings (see Appendix D) includes the authors of those papers.

This report was compiled by the Universities of Birmingham, Nottingham and Wales at Bangor, and was edited by Fiona Nunan of the University of Birmingham.

1. BACKGROUND

1.1 Introduction

This report details the activities and findings of the project entitled "Baseline Study and Introductory Workshop for the Hubli-Dharwad city-region, Karnataka, India", undertaken between January and September 1997. The project is part of an inter-disciplinary, collaborative, demand-led research programme supported by the UK Department for International Development (DFID), focusing on the "peri-urban interface".

The overall objective of the DFID research programme is to increase the productivity of the peri-urban interface production system, with a particular focus on farming systems, energy, waste and environmental management. This objective will be achieved over 8 years. The objectives of this phase of the programme in Hubli-Dharwad being reported here were to:

- create a baseline database of natural resource information;
- develop an understanding of the peri-urban interface as a system; and
- identify research problems and priorities in as participatory way as possible.

Within this research project, the peri-urban interface has been perceived as a system of interactions between urban and rural areas which is most intense in the peri-urban region. It may be composed of flows of capital, commodities, natural resources, people, and pollution between urban and rural economies. It is a field of dynamic socio-economic, institutional and environmental change. Because of this, new situations and problems are continually developing which may require research to help generate optimal patterns of resource use. Research organisations have neglected the peri-urban interface. This programme is designed to help fill that gap. Two medium sized cities, Kumasi (Ghana) and Hubli-Dharwad (India) have been chosen as sites for the programme. In Hubli-Dharwad staff from the University of Agricultural Sciences (UAS) and Karnatak University, and other local colleges are collaborating with the Universities of Birmingham, Wales at Bangor, and Nottingham in developing the research programme.

1.2 The Project Logframe and Terms of Reference

The terms of reference for this study are included as Appendix A, and the logical framework as Appendix B. The `goal' of the research was to address the three `purposes' of the PUI Production System Programme, as follows:

- Management of peri-urban resources optimised through improved productivity, control of environmental degradation, and energy efficiency.
- Crop production intensified on a sustainable basis.
- Productive potential increased by greater use of `waste' materials and recycling of resources.

These `purposes' guided the collection of data for the baseline survey, the nature of the studies undertaken and the recommendations of future research.

A number of comments can be made about the progress of the research. This was the first stage of a collaborative research process. As such, working relationships and understandings had to be developed among team members. A division of labour had to evolve, and responsibilities taken for the various activities and outputs specified in the proposal. The activities were carried out and the outputs have been created; however, there were also a number of constraints, not all of which were anticipated, which have affected the quality of the output.

The strategy from the beginning was to involve individual researchers in Hubli-Dharwad and, as a far as possible, the identified Indian research organisations as fully as possible in the research process. However, the researchers faced considerable time constraints juggling their inputs to the research with extensive teaching and administrative obligations, and, in some cases, with other research projects. On the UK side, the scope of the study required several team members, whose skills could not easily be found locally, including an additional unexpected input on farming systems which it had been thought would be provided by the Indian organisations, and the time inputs of UK staff were also severely limited by the budget available.

In the circumstances, a number of difficulties were experienced: there was too little time to establish a truly participatory process, involving NGOs as well as researcher-community interactions. A training programme in participatory research was carried out, and some fieldwork was completed, but this was done in a hurry, and the results were disappointing. However, the groundwork has been laid for future work, and for the first time relationships between researchers and NGOs have been established. This process and these relationships will require further nurturing from the UK team if they are to be of genuine use in future.

The quality of papers presented to the July workshop was variable. Some were excellent, others informative, but some were of limited value, due to the limitations in time for data collection, or analytical rigour. Terms of reference were provided for each study, but these were not always followed: in fact the whole structure of the research was unfamiliar to some members of the team - the idea of commissioned research with terms of reference being relatively new to several. Thus over time the research culture needs to be further developed if future specified outputs are to be achieved with greater precision.

As the objects of research are defined more precisely it will be necessary to attempt to recruit into the research team scientists specialised in particular topics. If these cannot be found locally (or indeed within the resources of the UK universities involved) they will need to be resourced from other Indian or UK institutes. The involvement of scientists from outside the current research organisations may help to improve the quality of outputs.

1.3 Research activities

The research was conducted in a number of phases which allowed the team to take stock of the data being collected and to assess the significance of the initial findings. The first phase involved a rapid, broad-brush survey of 25 villages or locations in the city-region, representing the different production systems. The data was collected through key informant interviews and focus group discussions. The focus groups included landless labourers, small, medium and large landholders, and occupational groups. The surveys produced both baseline information on natural resource issues and enabled the team to select issues and communities for further study.

The 25 villages were selected to fall within the following groups:
• within the Hubli-Dharwad Urban Development Authority area;
• within approximately 20km of Hubli-Dharwad - served by the city bus services; • within a 20-50km radius.

Different production systems were then selected within these areas, across the red and black soil areas. A map showing the location of the 25 villages is given in Chapter 3. Census data from 1981 and 1991 was also analysed for the 25 villages and supplemented the information gained in the surveys and focus group discussions.

Some of the key issues were pursued through sector studies, focusing on farming systems, energy, waste and socio-economic, institutional and landuse change. Data was collected through key informant interviews and through small sample surveys. The sources of information are referred to within Chapters 3 to 7, and further information is given in Appendix C. Further, more participatory, studies were then carried out in four villages. The results of all of these studies formed the basis for a workshop held in Dharwad in July 1997, bringing together local, national and international expertise to consider the information collected, the problems and research priorities identified. The Final Technical Report is based on all of this material.

A volume of papers was presented to the workshop (see Appendix D for the Table of Contents). The volume is available on request. Presentations were made, and group discussions were held to identify priorities for further research. These are discussed in Chapter 9.

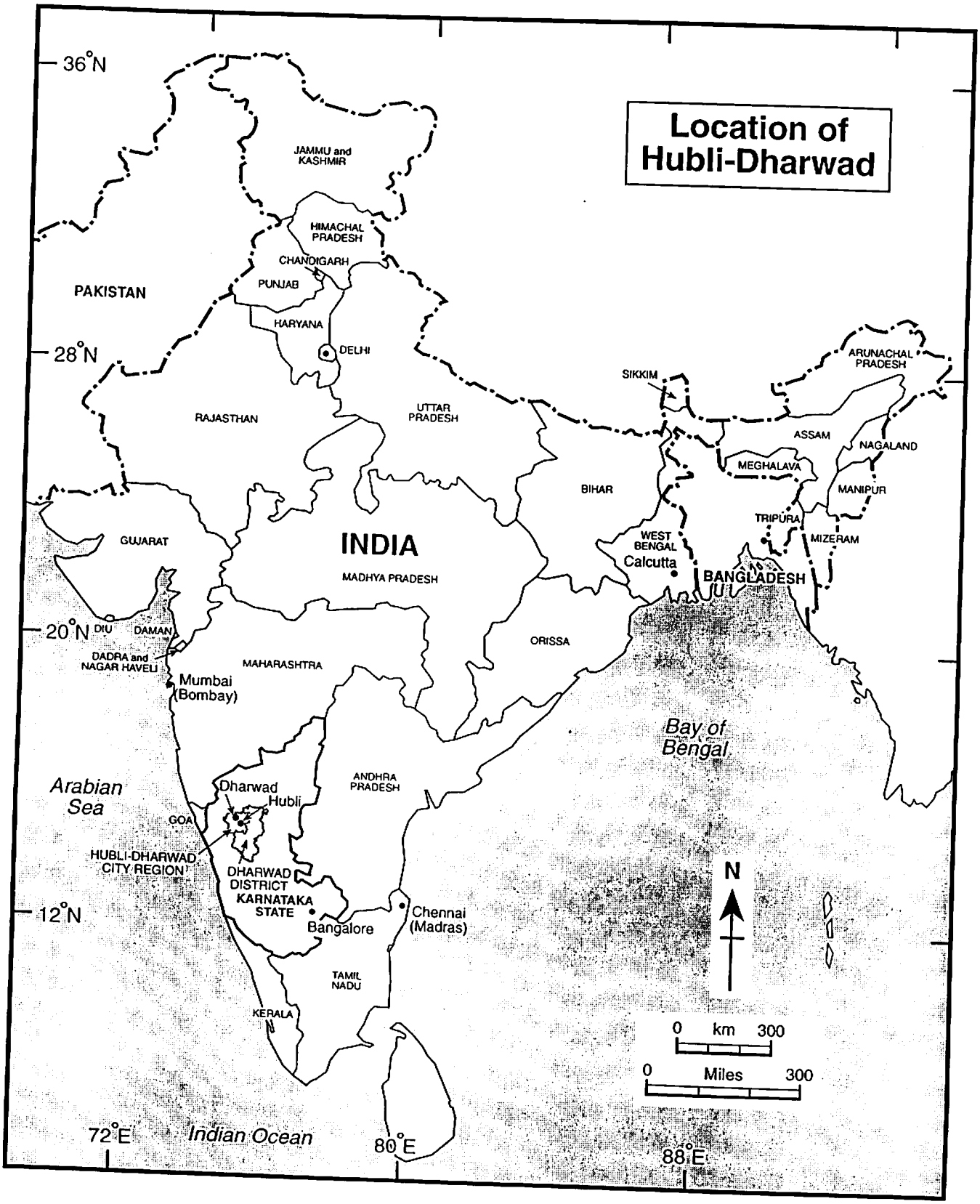
1.4 Outline of the report

This report begins with an elaboration of the peri-urban interface concept. This focuses on the need to move away from straightforward spatial notions of the "peri-urban", highlighting a number of key characteristics of the concept which should inform the analysis of the natural resources profile given in Chapters 3 to 7. These chapters describe and analyse a number of themes within the peri-urban interface context. Chapter 3 discusses the socio-economic characteristics and land uses in the PUI, and makes observations about the quality and sources of data. The key changes in the farming systems observed in the PUI are discussed in Chapter 4, noting the constraints

and opportunities presented by the PUI. Chapter 5 presents the results of a number of studies undertaken during the research on energy needs and sources, and highlights the constraints on urban development presented by electricity shortages and the scope for developing a more decentralised approach to energy generation. Chapter 6 focuses on the urban and peri-urban generation and utilisation of waste materials. Finally, water resource issues within the PUI context are set out in Chapter 7.

The report then goes on to examine government planning processes impacting on the PUI in Chapter 8. Urban, district, taluk and village planning processes are discussed and difficulties in co-ordination between the levels of planning examined. Finally, in Chapter 9, promising research directions are identified and elaborated.

A map showing the location of Hubli-Dharwad in India follows.


Location of Hubli-Dharwad
36°N
28°N
20°N
12°N
72°E
80°E
88°E
JAMMU and KASHMIR
HIMACHAL PRADESH
CHANDIGARH
PUNJAB
PAKISTAN
HARYANA
DELHI
RAJASTHAN
UTTAR PRADESH
SIKKIM
ARUNACHAL PRADESH
ASSAM
NAGALAND
MEGHALAVA
MANIPUR
TRIPURA
MIZERAM
BIHAR
WEST BENGAL
Calcutta
BANGLADESH
INDIA
MADHYA PRADESH
GUJARAT
DIU
DAMAN
DADRA and NAGAR HAVELI
MAHARASHTRA
Mumbai (Bombay)
ORISSA
Bay of Bengal
Arabian Sea
Dharwad
Hubli
ANDHRA PRADESH
GOA
HUBLI-DHARWAD CITY REGION
DHARWAD DISTRICT
KARNATAKA STATE
Bangalore
Chennai (Madras)
TAMIL NADU
KERALA
Indian Ocean
N
0 km 300
0 Miles 300

2. THE PERI-URBAN INTERFACE

2.1 Conceptualising the peri-urban interface

There are several starting points in conceptualising the peri-urban interface (PUI) production system. These are: the geographer's concerns; blurring the urban-rural divide; challenging planning orthodoxies (e.g. zoning); the search for production efficiencies; and, the economic importance of the peri-urban. Each perspective is briefly sketched below and a few concluding comments are made, identifying the key characteristics to inform the analysis of the natural resources profile of Hubli-Dharwad.

2.1.1 Spatial definitions of the Peri-urban Interface

The earliest characterisations of the rural-urban fringe represented a static rather than a dynamic concept. It was theorised that concentric zones of decreasing productivity, or intensity of activities and land uses, surrounded an urban area. The most productive zone immediately surrounding the urban core was classified as the rural-urban fringe or the zone of transition between urban areas and the more rural hinterlands.

The spatial pattern of a doughnut-shaped ring around the city has been modified, however, into one with finger-shaped extensions outwards along the main roads leading from the city. Radial routes characteristically lead to a star-shaped rural-urban fringe; reductions in travel times and travel costs along these main roads can lead to a semi-urbanised area in which changes take place due to urbanisation or agricultural intensification and extending outwards varying along distances from the city.

Although increasingly it is recognised that it is the processes taking place which give the peri-urban interface its dynamic character rather than these simple spatial patterns, the peri-urban interface may still also be visualised as a zone of varying distances around the urban core. Within the city itself, undeveloped, green or agro-based wedges or corridors may remain which continue to be used for livestock, horticulture, agriculture, recreation, or as flood plains or conservation zones alongside streams. The zone's outer limits are also unclearly defined: different definitions or indicators of the peri-urban will extend to varying distances into the surrounding rural areas. These varying spheres of influence for different functions and activities have led to uncertainties about the precise definition of the urban footprint or the geographical extent of the city-region.

However, when it comes to conceptualising peri-urban interface *production systems* spatial considerations give way to more dynamic resource flows, as discussed in Section 2.2.

2.1.2 Blurring the urban-rural divide

Development Studies and development practice has long cherished the conceptual divide between rural and urban development. It shows up in administrative structures,

degree programmes, and development theory. Academics are rarely both urbanists and ruralists. Administrators usually specialise in careers in one or the other type of area. Development professionals' *curricula vitae* fall clearly on one side of the divide or the other. People who resist this division are rare. There are some well established fields of study which cut across the divide, such as migration studies, though even in this case there was for many years a divide between analysts focusing on pull and on push factors. In fact, the flow of people, commodities, resources, ideas, culture and institutions between urban and rural areas lies at the heart of virtually any development process. Both urban and rural societies and economies can be engaged in a mutually reinforcing process of evolution, or it can be a process characterised by imbalance and exploitation. In order to achieve balanced growth there is a lot to be said for focusing explicitly on the interface between the two systems. This can be a research, problem-solving focus, or a strategic and developmental focus.

A difficulty with this blurring, will be to identify uptake pathways which are specifically peri-urban, because the institutions are weak. In Hubli-Dharwad, there is a new District Planning Board which combines delegates from the District (rural) Council as well as the Municipal Corporation. The Deputy Commissioner has already invited the research programme to contribute to the agenda of this new body.

2.1.3 Challenging planning orthodoxies

Urban and rural planners think spatially, and tend to zone activities: thus it is seen as efficient to keep spatially separate activities like industry, commerce, and residence. Likewise, it is seen that urban and rural areas should be clearly demarcated, and in the Anglo-Saxon tradition, separately administered. The peri-urban, by its very nature, offers a challenge to this neat classification and separation. Industrialists tend to move to peri-urban (or remote) greenfield sites; people prefer to live near work if possible; markets locate in relation to many factors, but tend to prefer centre-town locations. Agricultural enterprises remain within the city, and are often not amenable to easy zoning. Environmentalists have increasingly drawn attention to the flows of waste and pollution which cross the boundaries - i.e. to the interdependencies between zoned functions.

One implication for planners is the need to grasp more firmly the characteristics and peculiar dynamics of peri-urban communities. This is difficult while there is an institutional vacuum in peri-urban areas. The challenge for planners is, then, to develop a planning approach which is participatory and inclusive, rather than top-down and exclusive, and then to institutionalise this approach for peri-urban villages as they are absorbed by the Municipality (or Urban Development Authority). In turn, this will require organisational change in these two organisations.

2.1.4 The search for production efficiencies

At a system level, the process of urban development can be seen to generate many inefficiencies - situations in which resources are used suboptimally. This in turn

constrains the rate of economic growth. For example, pollution which is unmanaged causes ill-health which may reduce the efficiency of labour; land may be used for purposes which are unsuitable given its scarcity; capital may be tied up in relatively unproductive activities. Sometimes these suboptimal uses of resources are caused by policy distortions, sometimes by an absence of knowledge about the actual possibilities, sometimes by institutional failures. Markets may also be characterised by failure - absence of information; poor functioning of secondary markets (eg credit, insurance); poor infrastructure.

The PUI is characterised by rapid change, which creates disjunctions and lags as people and/or institutions struggle to catch up. There is also a co-existence of different production systems - technologies, social relationships. Production efficiencies can be measured against the scarce resources of capital, land, labour and other resources (e.g. water).

2.1.5 The economic importance of the peri-urban interface

Peri-urban space is the location for a high proportion of capital investment and new activity in any economy. It is here that factories and new housing estates are established; that people benefiting from, or displaced by, inner urban development tend to move to; and, that the wastes of a growing city are dumped. Agriculture in the peri-urban interface tends to become more capital and labour intensive, moving to high value enterprises (typically poultry, stall fed livestock and horticulture). Agricultural pollution may correspondingly increase. A substantial proportion of credit is allocated to peri-urban uses. Thus, it is likely that the peri-urban space is a contested one: different interest groups have varied projects for it; each would like policy to reflect their projects.

India's industrial policies have a particular impact on the peri-urban areas: big industry generally has to locate well away from cities. Hubli-Dharwad is about to experience a major investment by Tata in a vehicle factory. This may bring new challenges to the flows of labour, commodities and pollution between the peri-urban interface, the rural and urban areas.

2.2 Conceptualising production systems

The systems approach to the analysis of production systems has advantages over an enterprise approach, as far as policy and research programme development are concerned. It offers:

- a holistic framework, with emphasis on the inter- and infra-system interactions and flows;
- analysis at different levels: moving from the household, through enterprises to networks, joined by competition and co-operation in the market place, and framed by policy interventions; and,

• a focus on externalities and common/public goods (and bads). These are critical aspects of production systems which generally emerge beyond the individual enterprise level: they are conditions of enterprise success (e.g. infrastructure, supporting institutions), or negative impacts of producers on others. They often represent untapped resource flows, or neglected opportunities.

2.2.1 The peri-urban interface as a production system

The nature of a peri-urban interface production system may be determined by examining a series of related flows and changes:

• flows of commodities: these are complex as the market hubs for the great variety of agricultural and other commodities produced in the city-region lie both in Hubli-Dharwad and elsewhere. Initial investigation suggests that regional and national markets may be better developed than local markets for some key typically "peri-urban" high value commodities like vegetables, fruits and milk. Small farmers are looking for labour-saving enterprises, while medium and large farmers are increasingly growing higher value crops through new labour arrangements, and are thus able to command the necessary labour force. There seem to be market failures here which would justify further research and intervention to improve productivity.

• flows of labour: the extensive development of commuting from surrounding villages to the city has led to a labour-scarce village economy to which state sponsored research and development programmes need to adjust. This is a case of state failure to serve the PUI production system. Labour scarcity is paradoxically combined with relatively low wages in the peri-urban areas. The reasons for the non-adjustment of wages to factor scarcity in these areas should be investigated.

• flows of investment: there are investments occurring in designated urban development areas, but there are also speculative and income tax-avoiding investments in land around the incomplete ring road and in mango orchards to the west and northwest of the city. Increases in land values are clearly uneven, and, as expected, concentrated where urban development is most rapid.

• flows of waste: the PUI perspective highlights the flows of waste between the urban and surrounding areas, linking the needs of managing urban waste and accessing soil ameliorants, fertilisers and animal feed in the urban and peri-urban areas. The perspective encourages a shift in emphasis from how to dispose of waste to how waste materials can be better utilised and what systems are needed to facilitate increased utilisation. The flows of waste and pollution in the Hubli-Dharwad city region include the auctioning of waste pits from the Dharwad dumpsite, the use of untreated waste water for irrigation of horticulture and the contamination of drinking water by agricultural runoff. In turn, these flows point to a number of issues of concern, such as the health effects of using untreated wastewater on horticulture, the declining markets for urban waste and the potentially deteriorating quality of river water.

- flows of energy: these are largely rural to urban in the form of electricity from the grid, firewood for cooking (a declining source), and intra-rural recycling through biogas and use of agricultural residues. There are substantial deficits which could be filled by decentralised energy production; however, there appear to be policy barriers to expanded uses of technically feasible renewable sources of energy. This is a constraint on further urban, industrial and broader economic growth. There is also a shortage of biomass for decentralised energy production: a first step is to identify underused sources. Labour requirements in collecting agricultural waste as a fuel and the impact these requirements have once more people take up urban employment, and, the scope for more decentralised electricity production to address power shortages are key issues raised by the PUI perspective.

- labour shortage means that agriculture is increasingly mechanised, with a significant increase in the number of tractors in use. This is also a response to a secular decline in fodder availability due to the privatisation of common land and two major droughts which have combined to reduce the buffalo population. In turn, the reduced buffalo population and the widespread use of dung for cooking fuel contributes to a decline in on-farm nutrient recycling and soil fertility problems. The decline of the cattle population is especially marked in the peri-urban area, despite an unsatisfied market for milk in the city: this may be due to the inefficiency of the major bulk milk buyer, the Karnataka Milk Federation.

- flows of water and water-borne pollution: the cities are supplied from a number of dams, the catchment areas of which still need to be investigated; these have replaced a large number of urban "tanks" which have either now silted up, been built over or are used for washing, buffaloes, and are possibly highly polluted. Underground aquifers are hardly tapped as yet, though extreme water shortage in the cities is leading to a rapid process of investment in peri-urban tubewells by farmers, and industrialists. There is no monitoring of the possibility that groundwater is being polluted. There is no effective regulatory system in place. Streams also carry polluted water away from the city: there is industrial pollution which leads to complaints from local residents; and there is sewage water. The intensification of peri-urban agriculture, in particular the common use of a number of highly toxic agro-chemicals, is an additional source of pollution, which is of increasing concern to consumers concerned about chemical residues in food.

- flows of knowledge: there are urban as well as rural sources of knowledge which compete at the interface. Farmers' technical knowledge is clearly being lost as farming systems change (generally become simpler) and small Earn-iers leave the land. Genetic stock may also be disappearing. The widespread use of the lunar calendar for cropping decisions may also be threatened. There is little well articulated scientific information to replace farmers' teclulical knowledge: what there is tends to be very partial and disintegrated.

Conceptualising the peri-urban interface production system as a series of interconnected flows and changes over time helps to ensure that the system is represented as a dynamic one, since the pace of change in the interface is rapid, and the flows within and between production systems are significant.

2.3 Key features of the system

2.3.1 Uneven development

The unevenness of the urban impact is a feature of the studies undertaken: strong impacts occur at particular points, and affect some villages quite differently from others. Enterprises are intensified and/or diversified in very different ways in different places. Thus undiversified, traditional businesses co-exist with diversified, resource-intensive businesses side by side. The peri-urban space is where the features of the "dual economy" can be seen very clearly. There are also big differences between rich and poor households' investment/survival patterns; thus within villages the social differences would appear to widen as the village becomes more peri-urban. In Hubli-Dharwad there are further differences caused by the clear distinction between areas characterised by black and red soils, with "urban" development concentrated in the red soils areas. There are further differences between the well oiled regional produce markets compared with poorly articulated local markets (for example, in horticultural production).

2.3.2 A high degree of "rurality"

It is a highly "rural" city-region, with substantial proportions of the "urban" population engaging in typically "rural" occupations (farmer, herder etc.). Urbanisation is taking place, but under a set of key constraints: electricity and water supply; shortage of municipal investment resources; and an institutional vacuum in the peri-urban zone, once villages are absorbed administratively into the city. The severity of these constraints means that the strategic choices which have to be made cannot often be made within a standard "urban" frame of reference, which assumes that the resources are available to urbanise evenly and rapidly. The urban form which results is a typically uneven one, as mentioned above; investments made in land development are therefore highly varied, and may not conform well to any master plan. A particular feature (of India in general) is the location of large scale industry well away from the city: the location of Talco well up the Belgaum road, and other factories further away is partly a result of the locations of raw materials (e.g. timber for paper), electricity and roads, but partly also a result of government policy on industrial location. Thus big industries which might otherwise help urbanise more rapidly and deeply are generally located elsewhere.

2.3.3 **Absence of information and scarcity of public investment**

There is an absence of information about and investment in the production/waste interface which characterises the peri-urban interface; an absence of a comprehensive database against which to monitor natural resource use and degradation, because, despite the rapidity and depth of change, it has not been considered a vulnerable environment; and an absence of public investment resources for public goods/bads, due to the historical centralisation of public resources in India, a neglect of the smaller cities, and non-recognition of the special characteristics of the peri-urban.

The absence of strong public institutions supported with a regular flow of development finance means that problems are not tackled till they become severe (or emergencies). Weak planning frameworks and procedures can be attributed to the lack of revenue (in part due to the demise of *octroi,* a tax on goods brought into the state), the absence of institutions in the peri-urban, and the absence of an analytical framework which deals effectively with the peri-urban.

Table 2.1 below indicates in summary the main flows and changes in flows observed for the production systems of the Hubli-Dharwad peri-urban interface. Many of these features would be found to a greater or lesser degree in other medium sized South Asian cities, and some would be common to medium sized cities in poor countries in general. In this sense, the choice of this city as a location for the research is well justified.

2.4 Conclusion

A number of key points can be identified from the above discussion, including:

- The PUI should be viewed as involving a dynamic process of change and flow of resources. These processes of change give the PUI its defining characteristics rather than the spatial notions of the rural-urban fringe.
- The PUI challenges the rural-urban divide, and, hence, challenges the theories and practice of development that have maintained this divide.
- These new challenges are particularly apparent in the lack of institutional arrangements to cope with the PUI perspective. For example, planners need to grasp more firmly the characteristics and peculiar dynamics of peri-urban communities.
- Related to the lack of institutional arrangements, it is difficult to identify uptake pathways which are specifically peri-urban.
- A number of production systems co-exist within the PUI, which leads to space being contested.

A systems perspective of the PUI brings a new approach to the analysis of farming systems, energy, waste and natural resource management and highlights a number of key points of particular relevance to Hubli-Dharwad, including:

- interactions between issues, for example, between the availability of waste materials and utilisation for soil fertility problems and as an energy source;
- the PUI is characterisation by the production of high value commodities, particularly vegetables, milk and fruit, with implications for labour costs and the development of marketing channels.
- water and electricity shortages have constrained industrial and urban development.
- Hubli-Dharwad may be broadly characterised as a `rural city', with an uneven spread of development.

Table 2.1 Flows characterising the Hubli-Dharwad peri-urban interface

Flow/change dimension	*Key flows/changes in Hubli-Dharwad*
Natural resource-based commodities	commercial mango production for national markets Import of dried skimmed milk from outside Declining fuelwood inflow Increased bus- and train-based small scale commodity supply to city
Labour	Development of bus-based intensive commuting up to 20 km Shortage of labour for agriculture; failure of agricultural wage levels to adjust, hence extreme inequality and significant level of absolute poverty
Investment	Speculative, unevenly distributed land purchase process; significant variation in land value trends Land purchased for mango production to avoid taxes Increased use of (often toxic) agro-chemical inputs for agriculture Tractorisation and replacement of buffaloes/plough cattle Privatisation of common land
Energy	Declining local energy production; compensated by increased inflow of LPG, subsidised electricity Limited scope for renewable or decentralised energy due to subsidy structure and scarcity of recyclable waste materials
Knowledge	Rapid loss of agricultural knowledge base Absence of appropriate scientific knowledge base due to neglect of peri urban specifics
Waste	Increased plastic fraction in urban waste; reduced organic nutrients Increased peri-urban industrial solid waste, some of which organic Wastewater increasingly used for high value crop production; increased pest and weed problems observed Growing pig population absorbing increasing proportion of urban organic waste Shortage of dung and other organic waste for peri-urban farm composting or biogas
Water	Urban tanks in decline; increased use of groundwater especially in peri-urban areas Some danger of aquifer pollution from sewage system Urban sewage polluting streams

3. SOCIO-ECONOMIC CHANGE AND LAND USE

3.1 Introduction

Urbanisation creates opportunities within the market for town dwellers, migrant and rural producers. Urban centres represent hubs of government, services and industry which may stimulate development and change in surrounding areas. Urbanisation also involves a loss of land for agriculture or forestry, potentially damaging impacts on the use of renewable natural resources, such as pollution and water shortages. Changes in occupations and economic activities may be expected among farmers or their families in the rural-urban fringes of cities. Lifestyle, cultural and social structures are also likely to change.

This chapter utilises the main secondary sources of information available on socio-economic characteristics and broad land uses within the peri-urban interface of Hubli-Dharwad. This provides a background to, and general understanding of, the dynamic processes influencing the use of renewable natural resources in the area. Geographical variations are outlined in as fine a spatial breakdown as feasible - by revenue villages (the lowest administrative tier in Karnataka State) within each of the taluks or blocks. Information is generalised into a comparison between the five taluks. For each of the characteristics examined, a series of tables are presented showing the number of villages in various size categories for each taluk. Where appropriate, reference is made to the small sample of villages selected for further analysis through more detailed focus group discussions, or for rapid rural appraisals. More detail can be found in Appendix H on the socio-economic characteristics of the city-region and in Appendix I on the surveyed villages.

The analysis of the secondary sources of information is divided into four sections:

- demography, which includes urban growth, village growth, scheduled castes, scheduled tribes, and literacy levels;
- economic activities, covering changes in the number of workers, cultivators, agricultural labourers and non-agricultural employment;
- land pressures; and,
- land uses.

Gaps and limitations in the available census information are identified, before proceeding to discuss information collected from the primary data-collection exercises.

Socio-economic information obtained during the village focus group discussions, rapid rural appraisals and key informant interviews are outlined in Section 3.5.1. These studies were undertaken to increase the understanding of the processes of change at the village level, and are intended to fill some of the identified information gaps. The main aspects presented in this chapter deal with:

- changes in land values,

• land ownership,
• the location of employment (within the village or elsewhere), and •
trends in non-farm activities.

Changes in farming systems are discussed in Chapter 4. Finally, remaining gaps in socio-economic information relevant for an understanding of the problems associated with the use of renewable natural resources in the peri-urban interface of Hubli-Dharwad are discussed.

3.2 Demographic characteristics

3.2.1 Urban Growth

The Hubli-Dharwad Municipal Corporation (HDMC), in the north of Karnataka State, includes the twin cities of Dharwad and Hubli, whose central bus stations are about 20 km apart. Hubli-Dharwad had a population of 648,298 in 1991, making it the third largest urban agglomeration in Karnataka State after the capital, Bangalore, (4.13 million) and Mysore (653,345). When the city proper population only is considered, however, the Hubli-Dharwad Municipality was the second largest city in the state. In 1991 Hubli-Dharwad was ranked 44th among India's 308 urban agglomerations with over 100,000 population. Although its area of 190.94 sq.km. had not changed over the decade, it was the 26th largest urban agglomeration in the entire country.

Over the previous decade, 1981-1991, Hubli-Dharwad only achieved modest population growth. Its increase of 22.99% from 527,108 in 1981, was lower than the average growth rate of 36.27% over the decade for the 21 urban agglomerations in Karnataka State, and the national growth rate of 37.28% for the 308 Indian urban agglomerations. It was ranked only 14th in Karnataka State and 219th out of the 308 Indian urban agglomerations.

Its population density of 3395.3 persons per sq.km. in 1991 was relatively low compared to both the Karnataka State average urban density of 4985 persons per sq.km. as well as the Indian urban agglomeration average population density, 5953 persons per sq. km. It was ranked 216th out of the 288 Indian urban agglomerations with available figures on population densities. Population within Hubli-Dharwad Municipality is most unevenly distributed, with highly congested and very densely populated localities within both urban cores of the city. In 1981 there were 52 notified slums in the city, and slum-dwellers represented 8.68% of the total population.

As shown in Table 3. 1, Hubli-Dharwad's population has steadily increased since 1901 when there were 81,143 inhabitants. The highest growth took place during the 1961-1971 decade due to the merger of Dharwad Municipality with Hubli City in 1962, which also incorporated several villages to achieve geographical contiguity for the HDMC. By 1981, 15 villages (7 in Dharwad taluk and 8 in Hubli taluk) had been fully incorporated into HDMC. The reorganisation of the states in 1956 when

Dharwad District joined Karnataka State also led to a massive influx of people, especially to Hubli City, the premier city of North Karnataka.

Table 3.1 Population Changes in Hubli-Dharwad, 1901- 1991

Census Year	Population	%-Change
1901	81,143	
1911	91,031	12.19
1921	100,992	10.94
1931	124,398	21.18
1941	143,504	15.36
1951	196,180	36.71
1961	248,489	26.66
1971	379,166	52.59
1981	527,108	39.02
1991	648,298	22.99

Source: Census of India, 1981 Dharwad District Census Handbook, pp. 254-255, Town Directory Statement L Status and Growth History.

Although administered within the same Municipal Corporation, both Hubli and Dharwad have had a history of more than a hundred years as separate towns. Temple inscriptions in an ancient temple in Hubli date back to the eleventh century. A British trading factory was established in Hubli in the Seventeenth Century, and forts were built in both Hubli and Dharwad in the Eighteenth Century. Hubli is mainly a centre of trade and commerce as well as industry and transport. Dharwad, on the other hand, is mainly a centre of administration and higher education. Dharwad is the district headquarters and contains the Deputy Commissioner's Office and all other district-level offices. Two universities, Karnatak University and the University of Agricultural Sciences, are also located there, together with three medical colleges and an engineering college. Hubli also has a medical college/hospital and an engineering college, together with the Divisional office and workshops of the South Central Railway.

The central bus stations of the two urban centres are about 20 km apart along the busy National Highway 4, which also connects Poona and Mumbai (724 km away) with Bangalore (427 km). The area, known as *Navalnagar,* along this highway between the two built-up urban areas has the main railway line and a variety of non-agricultural activities are being developed - industries, offices, warehouses and residential areas. Navalnagar was planned in the 1970s as a new settlement to link up Hubli and Dharwad. This has perhaps relieved some of the development pressures from the peri-urban areas of Hubli-Dharwad. In addition, although the city was designated as an industrially backward area, not as many new industries as anticipated have moved into the area so population growth has been lower than expected. Industries do not appear to have been diverted to Hubli-Dharwad or decentralised from the Bangalore Metropolitan Area to this part of North Karnataka - perhaps not solely related to the

distance (450 km) but also due to problems in guaranteeing infrastructure services such as reliable electricity, water supplies and sanitation services.

3.2.2 The city-region

The Hubli-Dharwad City Region, defined on the basis of the villages connected to Hubli and Dharwad by the Hubli-Dharwad city bus services, includes five taluks (blocks) around the city within Dharwad District - Dharwad, Hubli, Kalghatgi, Kundgol and Navalgund.

Dharwad taluk lies to the north and west of the city, with Hubli taluk to the east of Dharwad, incorporating areas north east and south of the city. Kalghatgi taluk lies to the southwest of Hubli-Dharwad, and it adjoins Kundgol to the southeast of the city; Navalgund taluk, north of Kundgol and northeast of the city is, like Kundgol, farther away from Hubli-Dharwad. Although the Hubli-Dharwad peri-urban interface forms part of the same agro-climatic zone, the Northern Transitional Zone of Karnataka, there are differences in climate, soils and physiography within the city region. Kalghatgi taluk to the southwest of the city is part of a hill area, with higher rainfall; Dharwad taluk is in a semi-hill area, and Hubli, Kundgol and Navalgund are plains areas, in which rainfall decreases to the east, particularly in Navalgund and Kundgol taluks. Black cotton soils are characteristic of the northern and eastern sides of Hubli-Dharwad, contrasting with the Medium Red soils in the south and west of the city. Kalghatgi taluk, the southern part of Dharwad taluk and the southern part of Hubli taluk have red soils and higher rainfall, increasing to the southwest, while Navalgund taluk, Kundgol taluk, the northeast of Hubli taluk, and the northern part of Dharwad taluk have black cotton soils, with an eastward decrease in rainfall.

In 1991, the total population of the Hubli-Dharwad City Region was 1,428,174. This includes the 648,298 inhabitants of Hubli-Dharwad Municipality, 45.4% of the total population of the city region. The five taluks also include five smaller municipalities - the three taluk headquarters *(Kalghatgi, Kundgol* and *Navalgund),* plus *Alnavar* in Dharwad Taluk, and *Annigeri* in Navalgund Taluk, whose populations between 1901 and 1991 are listed in Table 3.2. These five small municipalities contained 72,758 inhabitants in 1981, amounting to 5.1% of the population of the city region. Altogether, then, 50.5% of the city-region's population were classed as urban. The rural and semi-rural areas of these five taluks had a population of 710,425 in 1991, at an average population density of 181.11 persons per sq. km.

Table 3.2 Populations of Other Municipalities within the Hubli-Dharwad City Region, 1901- 1991

Municipality (& Taluk)	MUNICIPAL POPULATIONS (Census of India)									
	1901	**1911**	**1921**	**1931**	**1941**	**1951**	**1961**	**1971**	**1981**	**1991**
Alnavar (Dharwad)	-	-	-	-	-	6,107	-	10,373	13,026	14,485
Kalghatgi **(Kalghatgi)**	-	-	-	-	-	5,210	-	-	11,035	-
Kundgol (Kundgol)	7,142	4,877	5,377	6,376	6,902	7,302	8,694	11,184	14,325	14,709
Annigeri **(Navalgund)**	7,172	6,877	8,039	7,525	8,091	8,923	13,455	14,681	18,614	25,239
Navalgund (Navalgund)	7,862	7,045	7,089	6,203	7,082	8,171	10,123	11,985	15,758	19,438

Source: Census of India, 1981 Dharwad District Census Handbook, pp. 254-255, Town Directory Statement I: Status and Growth History.

In 1981, these rural and semi-rural areas contained 544,715 inhabitants, 47.6% of the total population of the city region (1,144,581), compared to the Hubli-Dharwad city population of 527,108 and the five smaller municipalities with 72,758 residents. The rural/semi-rural population had increased between 1981 and 1991 at 30.4%, faster than Hubli-Dharwad's rate of increase of 23% over the same decade. In 1971, the rural and semi-rural parts of the five taluks contained a population of 436,494, increasing by 24.8% over the 1971-1981 decade, much less than the 39% growth rate of Hubli-Dharwad Municipality. The total 1971 population for the urban and rural areas of the five taluks was 863,883, with the majority of the inhabitants (50.5%) classed as rural.

3.2.3 Changes in village populations

The population tables in the Census of India for 1971, 1981 and 1991 have been analysed to identify the changes in population in the 372 revenue villages within the 5 taluks forming the Hubli-Dharwad City Region. Although these data sources are unable to account for the causes of growth or decline in village population, the analysis pinpoint where net changes are taking place, thereby suggesting where further research into the implications of demographic changes on renewable natural resources might be undertaken in the Hubli-Dharwad peri-urban interface.

A spatial model of the peri-urban interface would predict that villages closer to Hubli-Dharwad, or closer to the main radial routes, would have higher levels of in-migration. This could result from inward rural/peri-urban migrations from more distant rural areas; these rural migrants being unable to afford higher prices of land for building, or higher housing rents, within the urban areas. Middle and upper income groups already established within the city might also be expected to undertake outward movements into these near-city peri-urban areas, seeking more space and a more attractive environment.

The demand for agricultural labour to meet the needs of the urban market for agricultural produce would also encourage in-migration of agricultural labourers into these peri-urban areas. This group may simply replace the farm labour lost when original family members obtain nonfarm employment in the city. Proximity enables commuters to make daily journeys to work in Hubli-Dharwad relatively cheaply. Villages towards the outer margins of the city's rural-urban fringes might be expected to be less attractive for commuting since travel costs in terms of time and money will be greater. These outlying areas might be expected to lose population as a result of the influence of Hubli-Dharwad. However, a production system approach to understanding the PUI would predict a more varied pattern of growth and relative contraction depending on a range of variables (see Chapter 2).

Indian Census data unfortunately does not contain information on the key components of population change - migration levels or on the rates of natural increase (birth rates and mortality levels). Net population change figures for Karnataka State, or for smaller areas within the State, do not separate net natural increases from net migration movements. Consequently the Indian rates of population change, which minimise the effects of net international migration, have been used to estimate the likely rates of natural increase within the villages of the Hubli-Dharwad region. Nationally, the Indian population grew by about 24% between 1981 and 1991, and by about 21% between 1971 and 1981. If it is assumed that the villages in the Hubli-Dharwad city region had similar rates of natural increase as in the country as a whole, these rates can be subtracted from the 1981-1991 or 1971-1981 changes in a village's population to indicate the Ievel of net (in/out) migration found there. Further studies would, of course, be required to determine whether each village has birth rates or death rates which are markedly different from the country as a whole, or to measure the actual levels of in-migration and out-migration taking place, perhaps as part of a study to examine specific local causes of these components of change.

The following analysis is by taluk, covering the five peri-urban taluks: Dharwad, Ilubli, Kalghatgl, Kundgol and Navalgund. Average village size varied in 1991 from 1,394 (Kalghatgi) to 2,772 (Navalgund), with the larger villages in the black cotton soil irrigated areas. However, these villages tend to have lost population through out-migration over the 1980s, while villages in the wetter, red soil areas north and east of t h e j 7 city. Dharwad taluk in particular has a concentration of villages (c 70%) which have [1] grown by attracting in-migrants (see Tables 1 and 2 in Appendix G). In Hubli and Kalghatgi taluks villages growing at more than the average natural rate of increase have tended to be close to the city; villages further away have tended to lose population.

Growth in population may be explained by the increase in non-farm employment opportunities in the three taluks closest to I-Iubli-Dharwad: Hubli, Dharwad and Kalghatgi. 62 villages in these three taluks doubled their numbers of non-farm workers over the decade. The increase in non-farm employment was particularly marked for men. Few villages in Navlgund and Kundgol had achieved this level of growth. 101 villages in the five taluks had experienced a decline in non-farm employment, suggesting both a concentration of such employment and an inability to compete with city enterprises. The pattern of increase and decrease in cultivators and agricultural

labourers is broadly the same, though Kalghatgi (the forest fringe) has had the greatest increase in the number of cultivators.

Participation in the labour force as a whole has increased particularly rapidly for women in the three taluks nearest the city (see Appendix I) Given that female non-farm workers increased much more slowly than male, most women were finding work in the lower paid farm sector. Poverty in the peri-urban areas thus has a strong gender dimension. Farmers reported labour scarcity in two out of four villages where participatory research exercises were conducted (see Chapter 4, Section 4.3.1).

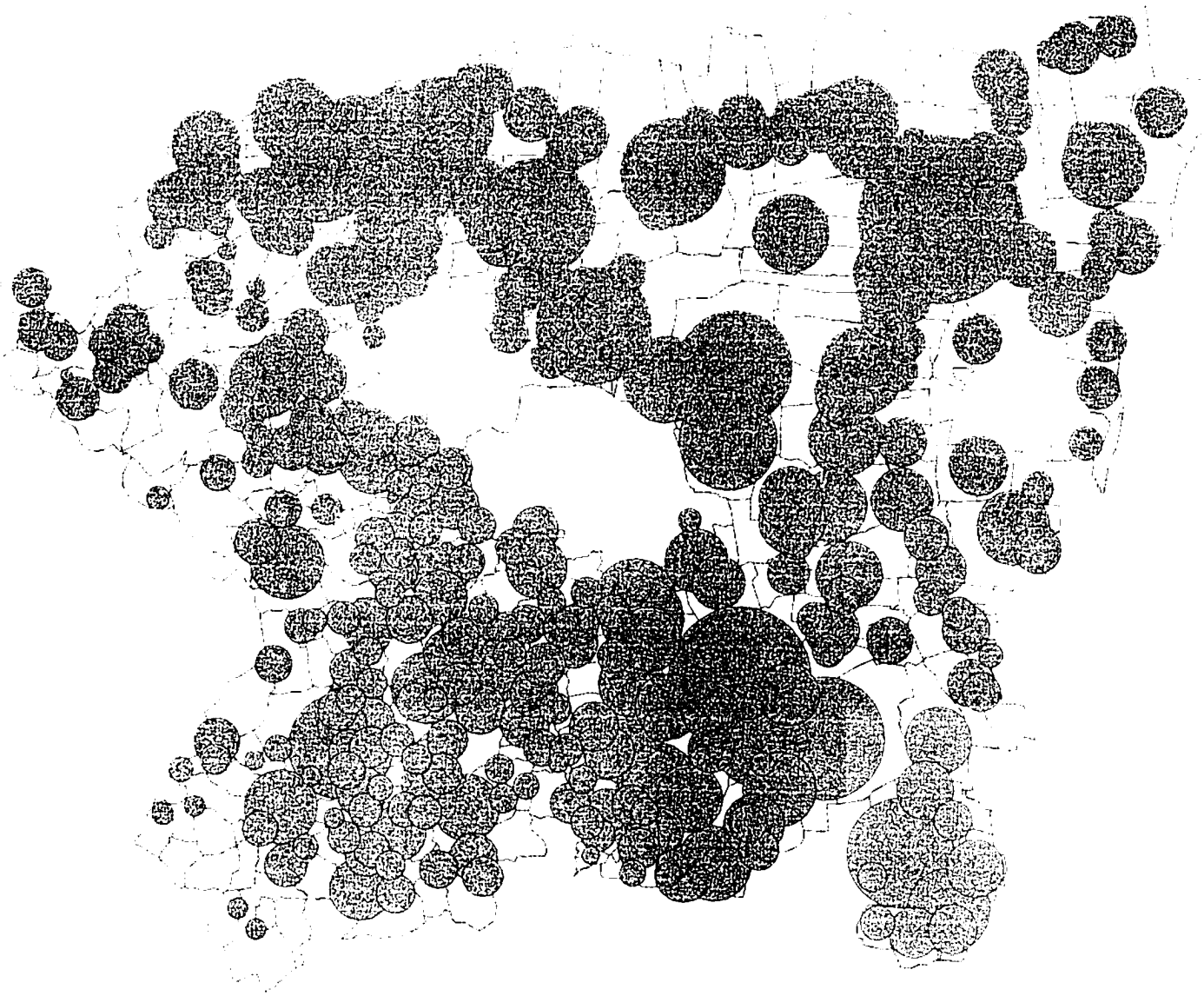
Thus there is a group of peri-urban villages, largely in the north and west sector of the city-region which have grown considerably both in population and in terms of economic activity. There is also a group of villages, concentrated in the black soil taluks further from the city which have declined (relatively) in population and activity. This difference may be explained by several factors and is illustrated in the following maps. There may be varied degrees of land pressure, new opportunities presented by irrigation and changing cropping patterns, new opportunities for employment providing goods and services to the city, and possibilities for commuting.

Literacy levels were studied, as an indicator of wellbeing/poverty (see Tables 2 and 3 in Appendix I). In general male rates (aound the 50% mark) were more than double female in 1981 and almost double in 1991. There was significant variation by taluk, with Navalgund and Kundgol having the highest rates and Kalghatgi the lowest. The difference between female literacy in Kalghatgi at 25% and male literacy in Navalgund at 61% is an indicator of the range of inequality in wellbeing and access to services between men and women and across the five taluks.

According to the 25 village RRA study, villages in Navalgund and Kundgol taluks have higher proportions of large and medium sized farms, and fewer (and declining) agricultural labourers (perhaps due to mechanisation), and are generally more prosperous but less dynamic than changing agricultural areas. It may be easier for most families there to send their children to school. This may help to explain the differences observed above. Given the significant differences in female literacy rates among the taluks, one would also expect other indicators such as infant mortality rate to follow suit.

The more dynamic, rapidly changing areas have lower literacy levels, indicating that they are absorbing unskilled, uneducated migrant labour. A proportion of this labour force may even come from the richer black cotton villages which are losing population. Poverty is thus likely to be unevenly distributed in the peri-urban areas, concentrated among women in the most rapidly growing villages. This is therefore where future research effort should be focused.

HUBLI - DHARWAD REGION
Village Population 1991



0 miles 10 20 30

scale = 1:500,000

Total Population

19438

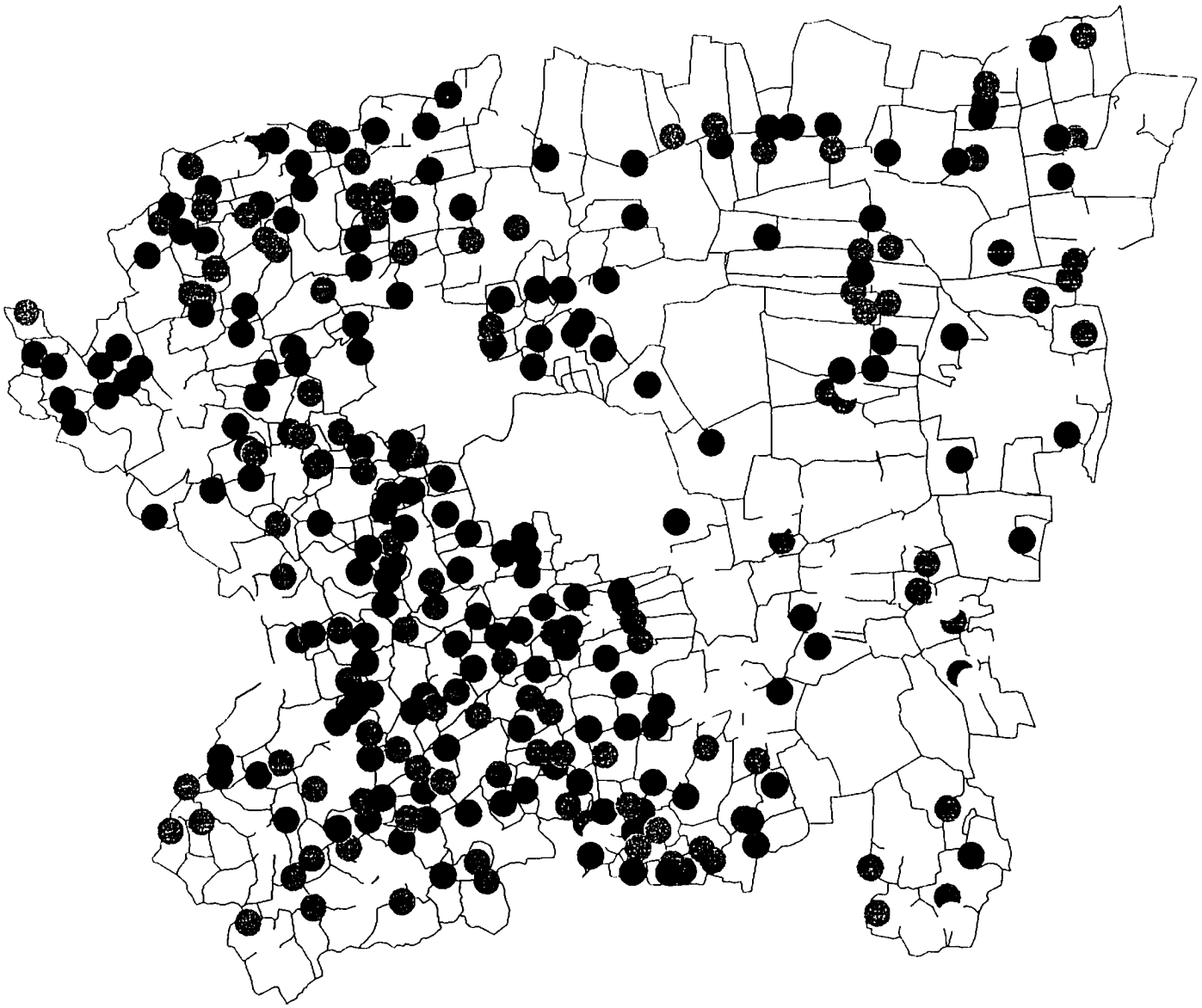
9756

74

N

HUBLI - DHARWAD REGION

Changes in Village Population Between 1981 and 1991



0 miles 10 20 30

scale = 1:500,000

N

- Population Loss
- 0% to 10% Increase
- 10% to 20% Increase
- 20% to 30% Increase
- 30% to 40% Increase
- 40% to 50% Increase
- 50% to 100% Increase
- Greater than 100% Increase

to the city - it is caused by more complex factors, suggesting again that the flows and linkages PUI model may have more explanatory power than the spatial model.

3.4 Changes in land use

A computer printout of information derived from the Village Directory - Amenities and Land Use section of the 1991 Census of India was requested for the five taluks in the Hubli-Dharwad City Region from the National Informatics Centre in Dharwad. Spreadsheets were then created showing the total area of each revenue village (in hectares), divided into five broad types of land use - forests, irrigated areas, unirrigated areas, culturable waste, and the area not available for cultivation. Comparable information was then abstracted from the 1981 Census of India, Village Directory, Amenities and Land Use of the District Census Handbook for Dharwad. The information was based on village records for a reference year normally two years prior to each census, so the data refers to 1979 and 1989. No breakdowns were available for uninhabited villages. This involved 10 villages in 1991 (4 in Dharwad Taluk, 5 in Hubli Taluk, and 1 in Kundgol Taluk) and 7 different villages in 1981 (2 in Dharwad Taluk and 5 in Kalghatgi). In 14 cases, however, the sum of the areas reported under the five land uses in 1991 were found to exceed the total area of the village; in these cases the unirrigated area was actually greater than the total village area, and so were adjusted accordingly.

3.4.1 Forest

According to census data, forests form significant land uses only in the hillier, wetter areas south and west of Hubli-Dharwad. Forest encroachment is not a major problem. Indeed land set aside for forests showed a modest increase between 1981 and 1991 in some villages, while there were losses in others.

3.4.2 Irrigation

Irrigation is only at all extensive in Navalgund taluk, where some land is served by the Malaprabha Right Bank Canal. Even there, half the villages have no irrigated land; and others have highly varied quantities. Elsewhere the irrigated areas are very small - usually no more than a few hectares. Dharwad taluk has the biggest number of villages with increases in irrigated area over the decade, and the biggest increase in area irrigated. This may be linked to the growth of population and economic activity in the taluk. Many villages throughout the city-region also showed a decrease in irrigated area, suggesting considerable problems with maintaining irrigation schemes. Kundgol taluk as a whole experienced a decline in irrigated area. This may be linked to the increase in land area available per cultivator - the situation in the taluk bears further investigation, as it seems to buck the trend. Electricity for irrigation and irrigation availability came out as significant production constraints from the participatory research exercises (see Section 4.3.1 of Chapter 4).

3.3 Changes in the land economy

Four key indicators are examined using the census data in order to build up a picture of land use change and its implications: land pressure, land use changes, irrigation, changes in land value and in waste and common land. The detailed discussion of these indicators is in Appendix J: a summary of findings is given here.

3.3.1 Land pressures

In the absence of information on spatial variations in carrying capacities within the Hubli-Dharwad City Region, a number of simple indicators, derived from Census of India, are used to suggest where land pressures are taking place. No direct information exists on the levels of in-migration or out-migration for individual villages, which might suggest where land shortages are occurring, nor is there information available on the geographical distribution of agricultural incomes, which might also suggest precisely where agricultural intensification is taking place or where changes need to be promoted. Four separate but inter-related indicators are available, each reflecting a slightly different aspect of land shortages:

- Hectares per person simply divides the total area of the revenue village by the total population (which includes children, retired people as well as those engaged in non-agricultural activities);

- *Hectares per Household* divides the total village area by the number of households (which still includes families not engaged in farming);

- *Hectares per Cultivator* in which the total area of the village is divided by the number of male and female cultivators, or those owning or renting land and working on it themselves (which may include several members of the same family, and excludes agricultural labourers); and

- *Hectares per Agriculturist* is a similar measure but includes agricultural labourers as well as cultivators.

- *Hectares per Agricultural Labourer* would give an indication of capital intensity and therefore productivity and agricultural wages. However, the usefulness of this information is reduced because irrigated and non-irrigated land is not differentiated.

The picture is of generally increasing pressure on land throughout the city region, with the possible exception of Kundgol taluk, where there appears to have been an increase in land available per cultivator. However, there is a high degree of variation in hectares/household in the more dynamic taluks, compared to greater equality in the less dynamic taluks (Table 2, Appendix J).

Greater land availability in some villages could possibly explain some of the growth in population and economic activity in the rapidly changing taluks of Dharwad and Kalghatgi. However, in general there is now a high degree of land pressure in Darwad and Hubli taluks. Land pressure was not found to be strongly correlated with proximity

3.4.3 Culturable waste

Culturable waste includes all lands available for cultivation, including fallow land not cultivated during the previous five year period. This type of land use also includes grazing land and permanent pastures, as well as lands under miscellaneous tree-crops. The category includes lands under thatching grass, bamboo bushes and other groves. These lands may be in isolated blocks or within cultivated holdings.

There is little common land in many villages, though again there is some variation, from none in Navalgund and Kundgol to about a quarter of villages with up to than 10 hectares. There is little common grazing for animals. However, the land classified as "culturable waste" in the census has increased in over half the villages in the other three taluks, and has almost doubled in Dharwad taluk. It is not clear what is happening here - there may be abandonment of farm land close to the city.

3.4.4 Land not available for cultivation

The *area not available for cultivation* covers land in non-agricultural use, including buildings, roads, railways, parks and playgrounds, and the area under water, such as rivers, streams, canals, reservoirs, tanks, ponds. It also includes barren and uncultivated lands, such as quarries, rocky hills and ravines, which can only be brought under cultivation at a very high cost.

Land not available for cultivation occupied 15,917 ha in 1991, 4.05% of the total area of the revenue villages in the five taluks making up the Hubli-Dharwad City Region (see Table 4.26). This land use category does not adequately reflect increases in urbanisation, however, since the land devoted to buildings and other non-agricultural activities is simply one component of the category, which also includes the area of water bodies and quarries. There was a significant decline in the area of land unavailable for cultivation during the 1981-1991 decade, of 34.56% in the city region.

3.5 Addressing remaining information gaps

Although providing an invaluable source of information at the village level, there are inevitably a number of limitations and unanswered questions associated with the Census of India. In a dynamic situation, many changes can take place over a six year period. The published information does not provide sufficient information on births, deaths and migration levels. Circumstantial evidence suggests that some villages were failing to meet the estimated levels of natural increases, suggesting villages where in-migration might be taking place and other villages where out-migration appears to have occurred. It would be useful to have such crucial information provided directly for each village. Information is lacking on the age-structures of the populations of each of the villages - it is assumed that young people are responsible for out-migration, or shifting to non-agricultural activities, leaving the elderly to take responsibility for fanning, but it would be useful to have this confirmed, both for the villages losing population as well as the villages receiving the migrants.

The land use categories in the Census are too broad and provide only limited insights into the farming systems in operation within the villages. No information is provided on whether any intensification of agricultural production has taken place; the absence of data on agricultural incomes means that even indirect indicators of relative prosperity are lacking. The key indicator of agricultural change in peri-urban areas close to the city is likely to be an increase in the area devoted to horticulture, but no census data is provided on the area involved. Livestock are not mentioned in the Census, nor are the areas of permanent grazing or pasture land included as a separate category in it. The Census does not provide any clues on the variations in land values between the different villages, nor is there any indication of trends in land sales. Information is also missing on the sizes of land-holdings within a village. Smaller farmers might perhaps be expected to be more likely to sell land, or to need to do so, but the Census does not contain information on land held by the cultivators, let alone on any absentee landlordism with rented plots or share-cropping.

Gaps also exist on the commuting patterns present in the area, and whether employment takes place within the village, neighbouring villages, or more distant destinations. The industrial classifications appearing in the Census tend to be too general and do not reveal the types of non-farm employment or even the number of self-employed artisans as opposed to employees. Given the interdependence and linkages between agriculture and non-farm activities some of these gaps would be crucial for understanding the trends in use of renewable natural resources.

The following section draws on the findings of the village focus groups to see how far local informants and groups have been able to fill a number of these gaps in information.

3.5.1 Village focus group discussions

Twenty-five villages were selected as a sample for more detailed initial analysis, using key informant interviews in the communities with community leaders, leaders of each major section of the community or village officials like the village accountant. Focus group interviews with small groups from each major section of the community (by wealth/caste and gender) were also conducted within the community, with women and men interviewed in separate groups.

Discussions covered significant events in the recent history of the village, including specific improvements or particular problems which have arisen. Information was sought on farming systems, energy, waste, important organisations in the village, and on the amenities and services present in the village, including any institutional responsibilities for health, education, drinking water, roads, irrigation, markets, or input supplies. Major sources of employment within and outside the village were also examined, including wage levels or seasonal aspects, and any changes in occupations. Other discussion topics focused on any major changes in land use in the village (including changes taking place on private land or common land), particularly any non-agricultural land uses or new land uses. Changes in land values were investigated, including recent examples of sales compared to 10 years earlier.

Information on marketing, public transport provision, and any changes in links to Hubli-Dharwad were also examined.

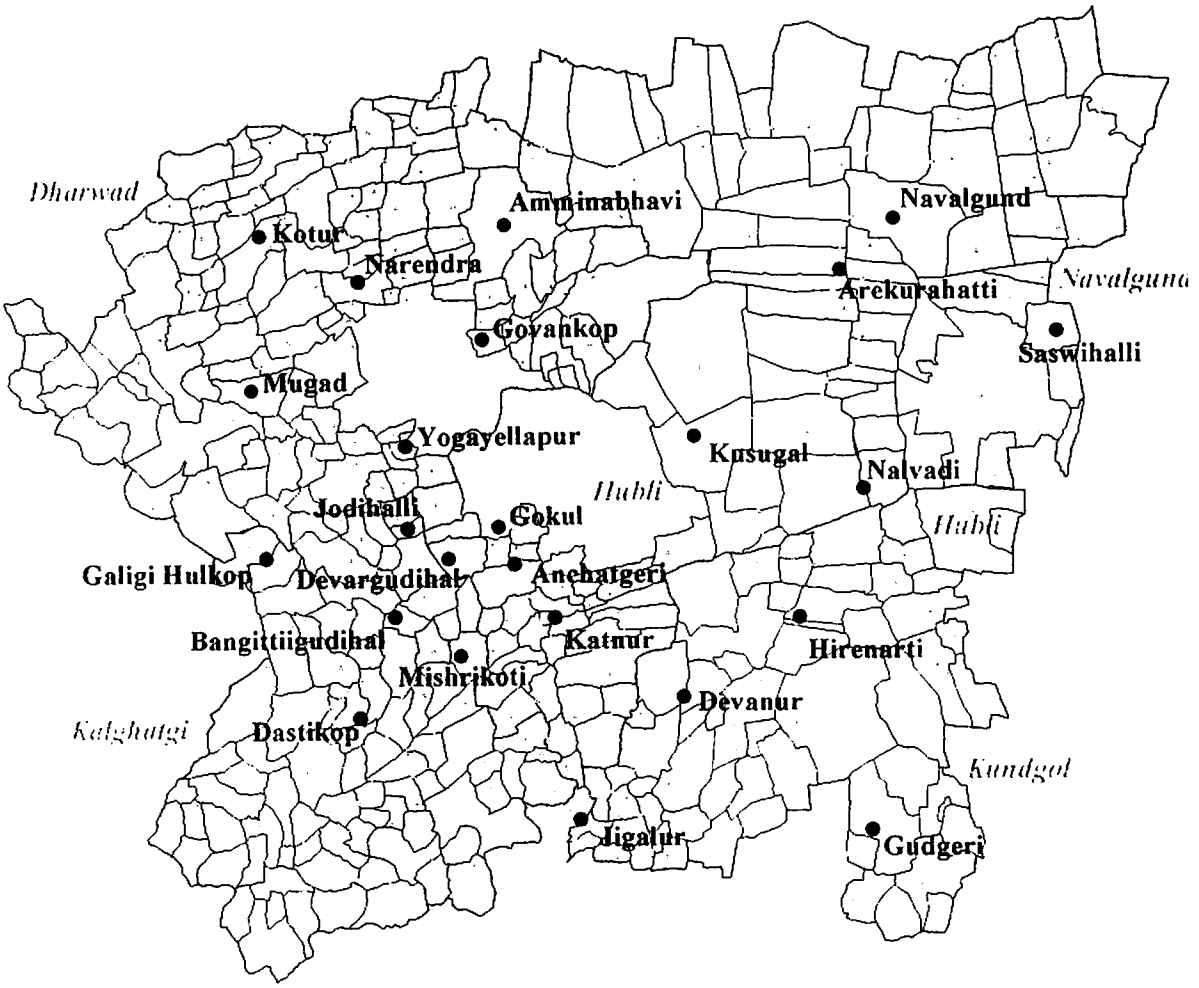
Villages were selected from three different types of area:
• villages within the Hubli-Dharwad Urban Development Authority area,
• within approximately 20 km of Hubli-Dharwad - served by the city bus services, • within a 20 - 50 km radius.

Table 3.3 lists the 25 villages included in this survey, and presents basic information from the 1991 Census of India on:
• the distance to Hubli-Dharwad (supplemented by survey information for Kundgol and Navalgund Taluks, where Hubli-Dharwad is not the nearest town), • the area of the selected revenue village in 1991,
• the population of the village in 1991, and
• the main characteristics of the village, used as a basis for selecting the village.

The following map shows the location of the 25 villages.

HUBLI - DHARWAD CITY REGION

Survey Villages



N

Scale = 1:500,000

Key

- Survey Villages
- Villages
- Village Boundaries
- Taluk Boundaries

Geography Department, University of Nottingham - GIS

(Based on NRDMS Centre, Dharwad)

Table 3.3 Main Characteristics of Villages Sampled for Village Focus Group Discussions in the Hubli-Dharwad City Region

	Distance km.(HD)	Area (Hectares)	Population `91Census	Characteristics
DHARWAD				
Yogayallap	8	154.71	604	Mangoes
Mugad	10	1311.07	4185	Potters, Fishermen, Basket-making, Leaf Plates
Narendra	5	1198.55	4222	Agricultural University
Kotur	16	1666.81	3145	Industrial Estate (nearby)
Amminabhavi	8	4633.50	9831	Potatoes
Govankop	4	533.76	1052	Sewage-water irrigation
HUBLI				
Bidnal	-	238.15	n.a.	Sewage-water irrigation, low income residences
Gokul	1	303.25	409	Industries, Brick making, and residences
Kusugal	12	3576.72	7231	Commuters, commercial crops (cotton, onions, etc)
Katnur	10	590.02	1362	Sapota, guava (direct marketing of produce)
Anchatgeri	7	1533.93	2871	Bricks, stone crushing, residential, Horticulture
Devargudihal	12	1063.68	980	Roses & Floriculture
KALGHATGI				
Dastikop	21	824.89	2009	Roses, Floriculture, Milk, Brick-making
Bangittigudihal	12	743.1	1728	Vegetables
Mishrikoti	14	986.15	7137	Commuters, Industries (Pharmaceuticals), Cotton, etc
Jodihalli	13	636.32	2149	Brick-making, other industries
Galagihulakoppa	18	2,121.99	6032	Milk (Khava sweets, cheese), Carpentry, Quarries
KUNDGOL				
Jigalur	22	482.53	885	Black cotton soils - chillies, garlic etc (Direct marketing)
Devanur	27	1219.03	2466	Black cotton soils - chillies, garlic, onions,cotton, etc
Hirenarti	27	1459.90	2407	Woollen & Cotton Blankets
Gudgeri	55	2726.64	**8828**	Dryland
NAVALGUND				
Navalgund	45	4030.15	713	Carpet Making, District headquarters (nearby)
Arekurahatti	29	2775.58	3008	Canal Irrigation
Saswihalli	38	1496.73	1323	Dryland Cropping system
Nalvadi	22	1251.38	3104	Chillies, cotton, onion, bengalgram, etc

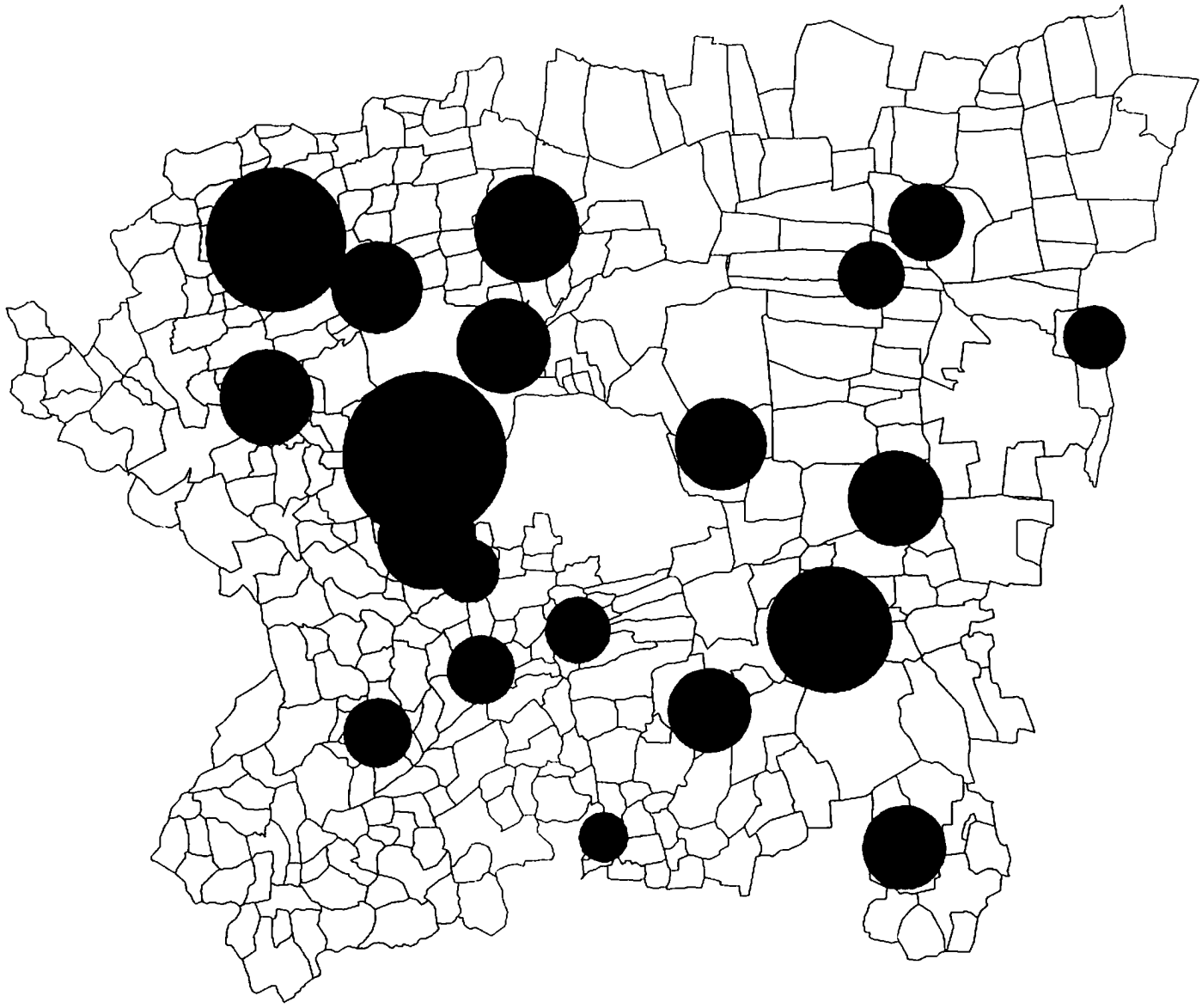
3.5.1.1 Land Values

Although information could not be provided on the number of land sales taking place, villagers were able to estimate the broad changes in the values of the land being sold. Table 3.4 presents the results of these discussions. In cases where information was given as a range of values, the mid-point has been calculated. Land along a highway is sold for more money, and wet land is more valuable than dry land. As shown in the

HUBLI - DHARWAD REGION

Changes In Land Value For Villages In The Village Survey

1987 - 1997



0 miles 10 20 30

scale = 1:500,000

Change in Landvalue

160000

82000

4000

N

following map, the figures for both 1987 and 1997 show marked variations among villages in the same taluk, although they do not appear to be closely related to the distance from Hubli-Dharwad city. Nevertheless, when averaged by taluk, there is a general spatial trend of a clear decline in land values away from the city in both 1987 and 1997.

Table 3.4 Changes in Land Values, 1987 - 1997, in Villages Sampled for Village Focus Group Discussions in the Hubli-Dharwad City Region

	LAND VALUES(Rupees)					
Villages	1987			1997		
	Minimum	Average	Maximum	Minimum	Average	Maximum
DHARWAD						
Yogayallap	15,000	* 27,500	40,000	100,000	* 150,000	200,000
Mugad	10,000	* 12,500	15,000	30,000	* 55,000	80,000
Narendra	15,000	* 27,500	40,000	50,000	* 75,000	100,000
Kotur		20,000		80,000	* 115,000	150,000
Amminabhavi	10,000	* 15,000	20,000	60,000	* 80,000	100,000
Govankop	20,000	* 27,500	35,000	60,000	* 80,000	100,000
HUBLI						
Bidnal		20,000			100,000	
Gokul	10,000	* 12,500	15,000	70,000	* 85,000	100,000
Kusugal		20,000			80,000	
Katnur		14,000			40,000	
Anchatgeri		-			-	
Devargudihal		18,000			40,000	
KALGHATGI						
Dastikop		10,000			80,000	
Bangittigudihal		n.a.			n.a.	
Mishrikoti		10,000			40,000	
Jodihalli		10,000			80,000	
Galagihulakoppa		n.a.			n.a.	
KUNDGOL						
Jigalur		4,000			8,000	
Devanur		10,000			60,000	
Hirenarti		4,000			110,000	
Gudgeri	4,000	* 12,000	20,000	10,000	* 40,000	70,000
NAVALGUND						
Navalgund		10,000			50,000	
Arekurahatti		8,000		26,000	-	35,000
Saswihalli		8,000			30,000	
Nalvadi	10,000	* 12,500	15,000	40,000	* 60,000	80,000

* = Mid-point of Range

Source: Village Focus Group Discussions, March 1997

In 1987, land values were lowest in Kundgol Taluk, but by 1997 its land values were comparable, if more variable than the other taluks, even overtaking Navalgund taluk. Although Dharwad and Hubli taluks had the highest averages in both years, there were substantial increases in land values everywhere during the decade. Kalghatgi

Taluk, in fact, achieved the highest rate of increase, (567%); both Navalgund and Kundgol Taluks, with increases of 468% and 466% respectively, exceeded the rates of increase of Dharwad Taluk (327°/x) and Hubli Taluk (308%) during the 1987-1997 decade.

Taluk	1987 Average (Rupees)	1997 Average (Rupees)
Dharwad	21,667	92,500
Hubli	16,900	69,000
Kalghatgi	10,000	66,667
Kundgol	7,500	54,500
Navalgund	9,625	42,625

In both 1987 and 1997, land sales in all the villages in Kundgol and Navalgund Taluks were reported as being to locals with no sales to outsiders. Black cotton soil in these areas is highly regarded for agriculture in these areas but is not sold for non-farm land uses. The red soils of Hubli, Kalghatgi and parts of Dharwad taluks are suitable for non-agricultural purposes, and the market forces, including the demand for suitable land close to the city, have pushed up land prices in these areas. Land sales were reported to as taking place to both locals and outsiders.

3.5.1.2 Land Ownership

Information provided in the villages on land holdings is presented in Table 3.5. The following map shows the number of large, medium and small landowners in 1997. The definitions used for large land owners is over 10 ha, medium is 5 - 10 ha, and small land owners have less than 5 ha. 17.5% of the 10,726 land owners reported in the sampled villages are large land owners, 37.3% are medium land owners and 45.2% are small land owners.

Large land owners tend to be concentrated in the drier east, where dryland farming takes place on black cotton soils. On average, the villages of Kalghatgi Taluk have the lowest proportion of large land owners (4.4%), followed by Dharwad Taluk (9.1%), while Navalgund Taluk has the highest average, 37.2%, followed by Kundgol Taluk (16.8%). Kalghatgi Taluk also has the largest percentage of land owners classed in the medium category, (68.5%), followed by Hubli Taluk with 45.8%; Dharwad Taluk again stands out as having the lowest proportion (18.7%). In contrast, the villages of Dharwad Taluk have the highest proportion of small land owners (72.1%), followed by Kundgol Taluk (48.8%) and Hubli Taluk with 40.5%. Navalgund Taluk's villages averaged only 26.7% as the proportion of small land owners, closely followed by Kalghatgi Taluk's 27.1%. As may be observed, however, from Table 4.32, however, there are substantial variations among the villages around the average percentages in each of the three categories for the taluk.

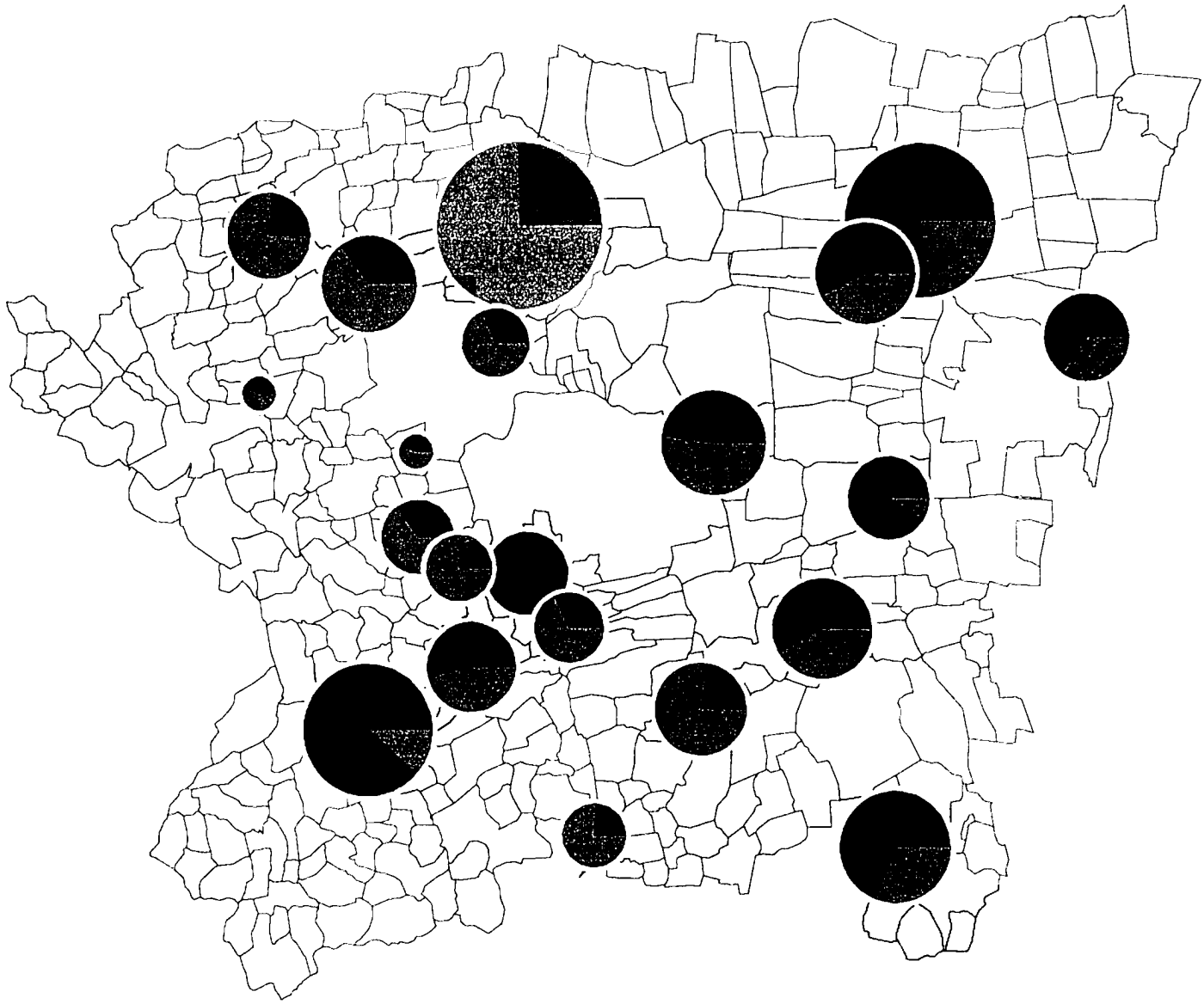
Table 3.5 Distribution of Land Ownership, By Size Categories, 1997, for Villages Sampled for Village Focus Group Discussions in the Hubli-Dharwad City Region

	LAND OWNERS					
	Large		**Medium**		**Small**	
	No.	%	No.	%	No.	%
DHARWAD						
Yogayallap	6	8.3	26	36.1	40	55.6
Mugad	6	8.3	26	36.1	40	55.6
Narendra	49	10.4	118	25.1	304	64.5
Kotur	20	5.9	60	17.6	260	76.5
Amminabhavi	170	9.1	300	16.0	1400	74.9
Govankop	24	12.7	35	18.5	130	68.8
	275	**9.1**	**565**	**18.7**	**2174**	**72.1**
HUBLI						
Bidnal	20	24.7	32	39.5	29	35.8
Gokul	45	26.5	125	73.5	-	
Kusugal	25	4.3	250	43.5	300	52.2
Katnur	28	13.6	38	18.4	140	68.0
Anchatgeri	87	27.5	229	72.5	-	
Devargudihal	4	2.2	26	14.4	150	83.3
	209	**13.7**	**700**	**45.8**	**619**	**40.5**
KALGHATGI						
Dastikop	45	4.3	880	84.2	120	11.5
Bangittigudihal	n.a.		n.a.		n.a.	
Mishrikoti	9	2.3	201	51.4	**181**	46.3
Jodihalli	20	8.7	60	26.1	150	65.2
Galagihulakoppa	n.a.		n.a.		n.a.	
	74	**4.4**	**1141**	**68.5**	**451**	**27.1**
KUNDGOL						
Jigalur	15	9.1	25	15.2	125	75.8
Devanur	20	4.9	70	17.2	316	77.8
Hirenarti	100	19.3	200	38.6	218	42.1
Gudgeri	166	23.5	321	45.5	219	31.0
	301	**16.8**	**616**	**34.3**	**878**	**48.9**
NAVALGUND						
Navalgund	513	33.6	665	43.5	351	23.0
Arekurahatti	160	30.3	143	27.1	225	42.6
Saswihalli	120	34.2	109	31.1	122	34.8
Nalvadi	220	**69.8**	65	20.6	30	9.5
	1013	**37.2**	**982**	**36.1**	**728,**	**26.7**
ALL VILLAGES	**1872**	**17.5**	**4004**	**37.3**	**4850**	**45.2**

HUBLI - DHARWAD REGION

Breakdown Of Land Owners For Villages In Village Survey

1987 - 1997



0 miles 10 20 30

scale = 1:500,000

Total Landowners

1870

971

72

Landowner Type

Medium Land Owners

Small Land Owners

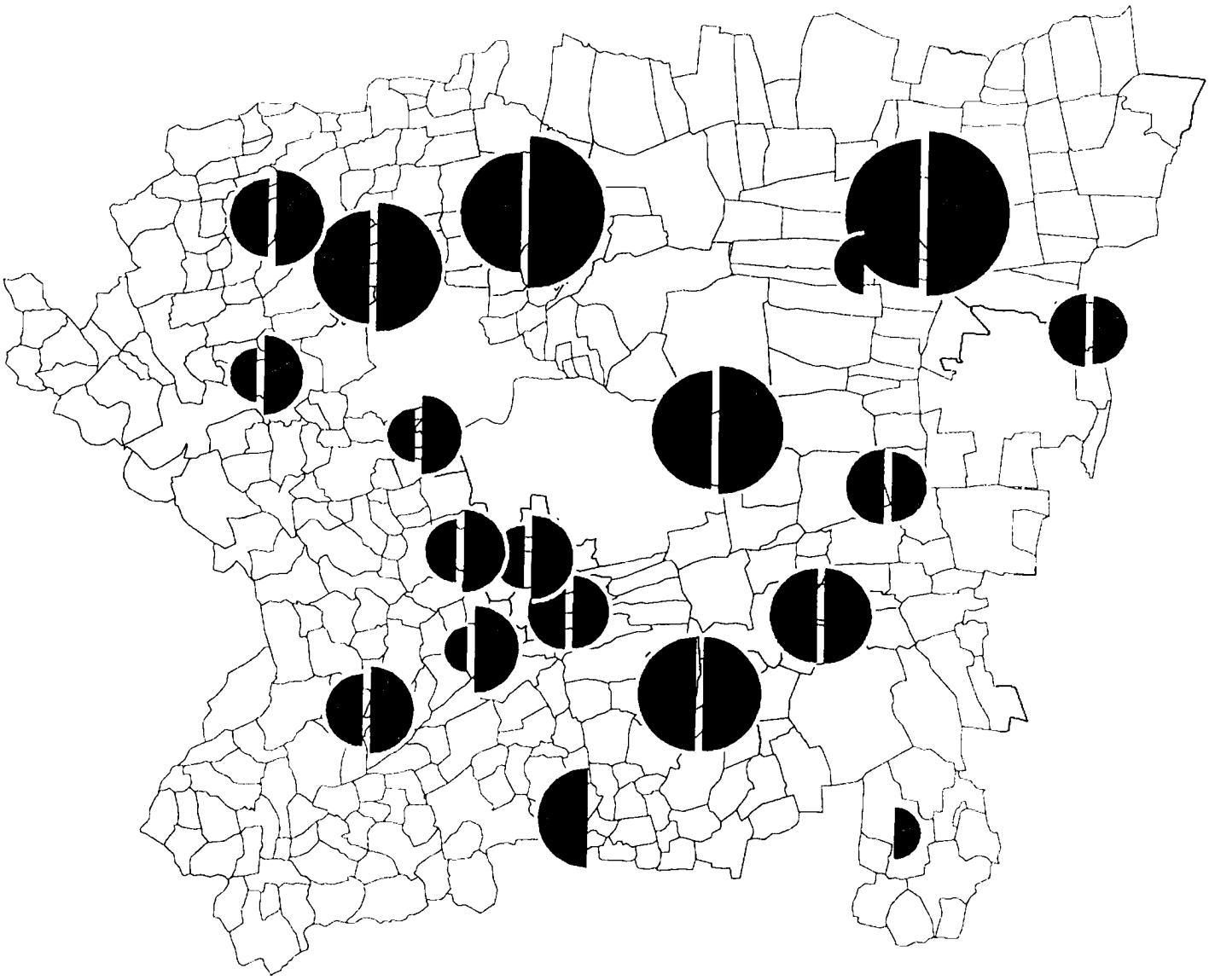
Large Land Owners

N

HUBLI - DHARWAD REGION

Changes In Landless For Villages In Village Survey

1987 - 1997



0 miles 10 20 30

scale = 1:500,000

Total Landless
(per semicircle)

1987 1997

1910

1010

110

Landless Type

Agricultural Landless

Other Landless (industrial and construction)

N

3.5.1.3 Labourers

Table 3.6 shows that there were 12,221 labourers reported by the village focus groups in the 22 villages able to supply this information, an increase of 33.9% from the 9,130 labourers estimated for 1987. Most of these labourers were engaged in agriculture, 8,785 or 71.9% in 1997, compared to 1,731 industrial labourers (14.2%), and 1,102 labourers in construction (9%). In 1987, a higher proportion, 82.5% or 7,536, had been agricultural labourers; even a decade ago there had been substantial numbers of labourers engaged in industry (1,159 or 12.7%) but substantially fewer, only 435 or 4.8% of all labourers, had been construction labourers.

The following map 5 displays the changes in landless between 1987 and 1997. Over the decade the number of agricultural workers increased in the 22 sample villages by only 16.6%; industrial labourers increased by 49.4%, but construction labourers exhibited the most dramatic increase, 153.3%. Not all of these labourers were working within the same village, however, since in 1997 15.2% of the agricultural labourers (1,335), worked outside the village, and 974 or 40% of the industrial labourers worked elsewhere. Travelling outside the home village to work increased over the decade. In 1987, 1,075 or 14.3% of the agricultural labourers worked outside their home village, and 34.7% or 402 industrial labourers travelled to work elsewhere. Those working outside the village as agricultural and industrial labourers increased at faster rates over the decade; agricultural labourers working outside the village increased by 24.2% compared to only 15.3% for those working in the same village. Industrial labourers working outside the village increased by 142.3% compared to only a 90.2% increase for those working within the village.

Indeed in half of the villages there was a smaller number of agricultural labourers working within the village than there were land owners, providing evidence that agricultural labour shortages probably exist in many villages. Although 3 villages in Dharwad and 2 in Hubli have fewer agricultural labourers than land-owners, Navalgund and Kundgol Taluks appear to be affected as much by this tendency since all four Navalgund villages and two of the four Kundgol villages have fewer agricultural labourers than land owners. Rural-urban migration may perhaps have reduced the labour force in these more peripheral taluks, whereas competition for non-agricultural labour in villages closer to the city may account for agricultural labour shortages there.

The largest proportions of industrial labourers are found in Hubli Taluk, 30.5%, although Navalgund Taluk, with an average of 22.3% industrial labourers, exceeded Dharwad Taluk's 19.6%, perhaps reflecting industrial activities in the small town which has also become the administrative headquarters of the taluk. 44.3% of all labourers in Kalghatgi Taluk were in construction, reflecting the opportunities for employment in the brickworks and stone quarries there.

Table 3.6 Numbers of Labourers Resident, 1987 and 1997, Villages Sampled for Village Focus Group Discussions in the Hubli-Dharwad City Region

	Agricultural Labourers				Industrial Labourers				Construction Labourers		All Labourers	
	Working Within Village		Working Outside Village		Working Within village		Working Outside village					
	1987	1997	1987	1997	1987	1997	1987	1997	1987	1997	1987	1997
DHARWAD												
Yogayallap	80	160	10	40	60	120	-	-	-	-	**150**	**32(**
Mugad	80	160	10	40	60	120		-	-	-	**150**	**32(**
Narendra	600	800	-	-	120	160	20	60	12	20	**752**	**104(**
Kotur	250	300	-	-	20	20	40	180	4	6	**314**	**50(**
Amminabhavi	600	950	200	400	60	60	8	20	20	120	**888**	**155(**
Govankop	60	90	10	20	-	-		-	-	-	**70**	**3C**
	1670	**2460**	**230**	**500**	**320**	**480**	**68**	**260**	**36**	**146**	**2324**	**376(**
HUBLI												
Bidnal	180	210	-		-	-	100	160	6	8	**286**	**37E**
Gokul	250	280	60	100	100	200	40	60	24	40	**474**	**68C**
Kusugal	600	600	150	150	20	20	40	200	25	50	**835**	**1020**
Katnur	280	160	-	-	-	50	-	50	2	4	**282**	**264**
Anchatgeri	120	200	40	80	20	50	10	20	4	10	**194**	**36C**
Devargudihal	60	225	-	-	112	50	20	70	2	5	**194**	**350**
	1490	**1675**	**250**	**330**	**252**	**370**	**210**	**560**	**63**	**117**	**2265**	**3052**
KALGHATGI												
Dastikop	200	250	50	50	15	20	-	30	6	60	**271**	**410**
Bangittigudihal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	**n.a.**	**n.a.**
Mishrikoti	6	79	-	-	-	-	76	24	42	300	**124**	**403**
Jodihalli	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a	**n.a.**	**n.a,**
Galagihulakoppa	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	**n.a.**	**n.a.**
	206	**329**	**50**	**50**	**15**	**20**,	**76**	**54**	**48**	**360**	**395**	**813**
KUNDGOL												
Jigalur	500	500	60	60	-	-	20	20	6	12	**586**	**592**
Devanur	675	675	75	75	-	-	-	-		-	**750**	**750**
Hirenarti	400	400	60	60	20	20	-	-	6	20	**486**	**500**
Gudgeri	-	-	50	60	30	50	-	-	20	35	**100**	**145**
	1575	**1575**	**245**	**255**	**50**	**70**	**20**	**20**	**32**	**67**	**1922**	**1987**
NAVALGUND												
Navalgund	**800**	750	300	200	120	500	20	60	250	400	**1490**	**1910**
Arekurahatti	**180**	220	-	-	-	-		-	-	-	**180**	**220**
Saswihalli	260	225	-	-	-	-	-	-	2	4	**262**	**229**
Nalvadi	280	216	-	-		-	8	20	4	8	**292**	**244**
	1520	1411	300	200	120	500	28	80	256	412	**2224**	**2603**
ALL VILLAGES	**6461**	**7450**	**1075**	**1335**	**757**	**1440**	**402**	**974**	**435**	**1102**	**9130**	**12221**

3.5.1.4 Artisans

The village focus groups in 21 of the villages were able to provide information on the number of carpenters, blacksmiths or potters for the current year and for ten years earlier. As shown in Table 3.7, the number of carpenters increased to 207 from 138 a decade ago, a growth rate of 50%. Similarly, the number of blacksmiths grew from 59 to 81, increasing by 37.3% over the ten-year period. In contrast, however, the number of potters declined from 9 to 5 in 1987, a decrease of 44.4%. Although individual village growth rates for carpenters varied, 13 villages increased the number of carpenters although 6 had the same number in both years; only Mugad in Dharwad Taluk had lost carpenters. In 8 villages, the number of blacksmiths increased over the decade, 7 had the same numbers, together with 4 villages which had no blacksmiths in either year; none of the villages suffered decreases in the number of blacksmiths. Pottery-making was less widespread since only 5 villages had potters, one of which, Mugad, which has an active potters society, was unable to provide figures on the number of potters there.

Table 3.7 Number of Non-Agricultural Enterprises in Selected Villages, 1987 and 1997, Sampled for Village Focus Group Discussions in the Hubli-Dharwad City Region

	Carpenters		Blacksmiths		Potters	
	1987	**1997**	**1987**	**1997**	**1987**	**1997**
DHARWAD						
Yogayallap	yes	yes	yes	yes	-	-
Mugad	2	1	yes	yes	yes	yes
Narendra	6	8	4	6	2	3
Kotur	2	2	2	2	-	-
Amminabhavi	12,	22	6	6	-	-
Govankop	4	7	5	7	-	-
	26	**40**	**17**	**21**	**2**	**3**
HUBLI						
Bidnal	4	4	-	-	-	-
Gokul	8	12	4	4	-	-
Kusugal	**8**	20	4	6	-	-
Katnur	2	4	2	4	-	-
Anchatgeri	4	8	1	3	-	Yes
Devargudihal	2	2	-	-	4	1
	28	**50**	**11**	**17**	**4**	**1**
KALGHATGI						
Dastikop	3	3	1	2	-	-
Bangittigudihal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Mishrikoti	10	10	8	**8**	3	1
Jodihalli	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Galagihulakoppa	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	13	**13**	**9**	**10**	**3**	**1**
KUNDGOL						
Jigalur	n.a.	2	n.a.	1	-	-
Devanur	4	6	4	4		
Hirenarti	4	4	2	2	-	-
Gudgeri	2	4	2	2	-	-
	10	**16,**	**8**	**9**	**-**	**-**
NAVALGUND						
Navalgund	40	60	12	20	-	-
Arekurahatti	6	8	2	4	-	-
Saswihalli	6	g				
Nalvadi	9	12	_	_	_	
	61	**88**	**14**	**24**	**-**	
ALL VILLAGES	**138**	**207**	**59**	**81**	**9**	**5**

3.6 Remaining information gaps

Although the village focus group discussions demonstrate that villagers are able to provide substantial amounts of information on some aspects of life in the villages, they are inevitably vague on some more confidential aspects. There is no evidence that they were able to supply precise information on the number of people travelling in to work in Hubli-Dharwad, and did not provide information on the number of newcomers resident in the village or on villagers who had left the village. Only general impressions could be obtained on what types of purchasers are buying land, whether it is farmers from other villages or urban dwellers buying land for investment or speculative purposes. Land values were expressed as ranges, with only limited information given on prices being paid for prime sites along roads or more productive wet lands. The presence of borewells or proximity to tanks would presumably be valued more highly so that irrigation could take place. Information was not provided on the number of sales taking place, only broad trends indicated.

Village informants were clearly able to quantify the number of landowners in the various size categories, and precise information appeared to be given both on the numbers of labourers working within the village and elsewhere at present and ten years ago, and on the number of artisans in the village. The village informants did not mention the total quantities or values of agricultural production in the village, or the amounts being paid for specific crops; it is likely, too, that only general information can be obtained on marketing and the middlemen's purchases of village farm produce.

A major gap appears to exist concerning the coping strategies adopted by farmers to compensate for the loss of their farmland when it is sold or when family labour is lost due to a shift to non-farm activities or out-migration, resulting in labour shortages.

While the analysis of Census information can indicate which peri-urban villages might be worth selecting as a sample for more detailed analyses, it is important to supplement this use of secondary sources of information by primary data collection, either through detailed village focus group discussions or applying participatory rural appraisal techniques.

Detailed records, however, are reported to be kept within the villages by the Village Accountants on each land holding going back for a considerable number of decades. This might assist in selecting samples of individual farmers for on-farm interviews and analyses. The Revenue Department maintains manual registers of land holdings for each village, together with village maps showing these land holdings. Although the Dharwad Deputy Commissioner is keen to initiate work on creating computer databases of land holding information, it will require substantial time and labour to achieve this database of land holdings. This might ultimately be expected to show land transactions and the amounts and values of land being sold in each village. Involvement in a pilot project for a few villages to assist in the the creation of the computer databases and related digital maps might be expected to greatly facilitate analytical research on the processes of change taking place within the peri-urban areas of Hubli-Dharwad.

3.7 Conclusion

Average village size varied in population in 1991 from 1,394 (Kalghatgi) to 2,772 (Navalgund), with the larger villages in the black cotton soil irrigated areas. However, these villages tend to have lost population through out-migration over the 1980s, while villages in the wetter, red soil areas north and east of the city, Dharwad taluk in particular, has a concentration of villages (c 70%) which have grown by attracting in-migrants. In I-Iubli and Kalghatgi taluks villages growing at more than the average natural rate of increase have tended to be close to the city; villages further away have tended to lose population.

Growth in population may be explained by the increase in non-farm employment opportunities in the three taluks closest to Hubli-Dharwad: Hubli, Dharwad and Kalghatgi. The increase in non-farm employment was particularly marked for men. 101 villages in the five taluks had experienced a decline in non-farm employment, suggesting both a concentration of such employment and an inability to compete with city enterprises.

Participation in the labour force as a whole has increased particularly rapidly for women in the three taluks nearest the city. Given that female non-farm workers increased much more slowly than male, most women were finding work in the lower paid farm sector. Poverty in the peri-urban areas thus has a strong gender dimension.

Literacy levels were studied, as an indicator of wellbeing/poverty. In general male rates (around the 50% mark) were more than double female in 1981 and almost double in 1991. There was significant variation by taluk, with the best rates in the wealthiest and more agrarian areas east of the city, and the lowest rates in the forest fringe areas. The three more dynamic taluks are probably are absorbing unskilled, uneducated migrant labour.

Overall, we can say that the pattern of growth and change is dynamic and complex to the west and north of the city; rather stagnant and more purely agrarian elsewhere. This difference may be explained by several factors. There may be varied degrees of land pressure, new opportunities presented by irrigation and changing cropping patterns, new opportunities for employment, providing goods and services to the city, and possibilities for commuting.

4. FARMING SYSTEMS AND AGRICULTURAL MARKETING

4.1 Introduction

This chapter maps the evolving farming systems of the peri-urban interface. The baseline survey was able to delve into what is a highly complex field of enquiry through a number of windows. Secondary sources were very few, and far wider in scope than the peri-urban areas of Hubli-Dharwad. The main ones are Hulamani & Radder (1996), Satish Chandran (1993); Vyasulu (1997), and surveys conducted by a team of agricultural scientists from UAS, Dharwad as part of the Baseline Survey.

Satish Chandran (1993) addresses the issue of stagnation of agricultural productivity in Karnataka in the 1980s. This report was, of necessity, rather broad in its scope, and most statistics provided are on a State-wide basis. Nevertheless, it provides useful general background material on the natural resource base and temporal trends in agricultural productivity, for the major staple and industrial crops. Hulamani and Radder (1996) is somewhat more specific in geographical scope, being concerned with the Northern Transition Zone of Karnataka, consisting of 14 taluka, three of which (Dharwad, Hubli and Kundgol) feature in the DFID Peri-Urban Interface Baseline Survey. The Report considered horticultural as well as staple and industrial crops, and looked at temporal trends in cropping patterns. It suggested reasons for the adoption or otherwise of certain crops, as well as giving extension recommendations. Vyasulu (1997) analysed the prospects for economic development in Dharwad District, which includes areas considered to be outside the scope of the Peri-Urban Interface study. There is an overlap with data presented in Satish Chandran (1993), as both draw on the same census and agricultural statistics data.

Primary data gathering was carried out in three forms: a set of commissioned studies on various aspects of the farming systems which were reported at the July 1977 workshop; the broadbrush survey of 25 peri-urban villages; and participatory research exercises conducted in four villages. All these sources have been used in preparing this chapter. Given the vast array of topics and systems which could have been covered, the chapter is inevitably selective, focusing on cropping systems, intensive crops and the organisation of markets. Significant issues have received little attention: more than in other fields, subsequent research will need to fill some of these gaps - this is further discussed in Section 4.8.

4.2 Background

4.2.1 Long term trends in cropping systems in Karnataka

The three decade period (1960-61 to 1989-90) considered in Satish Chandran (1993) covers three significant phases in crop production:

• Pre-Green Revolution - prior to 1964-65;
• Green Revolution - between approximately 1965-66 and 1979-80; •
Post-Green Revolution- following 1980-81.

Over this period the following trends in crop production in Karnataka have been observed:
• Staples: a fall in area of staple cereals planted, but a near doubling in production due to greater yield per unit area;
• Pulses: a slight increase in both area and production of pulse crops;
• Oilseeds: a slight increase in area of groundnut and a similar increase in production; a substantial increase in the area and production of other oilseeds;
• Cash crops: an expansion in fruit crop, plantation, vegetable and floriculture production.

4.2.2 Agriculture in the Dhanvad District

The section below first introduces some basic statistics concerning land area, basic landuse patterns and socio-economics before exploring trends in rainfall and describing the broad soil types found in the study area.

Dharwad District has a land area of 13,738 km', of which 1,130 km^2 are forested and 9,478 km^2 are under crops (Vyasulu, 1997). Although 70.4% of the population are engaged in agriculture, it only contributes 30% of the district's income. Given that the mean rainfall is only 700 mm and that there is little installed irrigation, with irrigation coverage at less than 30% of the national figure, the prospects for crops, staple crops in particular, do not look promising (Vyasulu, 1997).

Dharwad's sub-optimal environment for crop production had a significant impact on the up-take of Green Revolution technologies in its early years. The percentage of land under ir[r]igation is under both the national and state averages and many HYVs, especially those released during the early years of the Green Revolution, were not particularly suited to the local conditions. They tended to be more susceptible to diseases and pests than local traditional varieties and landraces, which were at a selective disadvantage for hybridisation due to their lower yields. The early HYVs required high external inputs in order to achieve their genetic potential, however, farmers are less likely to apply costly agro-chemicals in unirrigated areas due to the risk of crop failure.

Studies have shown that farmers were willing to invest in fertilizer on highly remunerative crops such as sugar cane and responsive HYVs grown under irrigation (particularly rice), but not on more marginal crops. Where conditions favoured HYVs there have substantial increases in production. In the area around Hubli-Dharwad, yield increases have been observed particularly in the irrigated areas of Navalgund and Kundagol Taluks. These increases are also linked, in part, to the dramatic increase in use

of agro-chemicals[1]. Over the whole of Karnataka, in the 11 years up to 1991-92, fertilizer consumption rose by 264%, of which the vast majority was due to access to irrigation and adoption of responsive HYVs. State-wide, mean nutrient application rates in 1991-92 were 32.0 kg N/ha, 20.3 kg P_2O,/ha and 11.3 kg K_2O/ha, but with the rate of application being four times higher on irrigated compared to non-irrigated land.

Nevertheless, agricultural productivity in Dharwad District is among the lowest in Karnataka (Satish Chadran, 1993). Despite the proportion employed in this activity, it is higher than the State or Indian average. Vyasulu (1997) has attributed the lack of labour mobility to relatively poor industrial development in Hubli-Dharwad, reducing agricultural workers' access to off-farm employment, however, further research may be needed in this area.

4.2.2.1 Rainfall Trends

Apparent changes in the timing of the onset of the monsoon, increasing rainfall variability and a reduction in overall rainfall were investigated as part of the Baseline Survey.

Monthly rainfall data for Dharwad and Mugad for 26 and 25 years, respectively, were plotted. These were the best data available readily. Figures 4.1 and 4.5 depict temporal changes in rainfall. There is evidently a slight annual *increase* in rainfall (by 3.4 mm/year in Dharwad, and 5.6 mm/year in Mugad, the latter regression approaching statistical significance). Although 1976 and 1989 were drier than average at both sites, there is no evidence of increasing variability, on an annual basis.

Figures 4.2 and 4.6 show mean monthly distribution of rainfall at the two sites. Over the period in question, Dharwad and Mugad received 728 mm and 998 mm, respectively. Standard error bars on the monthly data do not indicate that any particular month is more variable than the others, with perhaps the exception of June in Dharwad.

Figure 4.3, 4.4, 4.7 and 4.8 show rainfall data for each month, over the period in question. In Dharwad, June appears to be more variable than the other months, due to the *higher* than average rainfall in 1983 and 1991. There were no correlations in rainfall between adjacent months, either negative or positive, indicating that (for example) high rainfall in one month was being followed by either low or high rainfall in the succeeding month. In Mugad, the onset of the monsoon, in April, is earlier than in Dharwad, and since 1981 there have been a number of years with almost complete failure of rains in that month. There is also evidence of a slight decline in total rainfall in April, as shown by the (non-significant) linear regression line. However, the other months do not show a similar pattern of failure of rain, and most show no long term trends in total rain per month, or a

[1] There are indications that government grants for the construction of borewells has increased the availability of irrigation, which has had an inevitable impact on the cropping patterns and use of complementary inputs.

slight increase. The increase in rain in October may suggest a shift in timing of the monsoon, to later in the year, but not a change in duration.

4.2.2.2 **Soils**

Soils in the Hubli-Dharwad area fall into two main types, black and red soils. The black soils are divided into medium depth (23 - 90 cm) and deep soils (> 90 cm) soils. These soils occur to the east of Hubli-Dharwad, and are typified by their dark coloration, high clay content (dominated by montmorillonitic, swelling and shrinking clay minerals), high water retention but low hydraulic conductivity, and their neutral to slightly alkaline reaction. They have a high base saturation, dominated by Ca^{t+}, are fertile and can give good crop yields if rainfall is adequate. They are generally classified as Vertisols, in the Ustert sub-order. Crops which thrive on `heavy' soils, such as sorghum, cotton, wheat and potato are predominant. The deeper soils permit cropping on residual soils moisture in the north-east monsoon and dry seasons, known as `rabi' and summer cropping.

The red soils overlie acidic bedrocks such as granites and grantite gneiss, and so are usually acidic in reaction. Their red coloration is derived from the presence of ferric oxides. They vary in their sand and clay content and the clay fraction being usually illitic, their cation exchange capacity is low to moderate, and the base saturation varies with the clay content. They have good potential for irrigation, and this is the zone in which rain-fed irrigated rice is grown. They are generally classified as Alfisols. Where rainfall is adequate, particularly in the western areas, cropping is possible in both the heavy south-west monsoon (`kharif season) and the drier north-east monsoon (`rabi').

4.2.2.3 **Major and minor crops in Dharwad District**

Drawing on secondary sources (Hulamani & Radder (1996), data about five years old at time of writing) the following cropping patterns emerged, as illustrated in the graphs below[2].

[2] In Dharwad taluk, areas of major crops, in order of magnitude, are sorghum (20,000 ha), cotton, (16,000 ha), groundnut (12,000 ha), paddy rice (10,725 ha), 'rabi' wheat (8,248 ha), and greengram (3,265 ha). In Hubli taluk, crop areas, in order *of* magnitude, are cotton (14,000 ha), groundnut (14,000 ha), sorghum (12,000 ha), `rabi' wheat (6,447 ha), greengram (3,900 ha) and rice (2,000 ha). In Kundgol taluk, crop areas, in order *of* magnitude, are groundnut (18,000 ha), cotton (16,600 ha), sorghum (8,000 ha) and rice (1,000 ha). In Dharwad taluk, areas of minor, horticultural crops, in order of magnitude, are potato (4,000 ha), chilli (2,000 ha), mango (750 ha, since more than doubled in area), onion (500 ha) and tomato (500 ha). In Hubli taluk, areas of minor crops, in order of magnitude, are chilli (10,000 ha), potato (1,000 ha), onion (1,000 ha), mango (150 ha) and tomato (100 ha). In Kundgol taluk, areas of minor crops, in order of magnitude, are chilli, usually intercropped with cotton (15,000 ha), onion (900 ha), potato (500 ha) and mango (50 ha). Besides the foregoing, banana, sapota, brinjal and tole (brassica) crops are also grown, and flowers in certain localities.

Figure 4.1 Total Annual Rainfall. Dharwad - 1971 - 96

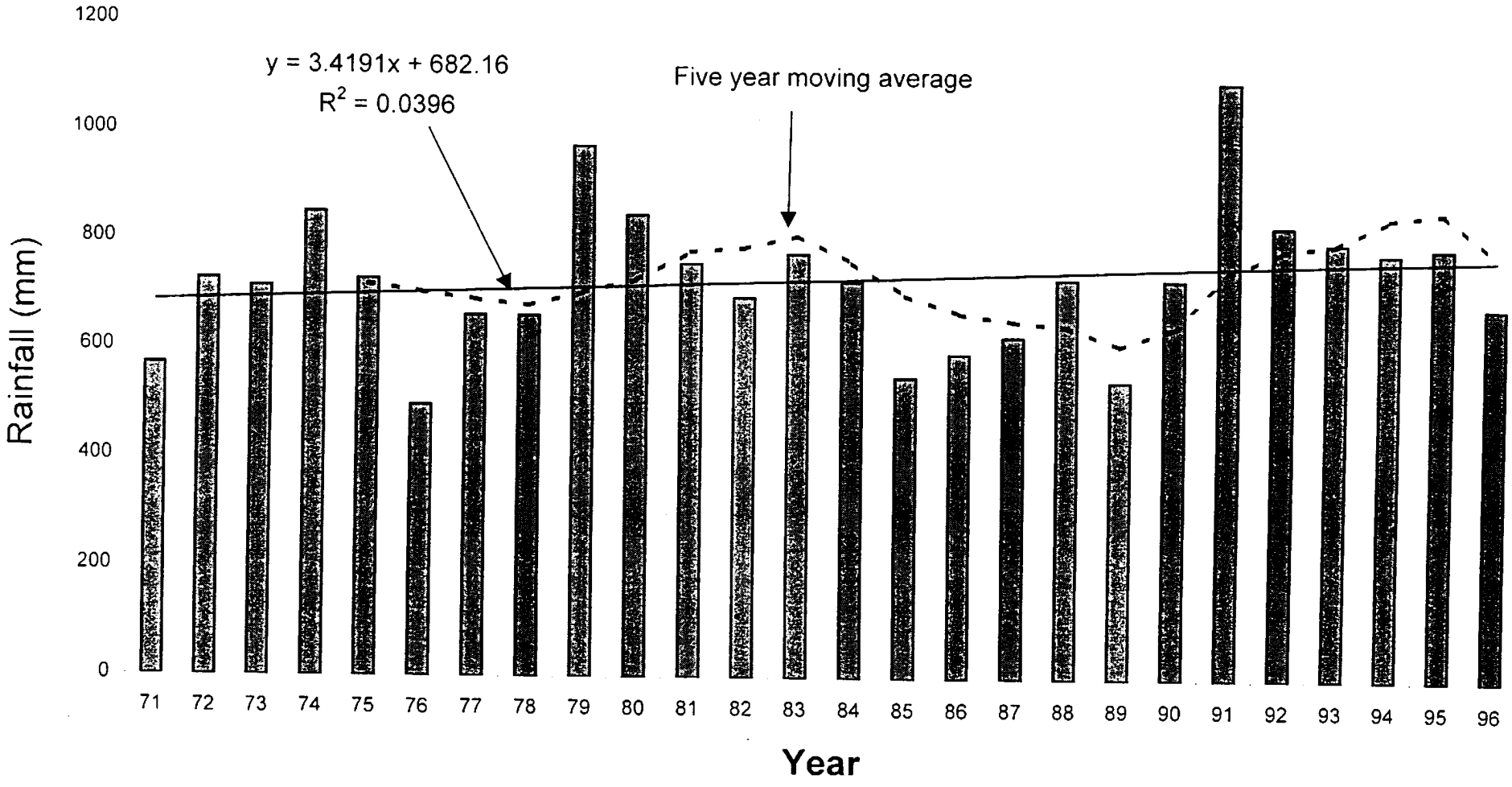
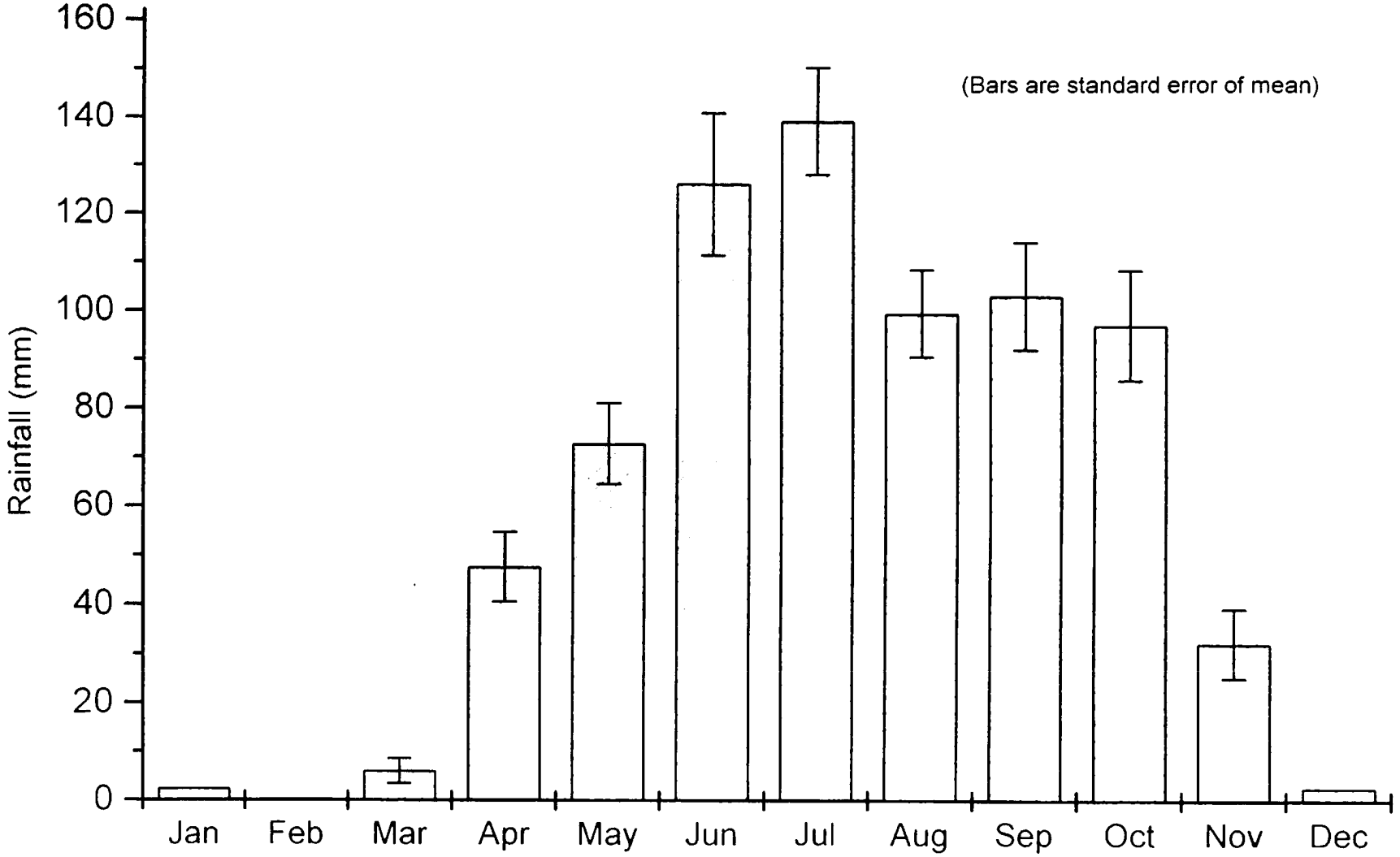


Figure 4.2 Mean monthly rainfall, Dharwad , 1971 - 96



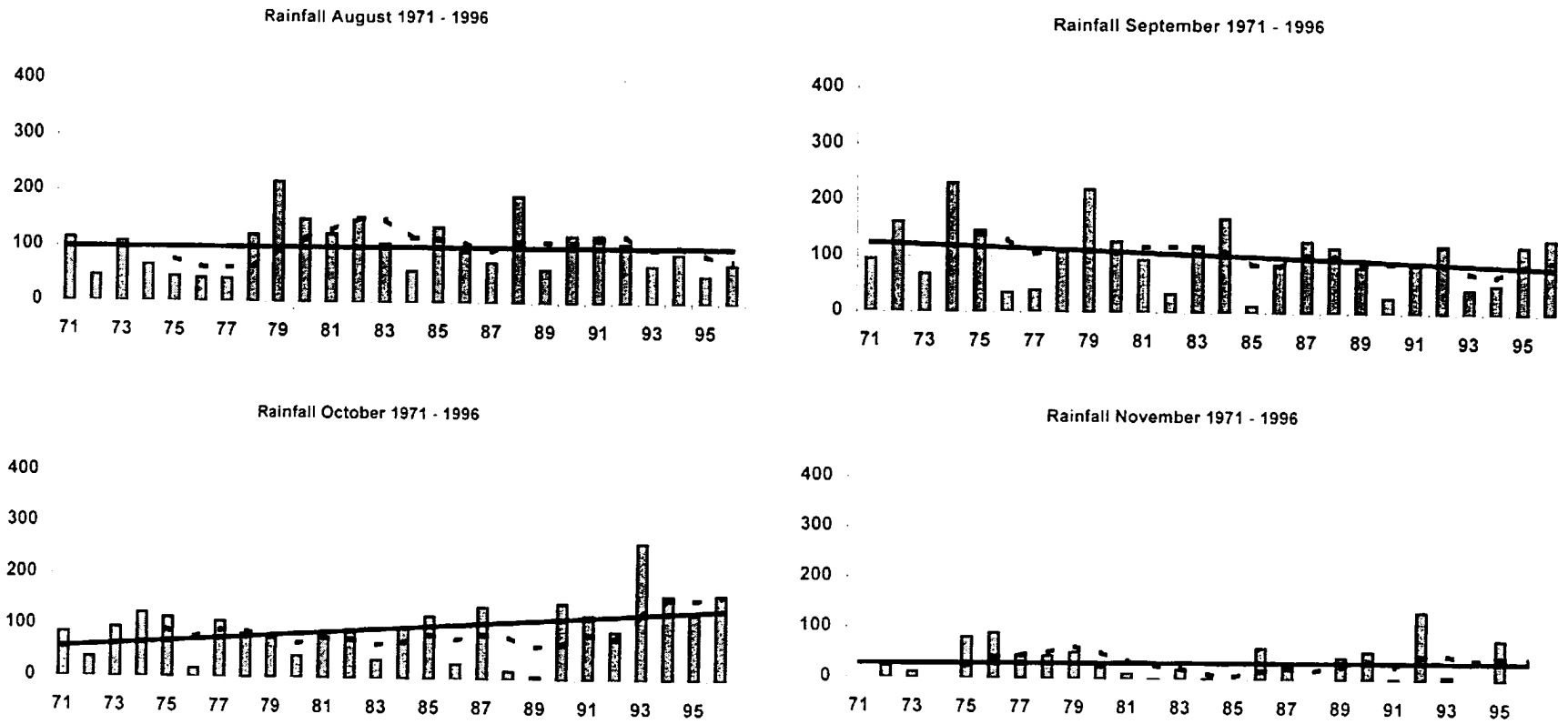


Figure 4.4 Monthly totals of rainfall, Dharwad. August - November, 1971 - 1996.
(Dashed line = five year moving averages. Solid line = linear regression)

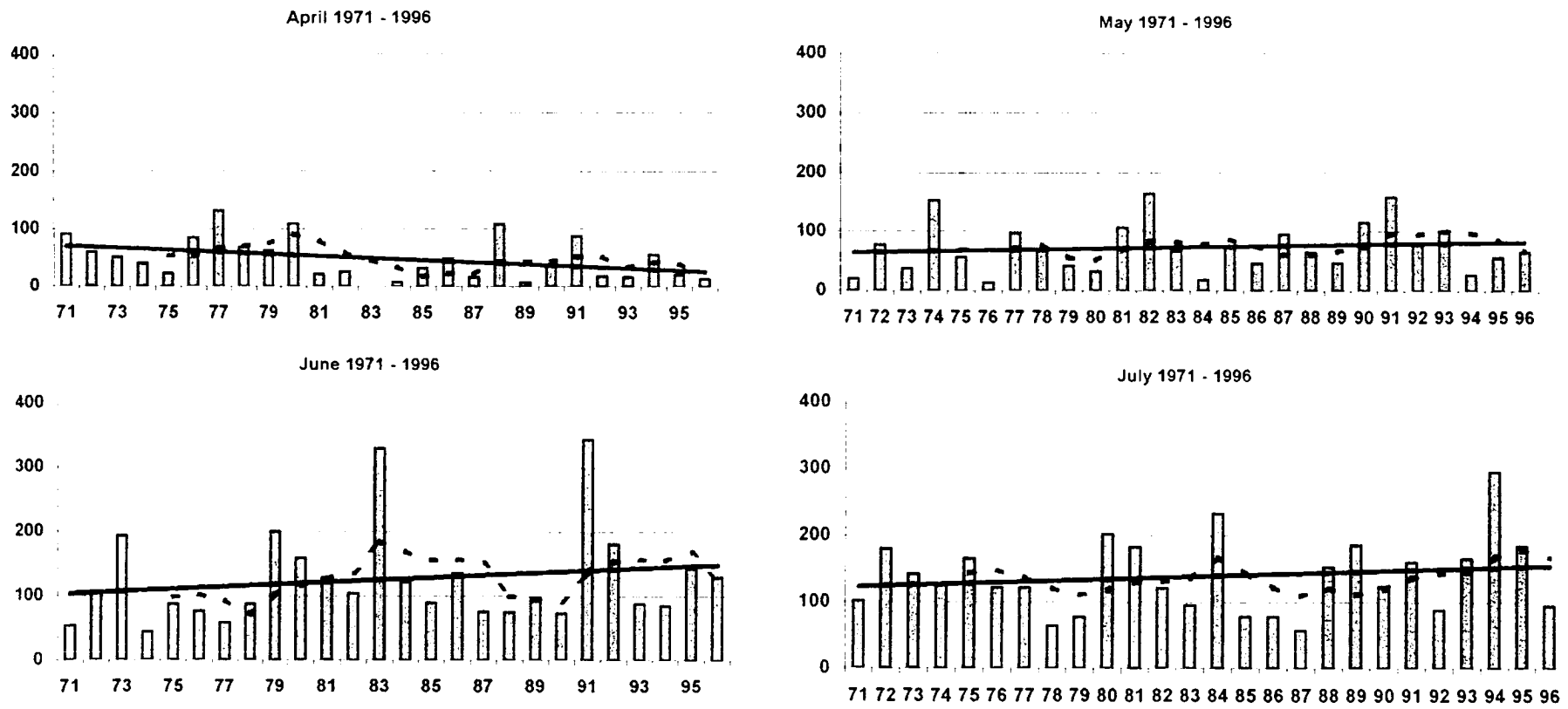


Figure 4.3 Monthly totals of rainfall, Dharwad. April - July, 1971 -1996

(Dashed line = five year moving averages. Solid line = linear regression)

Figure 4.6 Mean monthly rainfall, Mugad, 1972 - 96

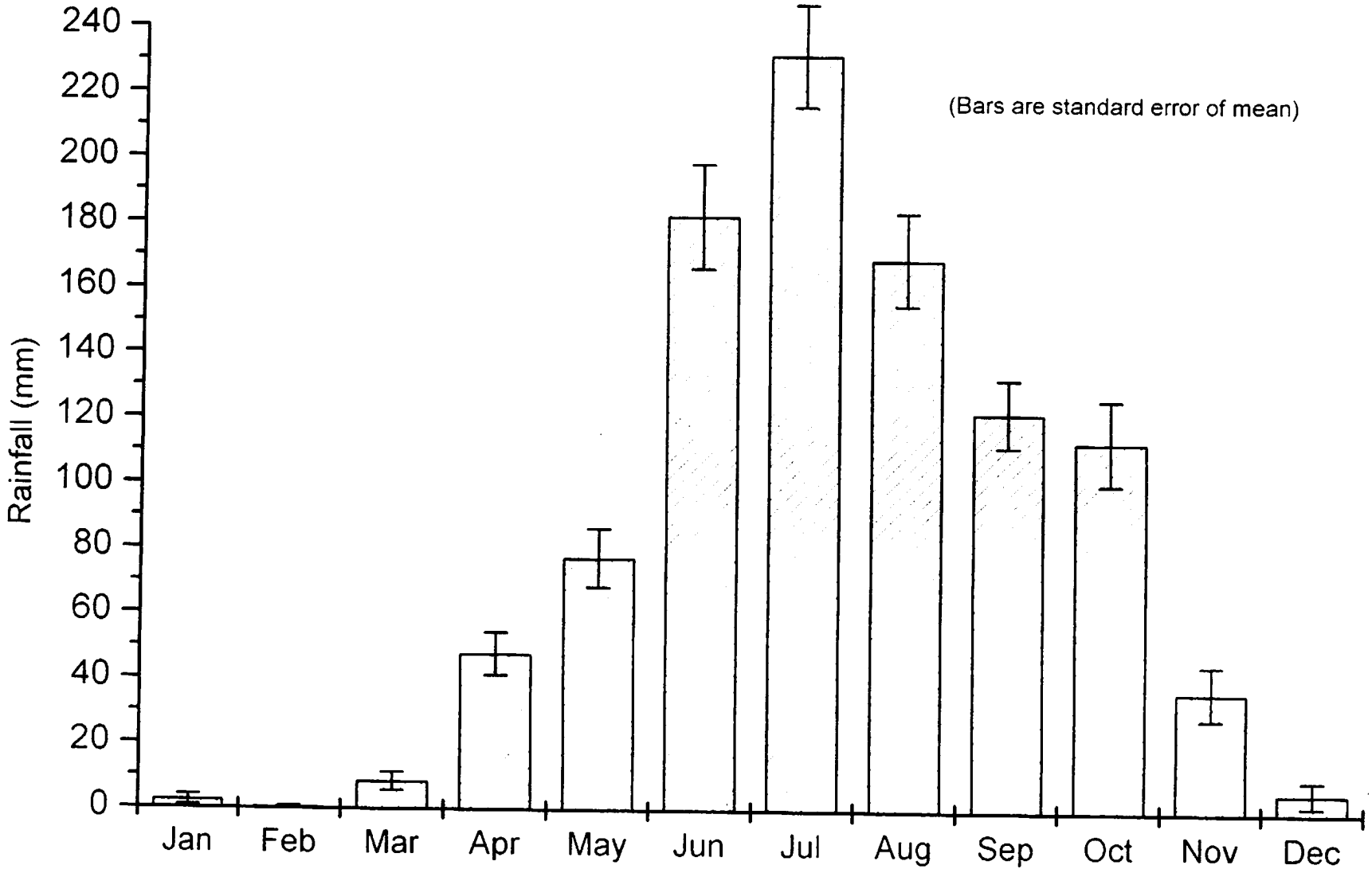
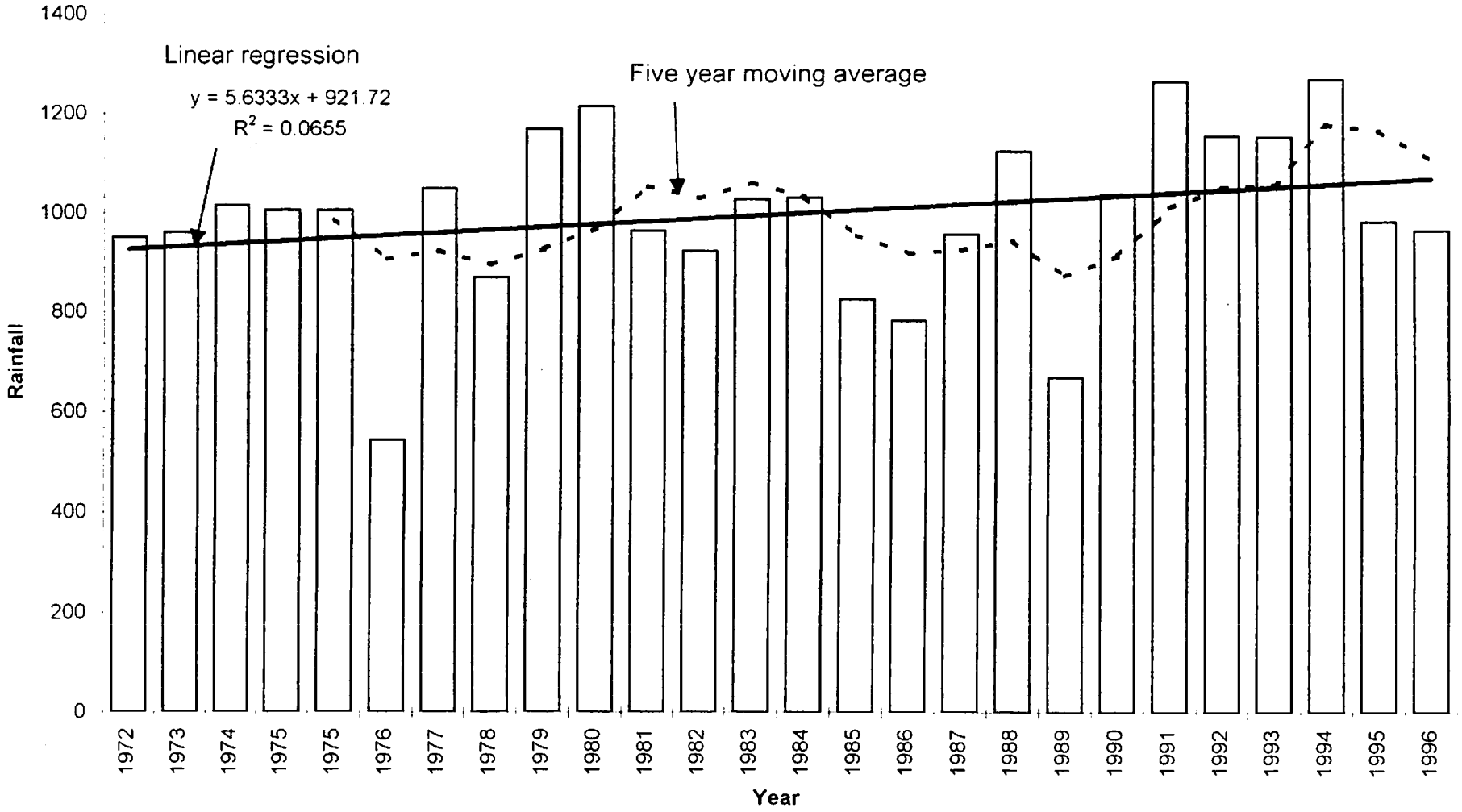


Figure 4.5 Total Annual Rainfall. Mugad - 1972 - 96



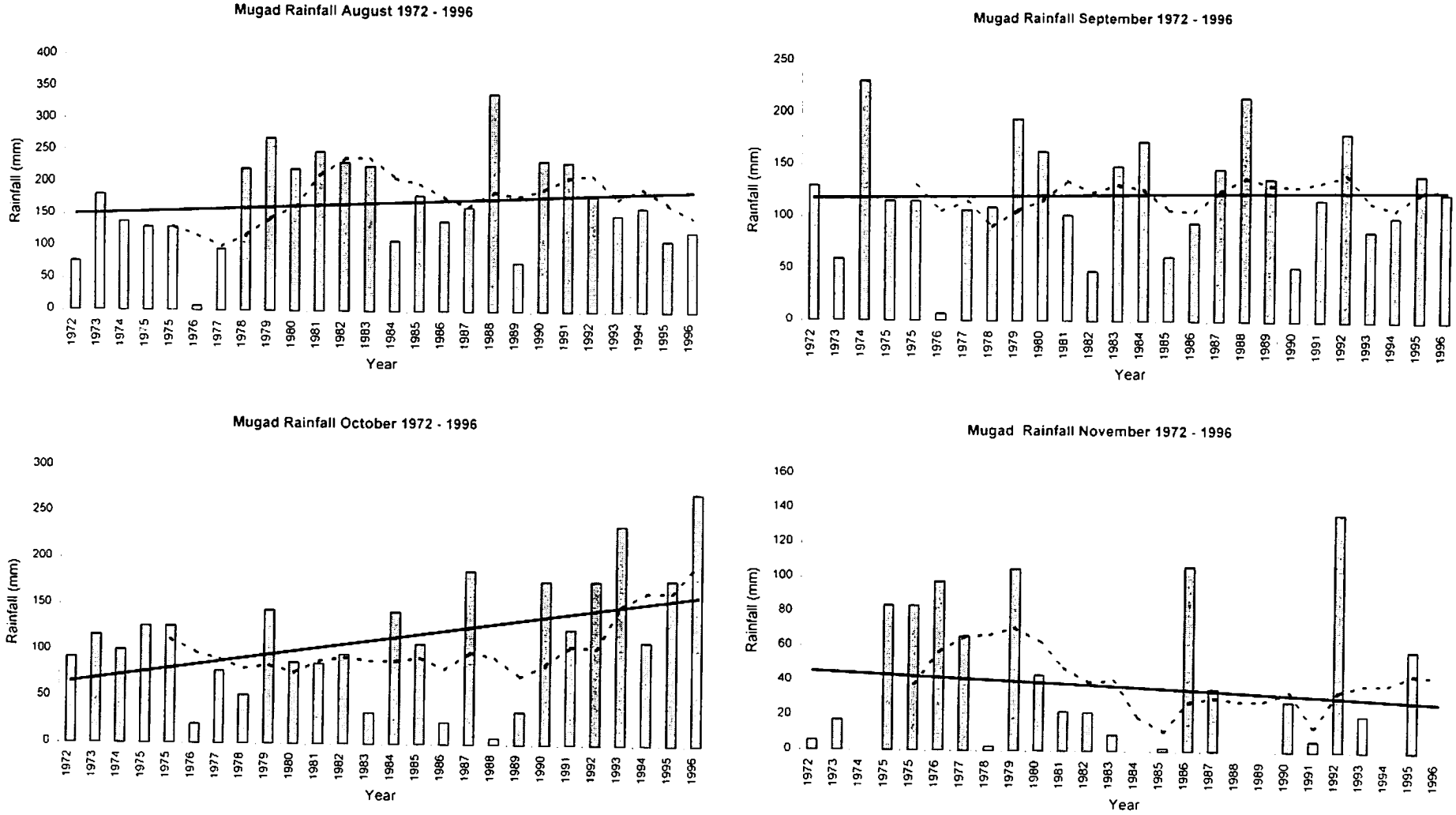


Figure 4.8 Monthly totals of rainfall, Mugad. August - November, 1972 - 1996
(Dashed line = five year moving average. Solid line = linear regression)

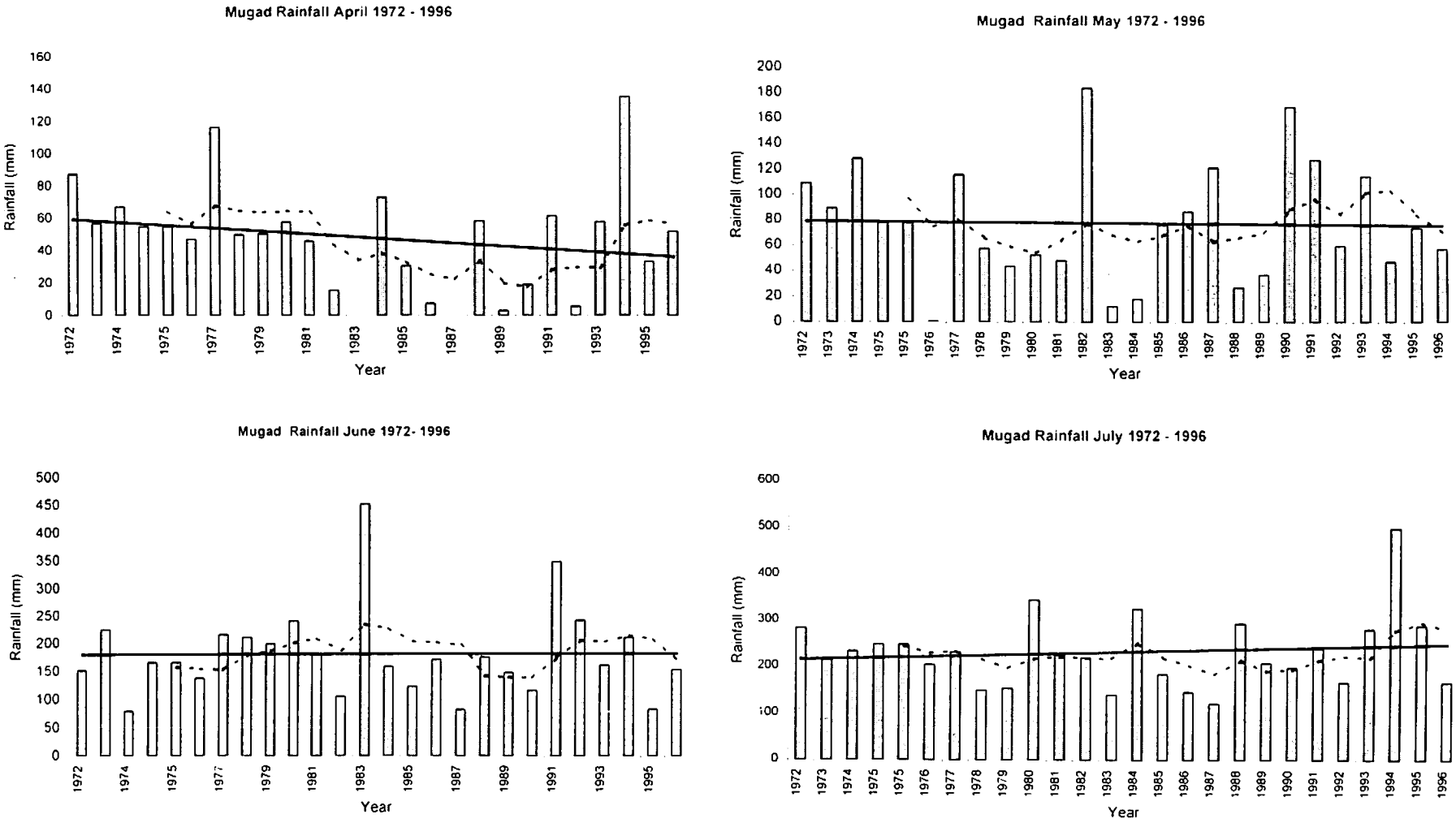
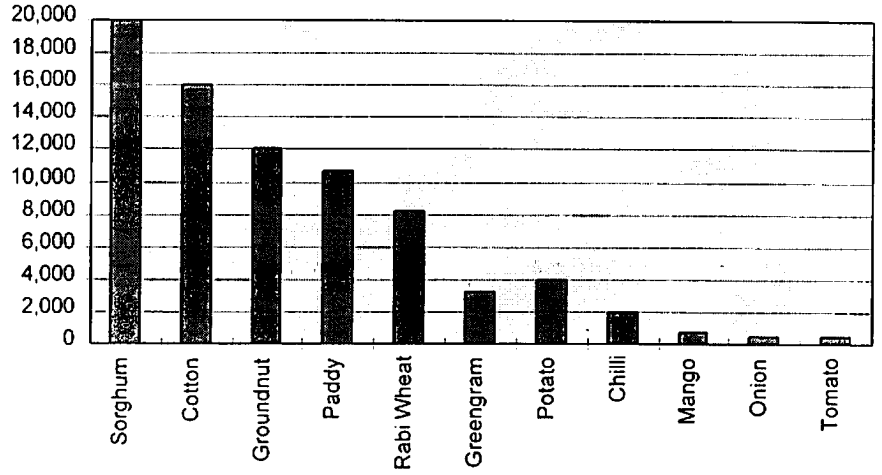
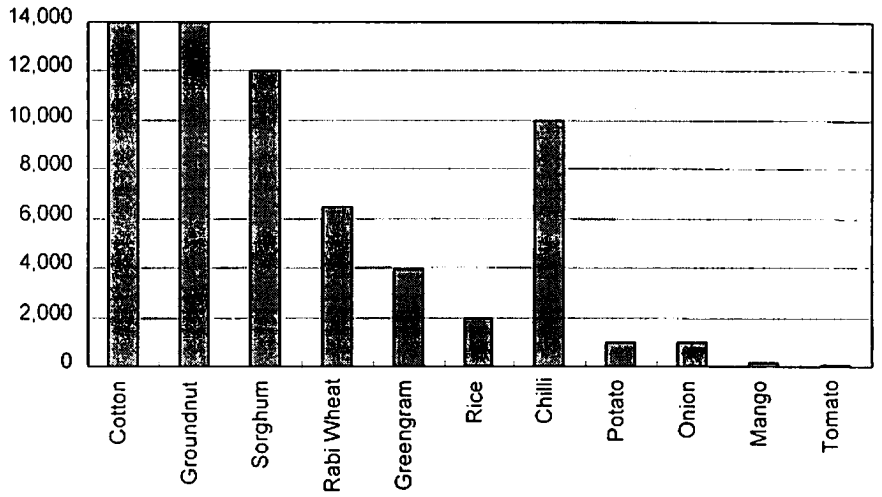


Figure 4.7 Monthly totals of rainfall, Mugad. April - July, 1972 - 1996.
(Dashed line = five year moving average. Solid line = linear regression)

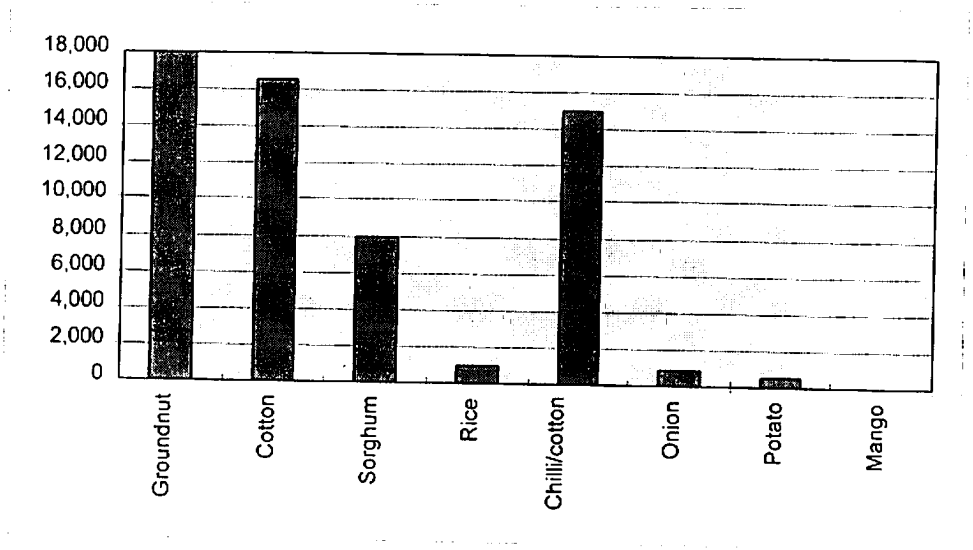
Graph 4.1 Major and Minor Crops Grown in Dharwad Taluk (ha.)



Graph 4.2 Major and Minor Crops Grown in Hubli Taluk (ha.)



Graph 4.3 Major and Minor Crops Grown in Kundagol Taluk (ha.)



The main cropping patterns are:

- Rainfed double cropping on medium to deep black soils. The main crops are sorghum (the main staple crop) greengram, potato, sunflower and wheat. The cropping intensity is 200%.
- Kharif single rainfed cropping is conducted on the less moisture retentive mixed black and red soils, which predominate in Kundgol. Sorghum is the main staple, and chilli-cotton intercrops are the main cash crops. Onion is also important.
- Rainfed drilled paddy rice. This is conducted in the red soil areas, and rice is the dominant staple.
- Rainfed long-duration hybrid cotton cropping systems feature on red soils with a higher clay content (red loamy sils).
- Horticultural cropping constitutes 11.7% of the cropped area of these taluka, particularly in Dharwad taluk. Orchard species include mango (rapidly expanding on red soil areas), sapota and guava. Vegetables are often grown where there is assured irrigation (usually borewells).

Table 4.1 compares key agricultural characteristics of Dharwad District with Karnataka State and with India as a whole.

Table 4.1 Comparison of some characteristics of agriculture in India, Karnataka and Dharwad district

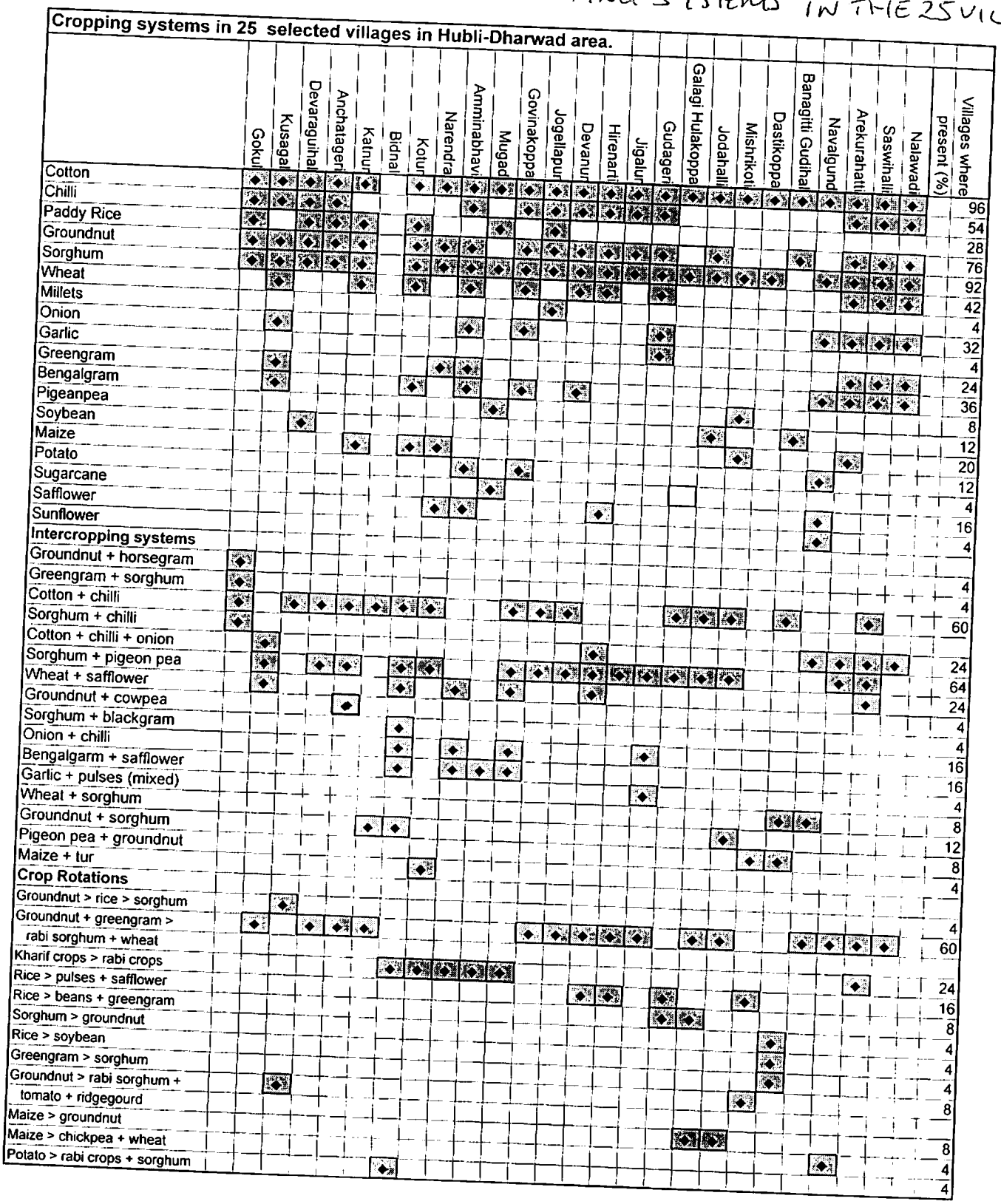
Characteristic	India	Karnataka	Dharwad District
Mean size of agricultural holding	1.69 ha	2.41 ha	3.14 ha
Proportion of cropped land irrigated	30.7%	18.05%	9.4%
Proportion of population in work	37.5%	42.0%	42.1%
Proportion of workers employed in agriculture	66.1%	67.3%	70.4%
Rate of population growth (1981-91)	2.14 % p.a.	1.90% p.a.	1.74 % p.a.

4.3 Changes in cropping systems within Hubli-Dharwad peri-urban interface

Table 4.2 shows the cropping systems in the 25 villages of the first survey (see Chapter 3). There have, however, been a number of changes to the cropping systems, due to changes in a number of factors, including:

- Climate (including rainfall intensity, duration and variability)
- Soil type
- Population pressure
- Marketing opportunities
- Farmgate prices (and changing gross margins - depending, in part, on the costs of factors of production)
- Frictional distance to the nearest large market
- Transactions failure (leading to market failure which may inhibit cropping changes to high value but high risk produce)
- Varieties of crops available
- Improvements in crop husbandry
- Availability of inputs (including early season and pre-harvest finance, irrigation. the timely availability of seeds and agrochemicals, and labour)
- Mechanisation
- Resource base (e.g. soil fertility)
- Opportunities for off-farm employment.

TABLE 4.2: CHANGES IN CROPPING SYSTEMS IN THE 25 VILLAGE

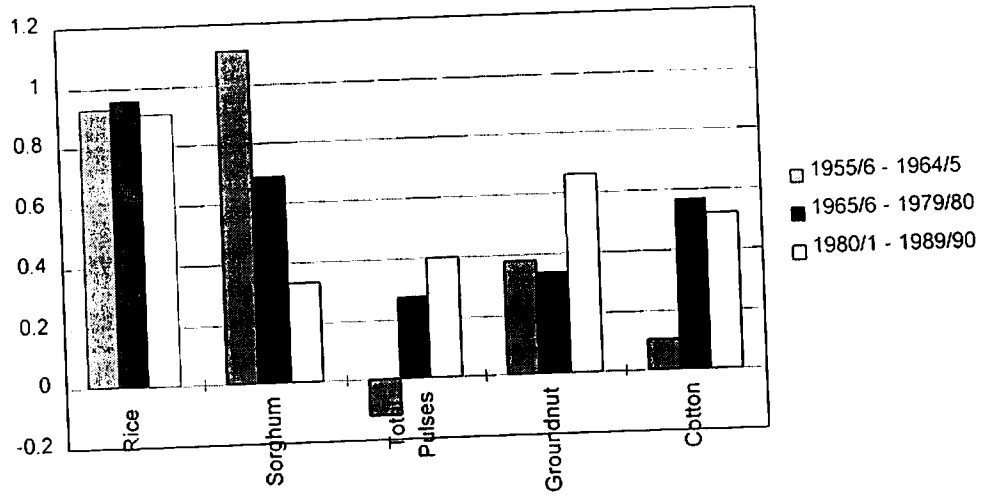


Some of the above issues are applicable to any area, peri-urban or otherwise, whereas others (e.g. marketing opportunities, off-farm employment, and possibly availability of inputs, soil fertility) are likely to be more transparently influenced by a nearby large urban settlement and by intense urban-rural interactions.

Information gathered by the Baseline Study showed evidence of change within farming systems. It appears that prices for staple grain crops have increased in relation to other crops during the 1990's, inducing farmers to change cropping patterns from 'high value' cash crops back to the traditional staples. In addition, Vyasulu (1997)[3], who examined changes occurring in cropping systems throughout Dharwad District (see Tables 4.3 to 4.5) indicated a probable link between changes in landuse and socio-economic indicators. The socio-economic data, collected by Hiremath *et al* (1997), indicate increasing pressure upon land, such as greatly increasing land values between 1987 and 1997.

Crop yields have generally increased within Dharwad District over the 35 year period described as indicated by Table 4.3. Over this period, rice yield maintained a steady increase, whilst the rate of increase for sorghum slowed and rates of increase for pulses and groundnut accelerated. The trend for yield change in cotton reached a steady rate of increase of about 0.5% p.a. in the 1960s. The increases are likely to be due to the introduction of hybrids and to changed husbandry methods.

Graph 4.4 Crop yields in Dharwad District: annual growth rate 1955 - 1990 (%)



[3] His sources of data were the same as used for the Hulamani & Radder (1996) and Satish Chandran (1993) reports.

Table 4.3 Crop yields in Dharwad District: annual growth rate 1955 - 1990 (%)

Period	1955/6 - 1964/5	1965/6 - 79/80	1980/1 – 1989/90
Rice	0.93	0.96	0.91
Sorghum	1.11	0.69	0.33
Total pulses	-0.12	0.27	0.40
Groundnut	-0.38	0.34	0.66
Cotton	0.10	0.57	0.52

Source: Vyasulu (1997).

The trends for changes in area cropped have been more erratic (Table 4.4), but over the period have generally shown an increase, particularly during the 1980s, and the evidence points to increasing intensification of land use. Obviously, there is a limit to the supply of land that can be brought into cultivation, so this trend cannot continue indefinitely, particularly in the peri-urban interface, where land is being bought for building purposes. It is not known what the environmental consequences of this increased pressure on land are, or how it influences decision making within farm households. The key reasons for changing cropping systems were investigated (Vyasulu, 1997), and it was found that the profitability of crops and the availability of irrigation were key determinants (see Table 4.5).

Graph 4.5 Landuse: annual change in area cropped (%), Dharwad District

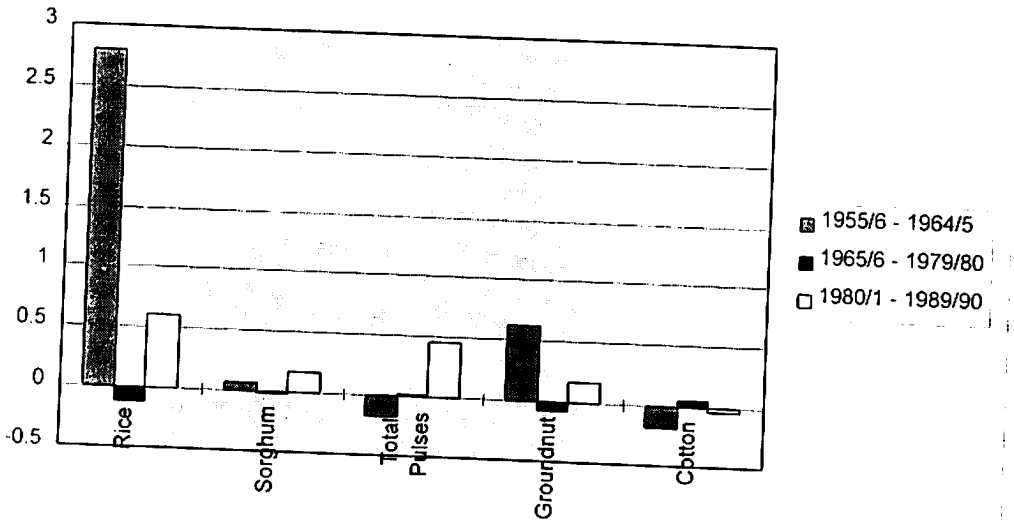


Table 4.4 Landuse: annual change in area cropped (%), Dharwad District

Period	1955/6 - 1964/5	196516 - 79/80	1980/1 - 1989190
Rice	0.28	-0.11	0.61
Sorghum	0.07	-0.01	0.17
Total pulses	-0.17	0.02	0.46
Groundnut	0.62	-0.06	0.17
Cotton	-0.19	0.06	-0.03

Source: Vyasulu (1997).

Table 4.5 Stated reasons for changing cropping system, Dhar%vad District[4]

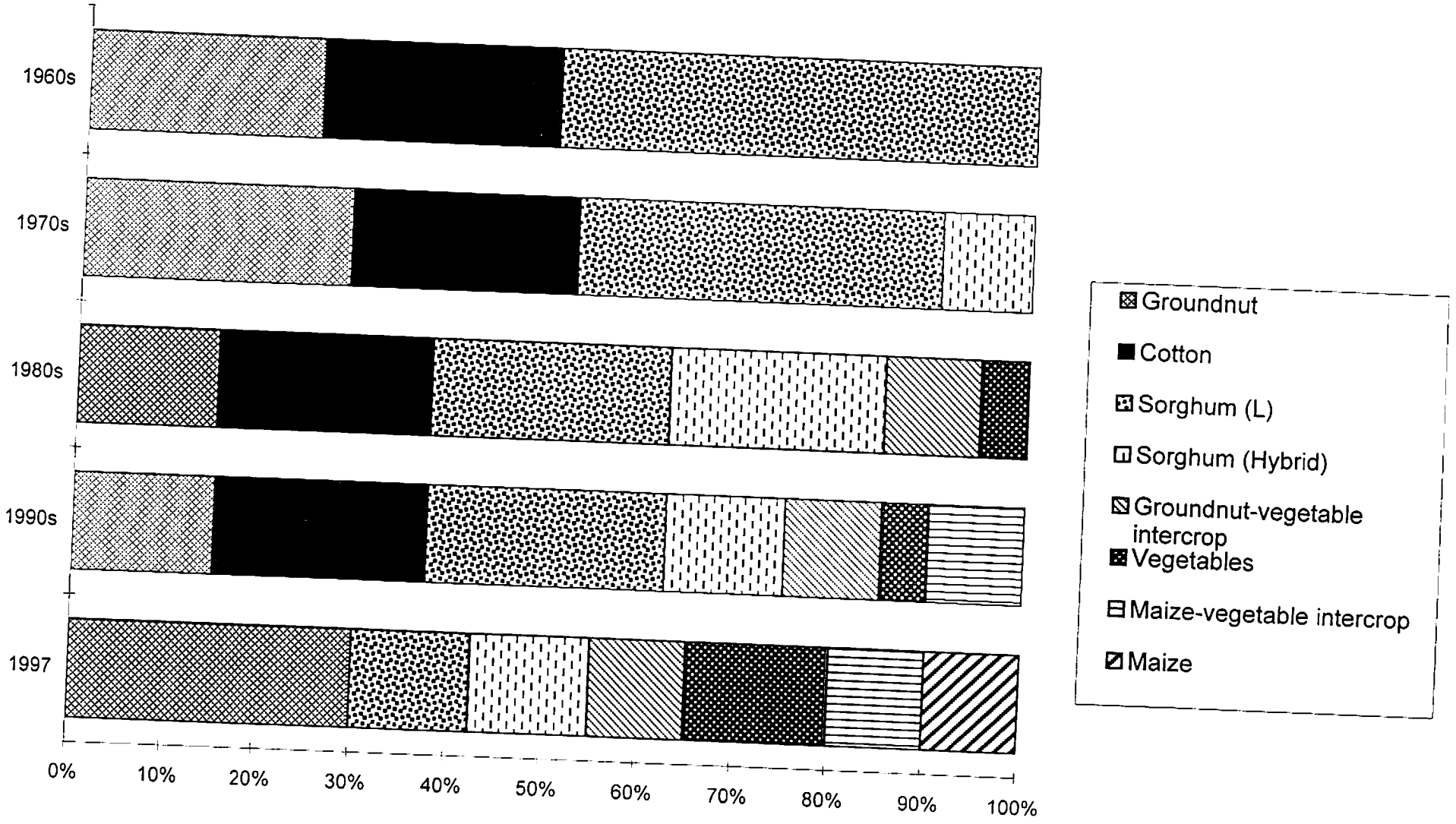
Reason stated	% of respondents
Profitability of crops	40
Installation of irrigation	30
Increase in (other?) employment	5
Decrease in rainfall	15
Lack of labour	15
Good market for flowers	5

Source: Vyasulu (1997).

[4] The accuracy of survey statistics as presented in Table 4 depend on respondent selection strategies. Also, the proportion of respondents who actually changed their cropping system was not stated. Nevertheless, this evidence taken together with that from the rapid rural appraisals (RRA) conducted as part of the baseline survey, suggests a land use system in a state of change.

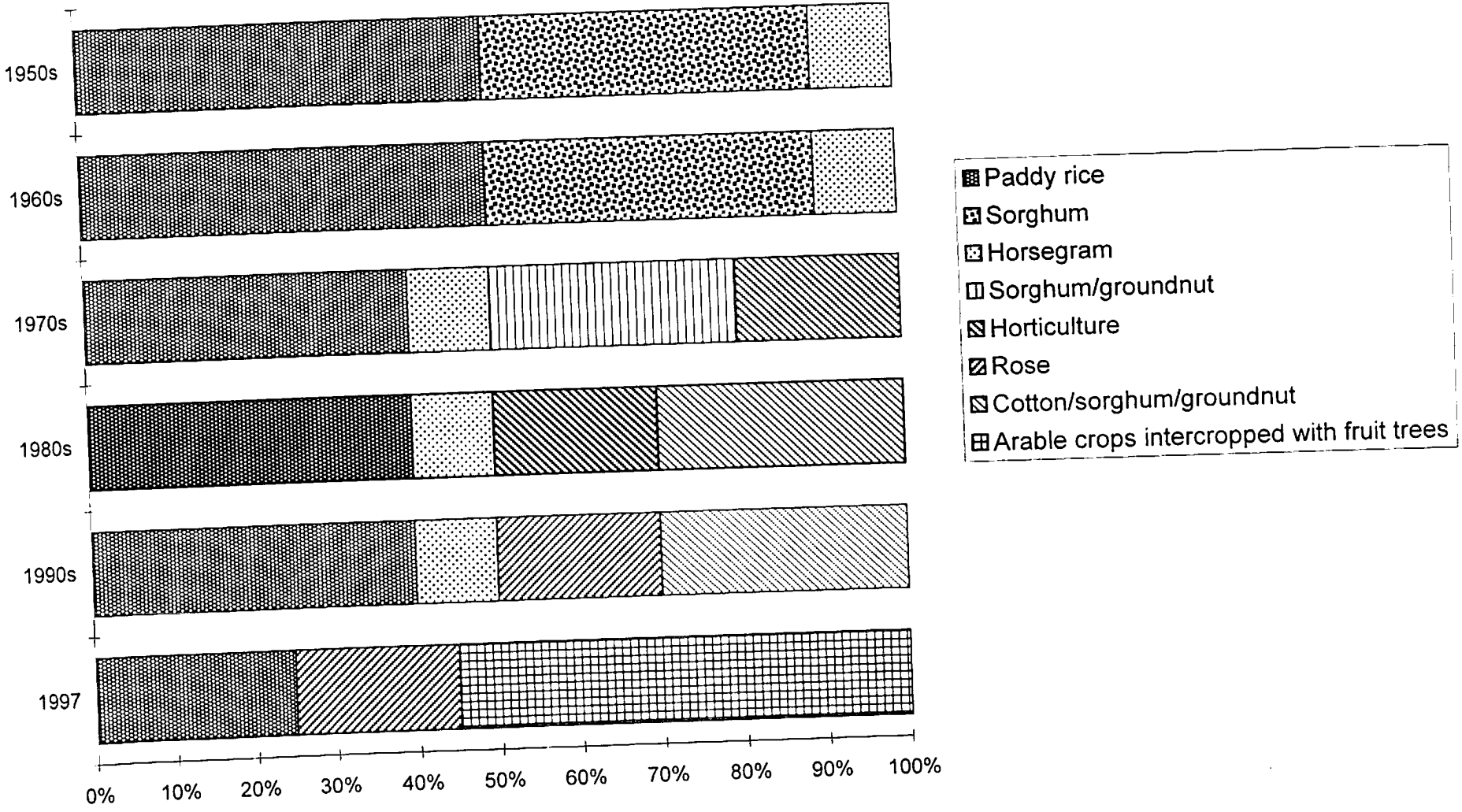
GRAPH 4.6

Hale Gabbur - changes in cropping systems



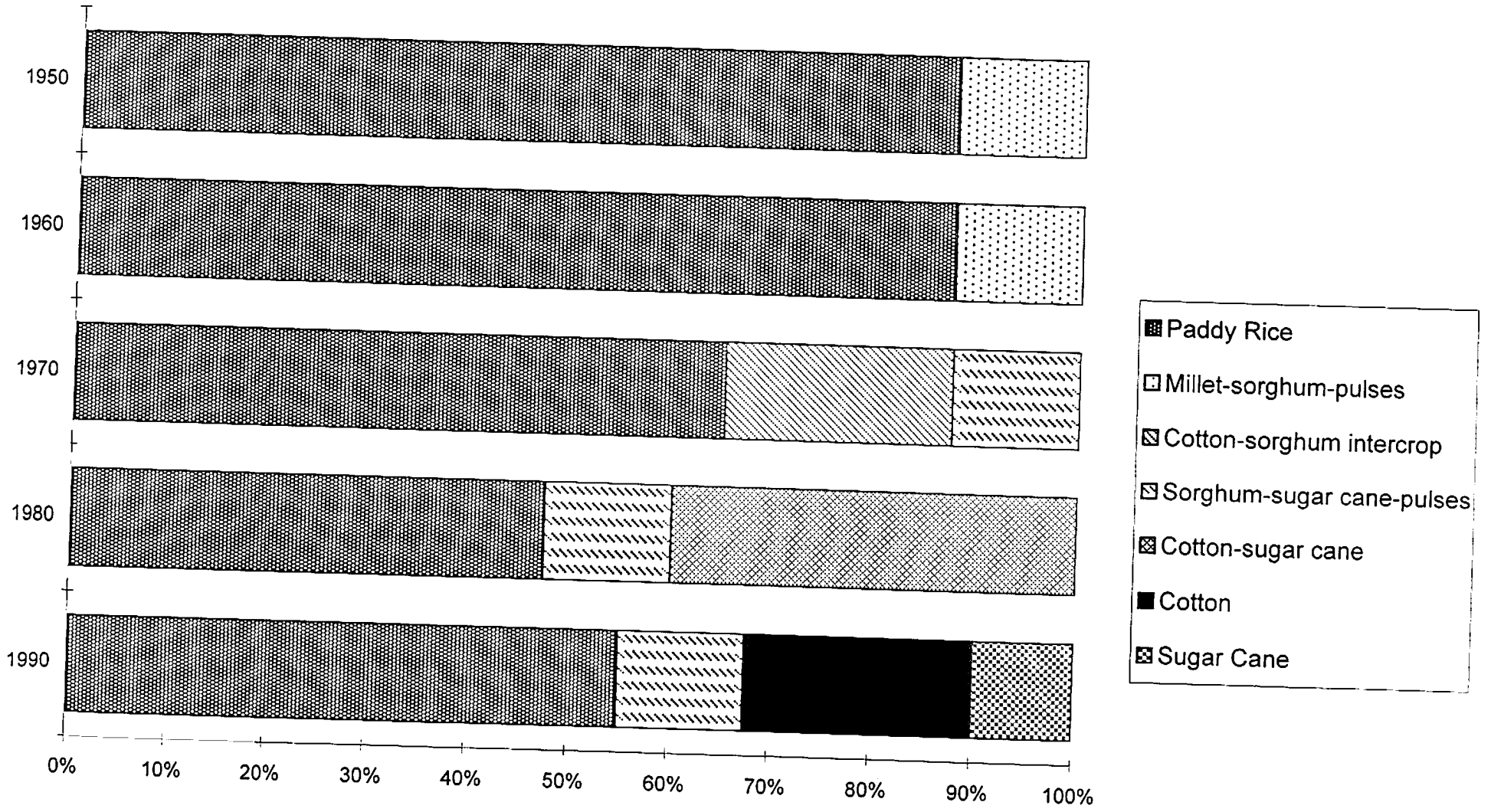
GRAPH 4.7

Devaragudihal - changes in cropping systems



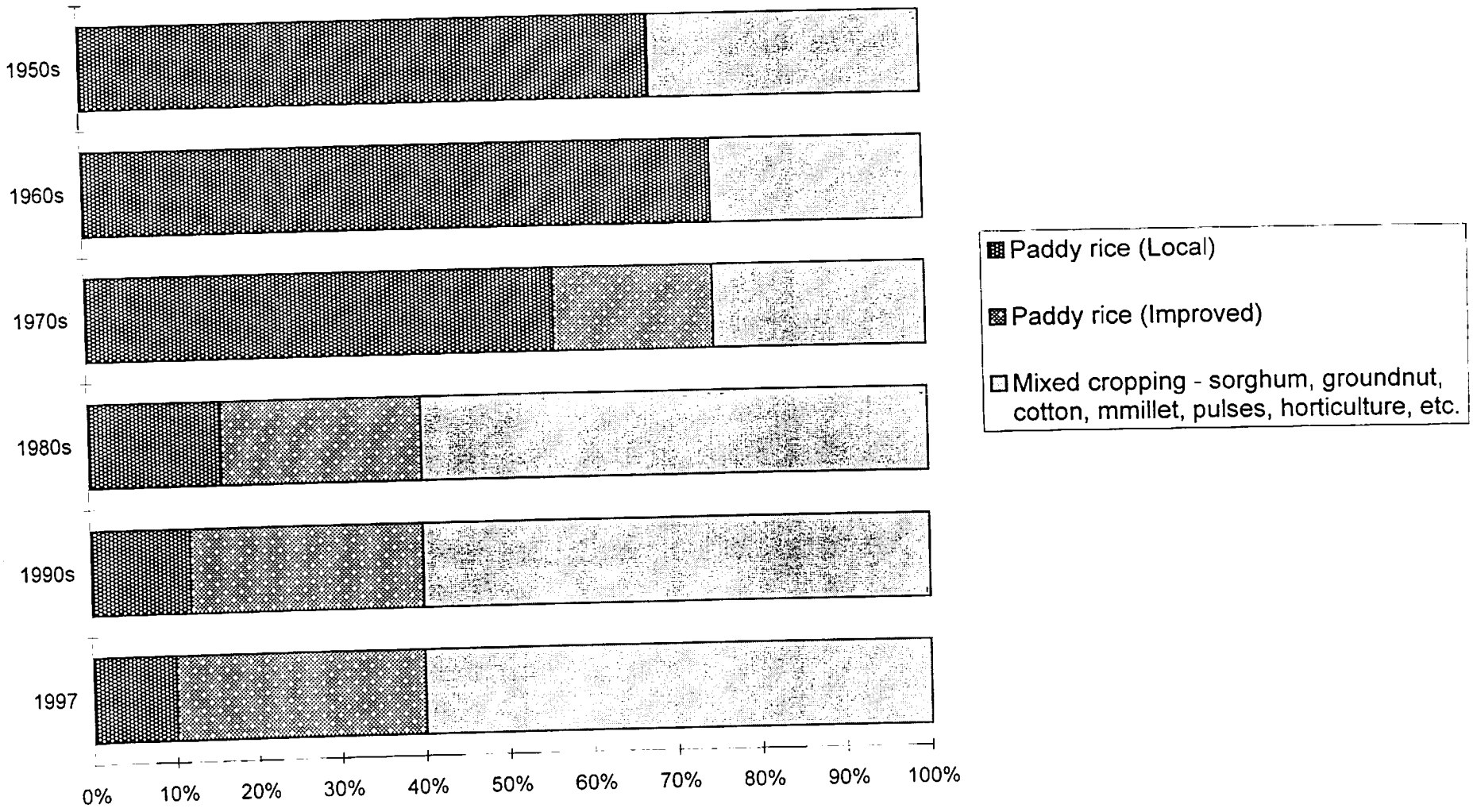
GRAPH 4.8

Mugad - changes in cropping systems



GRAPH 4.9

Kotur - changes in cropping systems



4.3.1 Participatory research findings

Participatory research exercises were conducted in four villages in the study area, Mugad, Kotur, Devaragudihal and Hale Gabbur. The studies were commissioned in order to deepen the research team's understanding of important trends and themes in farming communities in the study area, and to build on findings drawn from the initial rapid overview survey of 25 villages within the study area (see Appendix H), and the four villages were selected purposively, based on their farming systems and other significant characteristics.

Teams comprising of academics and development practitioners worked together in the four study villages. The academics were drawn from the counterpart team based at UAS Dharwad, Karnatak University and SDM College of Engineering and Technology, while the practitioners were the staff of a local NGO connected with a DANIDA watershed project in Karnataka.

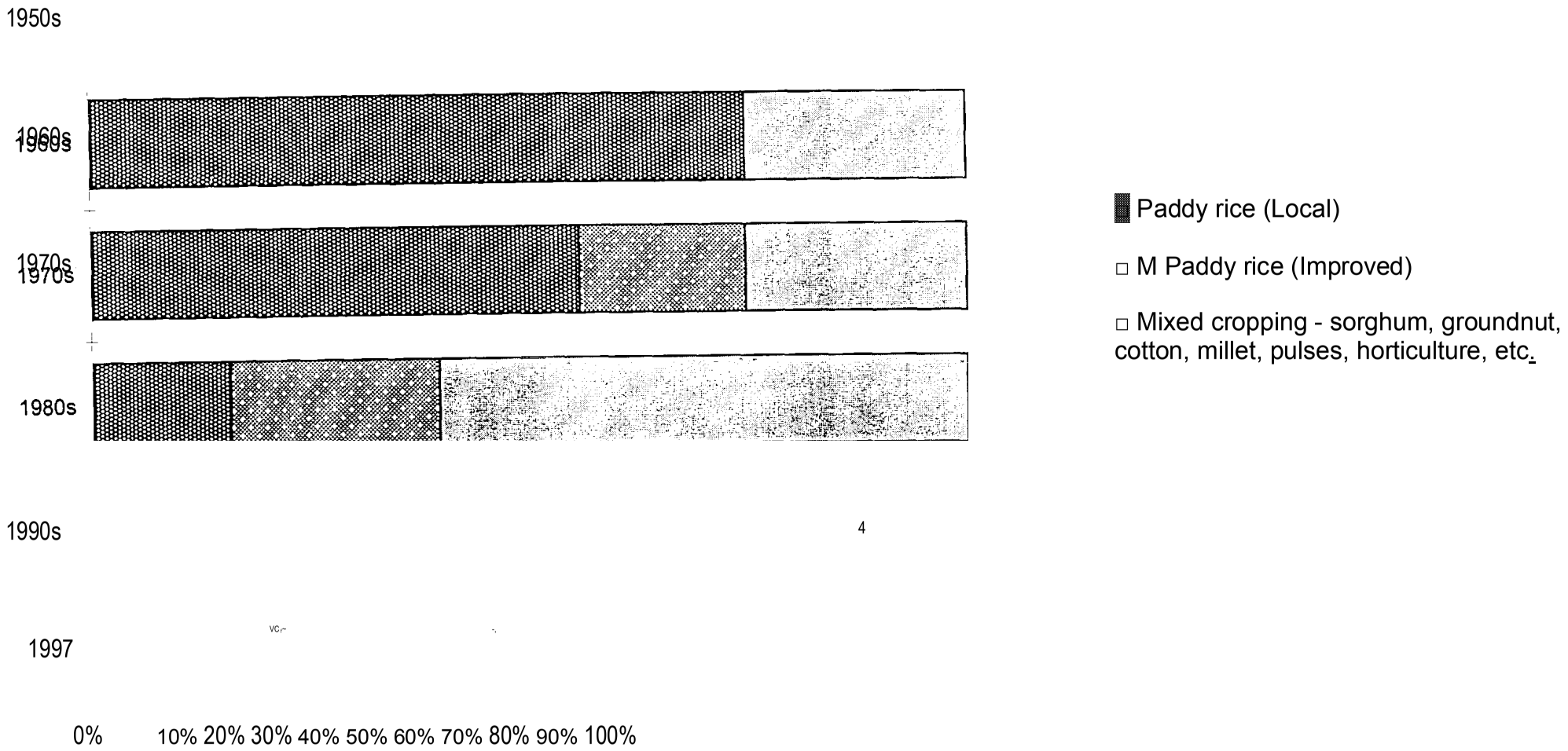
Many activities normally associated with RRA exercises were conducted:

- Resource and social mapping
- Venn diagrams.
- Time trends for significant events and changes in cropping enterprises, calendars of cropping activities, rainfall and labour activity
- Categorising employment by type
- Matrix scoring of preferences for: fuel, agroforestry, motive power for agricultural operations
- Livestock numbers and type
- Crop yields
- Ranking of agricultural production constraints

This was an important training exercise for the academic staff, none of whom had been previously exposed to participatory research methods, and established institutional links between academia and NGO's which may be of use in the future. However, the exercises themselves were not as extensive as initially hoped as they were curtailed by the heavy teaching schedules of the counterpart research team and the social obligations of the farming communities, as the visits coincided with the local wedding season. Despite these constraints, the findings have deepened our understanding of the study area and have been used to support other data in this report. The following charts (graphs 4.6 to 4.9) show changes in cropping systems in the four study communities.

Findings from the RRA exercises in the four study villages showed that farmers cropping decisions were being affected by late onset of the monsoon, increased rainfall variability and reduced rainfall (see Table 4.6).

Kotur - changes in cropping systems



4.3.1.1 Production Constraints.

The principal production constraints cited during the RRA exercises in the selected villages were: labour (presumably availability and/or cost), the supply and cost of inputs (seeds, fertilizers and pesticides) and electricity (all villages have a supply, so reliability may be the issue) (see Table 4.6). A more exact identification of constraints is difficult, as the researchers facilitating the RRA exercises were imprecise in specifying constraints.

It is clear, however, that the constraints indicated in the table below, along with opportunities arising from proximity to Flubli-Dharwad, and changes in available varieties of crops, have resulted in changes to cropping systems. Hale Gabbur aside (being on `black' vertisolic soils not suitable for paddy rice), paddy rice has declined as a proportion of land cultivated, to be replaced by either intercropping systems, horticulture (vegetables, flowers, fruit), or bulk cash crops such as sugar (which declined in the 1990s due to a slump in prices) or cotton, which is currently very popular, due to high prices received. In one case, Hale Gabbur, cotton is being replaced by maize as a cash crop. One agrochemical merchant claimed that this was due to inability of fanners to control pests on cotton using the currently available pesticides. Although each village is different, thus rendering comparisons difficult, one trend is common to all, which is the move towards cash yielding enterprises. Whether this is a trend amongst all farmers is yet to be investigated.

However, there is disagreement amongst researchers concerning cropping trends within the study area as a whole. A study produced by UAS Dharwad suggests prices for staple grain crops have increased in relation to other crops as we have moved into the 1990's, inducing fanners to change their cropping patterns back from `high value' cash crops to the traditional staples. Other researchers have not observed this shift and believe that the proportion of cash cropping is still increasing at the expense of staple food crops.

One reason often cited for changing cropping systems is a decrease in rainfall, or a more uncertain start to the monsoon. Any effect is clearly not limited to peri-urban areas, but as a motive for change, it should be investigated, as climatic uncertainty may influence the success or failure of any proposed amendments to existing cropping systems arising from research projects.

Table 4.6 Main features of farming systems: constraints to production (identified and ranked by farmers)

Village	Hallegabbur	Mugad	Kotur	Devaragudihal
Features	Sewage water used for irrigated horticultural production.	• Site of research station. • Forest fringe. • High rainfall.	• Near NH4. • 15 km north west of Dharwad.	• I 1 km west of Hubli. • Rose cultivation. • Some black soils.
Constraints (ranked)				
1	Labour scarcity	Labour (unspecified)	Insecticides (unspecified)	Supply of inputs
2	Weeds & pests	Uncertain rain	Seed supply	Transport of flowers to market depot
3	Electricity (unspecified)	Finance	Irrigation	Prefer a nearer market for roses
4	Slow payments	Electricity (unspecified)	Rain	Labour for growing groundnuts
5	Low prices for produce	Costs of inputs	Labour	Electricity for irrigation
G	Non-availability of seed	Fuel supply (linked to restricted access to forests)	Cynodon and Cyperus weeds	-
7	High prices for manure (fertilizer?)	Rats	Herbicides (unspecified)	-
8	-	Wild boar	Termites and rodents	-

Source: RRA exercises

4.4 **Mango Cultivation**

Intensive commercial mango cultivation began in the Hubli-Dharwad area at the start of the 1970s and Dharwad, along with Kolar, Bangalore, Bidar and Tumkur are now some of Karnataka's best known mango producing areas.

There has been a recent expansion of mango cultivation within the study area especially in the western part of Hubli-Dharwad, where conditions are favourable. The eastern fringes of Hubli are not favourable to cultivation due to the properties of black cotton soils, including flooding (Hunshal and Nidagundi, 1997:1). Within Dharwad District, mango cultivation is now concentrated in Dharwad Taluka where mango production has increased noticeably in the last three to four years with the hectarage rising from 1528 ha in 1994-5 to 1574 ha in 1995-6 and then 1608 ha in 1996-97 (Hunshal and Niagundi, 1997). The following map shows the extent of fruit production in the city-region.

This increase can be partially explained by the increase in the export market, which is clearly independent of any peri-urban effect. However, peri-urban effects can be recognised in a number of other factors. The low availability of agricultural labour, due to increased off-farm work in village enterprises and in Hubli-Dharwad, has an impact on farm household cropping decisions, and mango is an attractive alternative to high labour input arable crops. It has a lower labour requirement and much of this requirement can be passed on through the use of pre-harvest contracts. The proximity to a large local market which includes the Tarihal mango pulping factory 12 km outside Hubli provides farmers not entering into contracts with a relatively reliable and local market.

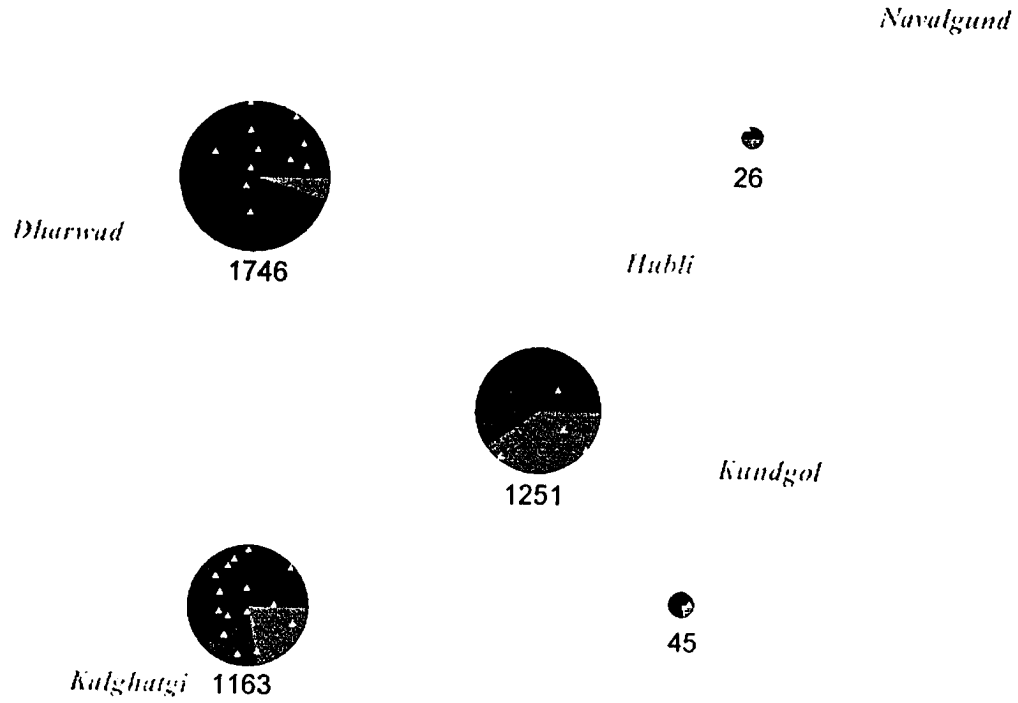
Other reasons for the expansion include:
- low farmgate prices for other agricultural crops, encouraging a change to higher value crops
- reduced rainfall, making cultivation of non-tree crops more risk prone
- low yields of alternative crops
- lack of on-farm storage facilities for staple crops
- land speculation by businessmen and others who hold land under orchard cultivation in order to avoid taxation.

Mango holdings in the study area vary from 1 to 25 acres in size, with an average size of only 1-2 acres. However, as establishment costs for orchards are high and decrease inversely in relation to the size of the orchard (Gummagolmath, 1994) there are barriers to entry for producers with limited access to capital.

Once production is established irrigation costs account for approximately 30% of production costs *(ibid.* However, the use of this irrigation and other inputs is maximised by inter-cropping beneath the mango trees. Intercrops are likely to include both cash and staple crops, for example chilli, cotton, blackgram, and jowar.

AREAS OF PRODUCTION IN HUBLI-DHARWAD CITY REGION

Fruit Production (ha)



N

Scale = 1:500,000

Key

Villages
Taluks
Mango
Guava
Sapota
Survey Villages

Geography Department, University of Nottingham - GIS

(Based on NRDMS Centre, Dharwad)

Labour requirements vary during the growing cycle. In order to reduce labour input, transactions costs during marketing and risk a large number of farmers arrange pre-harvest contracts with intermediaries. These vary in length from 1-3 years and have a range of terms. In 1996 an average contract for 100 trees was valued at Rs. 12,000-15,000. Contractors normally undertake all operations during the contract period, including guarding the ripening fruit, which they then sell in a wide range of destinations, including Gujarat, Ahmedabad, Hyderaad, Bangalore and Bombay.

There is a distinct local market. The Totapuri and Aphanso varieties of mango may be sold to a pulp making and canning factory 12 km from Hubli. This factory is the only one in the area and sources mango and other fruit from a radius which incorporates Belgaum, Bangalore and Chittur (AP). Alphanso pulp is sold to Maaza, a soft drink producer in Parle, and Totapuri pulp is exported to the Middle East.

Not all farmers use contractors. Farmers who do not contract out their orchards sell the fruit locally themselves or through intermediaries. Some of the larger mango producing farmers in .logayellapur (in the Hubli-Dharwad city region) have diversified their product range, and sell mango and sapota seedlings to farmers in other states.

4.5 Floriculture

The key flower types grown in the study area are chrysanthemum, rose and gylardia. These have emerged in the last twenty years as an important cash crop. However, floriculture is a more risky enterprise than the production and marketing of other high value crops. It is heavily reliant on investment capital, irrigation, reliable marketing channels (highly perishable product) and labour availability at key points in the growing cycle. Many small floriculture units rely heavily on household labour and, as a result, the availability of waged off farm employment may have future implications. An historical perspective on horticulture and floriculture is set out below:

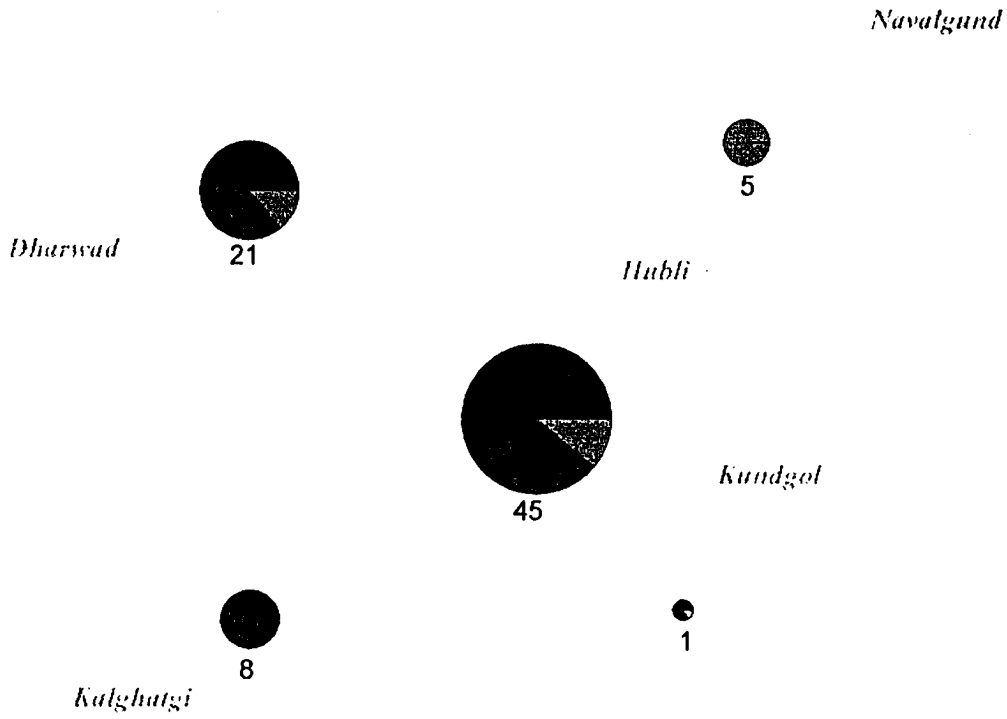
1977 --) Sapota and mango cultivation began
1984 4 Borewells dug. Subsidy provided @ Rs.4,000 for farmers with less than 7 acres and @ Rs. 8,000 for those with over 7 acres. -~ Rose cultivation started.
1992 4 Gylardia cultivation started
1994 4 Financial help of Rs. 30,000 per acre for rose cultivation

Taking chrysanthemum as an example of floriculture in the region, we may note that cultivation within Karnataka is concentrated in Kolar, Dharwad and Chitradurga, with Dharwad being the second largest producer in the state[5]. Within the Dharwad area chrysanthemum cultivation is significant in Gadag and Mundargi Talukas (Patil, 1985). The following map shows the distribution of flower production in the city-region.

[5] Devaragudihal, one of the four villages selected for the RRA exercise, is a significant producer of roses

AREAS OF PRODUCTION IN HUBLI-DHARWAD CITY REGION

Flower Production (ha)



N

Scale = 1:500,000

Key

Taluks
- Marigold
- Rose
- Jasmin

Villages
Survey Villages

Geography Department, University of Nottingham - GIS

(Based on NRDMS Centre, Dharwad)

The peak marketing season is during September and November, however price variability is acute due to peaks in demand caused by the festival season and seasonally induced variability in supply. Flower producers tend to capture a low proportion of the retail price as they have failed to form marketing co-operatives or any other type of intermediary organisation. As a result a high proportion of retail price is captured by wholesalers and commission agents and retailers. Some small producers bus their produce to the markets themselves. The flowers grown in the Dharwad area marketed mostly in Hubli and Belgaum, with a smaller proportion of the harvest going to the market in Gadag. A better price can be obtained by producers at Belgaum market, but travel costs[6] deter many farmers from taking their produce there for sale.

It is clear that floriculture is an important cash crop in the study area due to its proximity to a urban market. However, any increase in the hectarage under floriculture is dependent on the development of lower cost marketing channels, and an improvement in the availability of early season finance, irrigation and labour.

4.6 Marketing

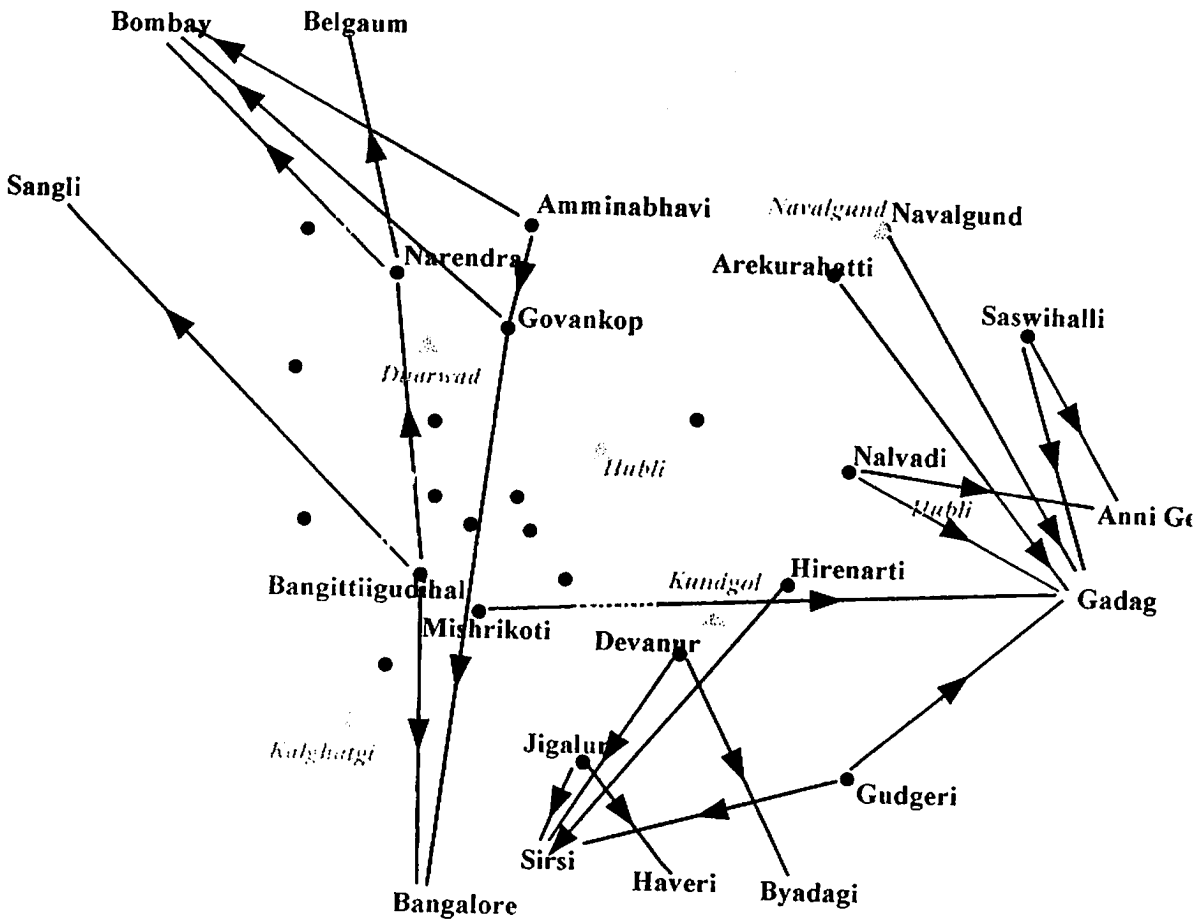
The availability of a reliable marketing route for produce has a significant influence on farm households' cropping decisions. However, agricultural produce markets within the study area appeared to be severely fragmented, with insufficient linkage to the state, national and international markets resulting in highly localised gluts, sporadic price collapse and price signal distortions. In the short term these deterred farmers from harvesting crops and in the medium term discouraged the growing of certain high value, high risk products. This may lead to farmers returning to the cultivation of traditional staple crops to avoid price and post-harvest and storage risk. There was evidence of this occurring, especially amongst poorer farmers, particularly away from horticultural produce and sugar cane.

This picture counters our expectations of production in the peri-urban interface, where we would expect to see well developed markets, high levels of competition in the post-harvest marketing chain, and sensitive and responsive price signals. It is clear that simple linear distance to market is not the key to the accessibility or otherwise of marketing routes. The availability of on-farm storage, credit, information and access to appropriate farmers' organisations were key to producers being able to manage the way in which they marketed their produce. Other factors which had significant impact on market access and price were transactions costs within the marketing chain and frictional distance to the market (affected by distance, road quality and access to transport). The following snap shows the key produce marketing flows in the Hubli-Dharwad city-region.

[6] Full post-harvest costs may include: transport, commission, packing, handling and storage losses.

HUBLI - DHARWAD CITY REGION

Marketing Flows



N

Scale = 1:500,000

Key

- Produce Flow
- Taluk Head Quarters
- Survey Villages
- Taluk Boundaries

Geography Department, University of Nottingham - GIS

(Based on NRDMS Centre, Dharwad)

Table 4.7 The Percentage of Marketable Surplus for Key Crops

Marketable surplus (%)	
Horticultural Crops	
• onion, chilli	85-99%
• fruit, flower and vegetables	98-99%
Other Cash Crops	
• groundnut, cotton	85-99%
Staple Food Crops	
• paddy and wheat	70-80%
• jowah	20-22%

Source: UAS Dharwad study.

The effectiveness. or otherwise, of the market is more significant for producers creating a large marketable surplus. As we can see in the table above, the extent of the surplus follows a predictable pattern, with floricultural and horticultural products being largely for sale, and jowar being largely for on-farm consumption.

4.6.1 Alternative Marketing Routes

Although there is a surprising level of market fragmentation and failure in the Hubli-Dharwad peri-urban interface, there is, nevertheless, a wide range of marketing activity. Alternative marketing routes available to the producers include:

- small-scale producer marketing
- sale to village merchants
- sale through contractors
- various forms of regulated market
- marketing co-operatives

Examples of these alternative routes are shown diagramatically in Figure 4.9, `Network for Marketing Horticultural Produce' and in Figure 4.10, `Milk Marketing Channels. The range of routes is also indicated in Table 4.8 below.

Figure 4.9

Network for marketing horticultural produce

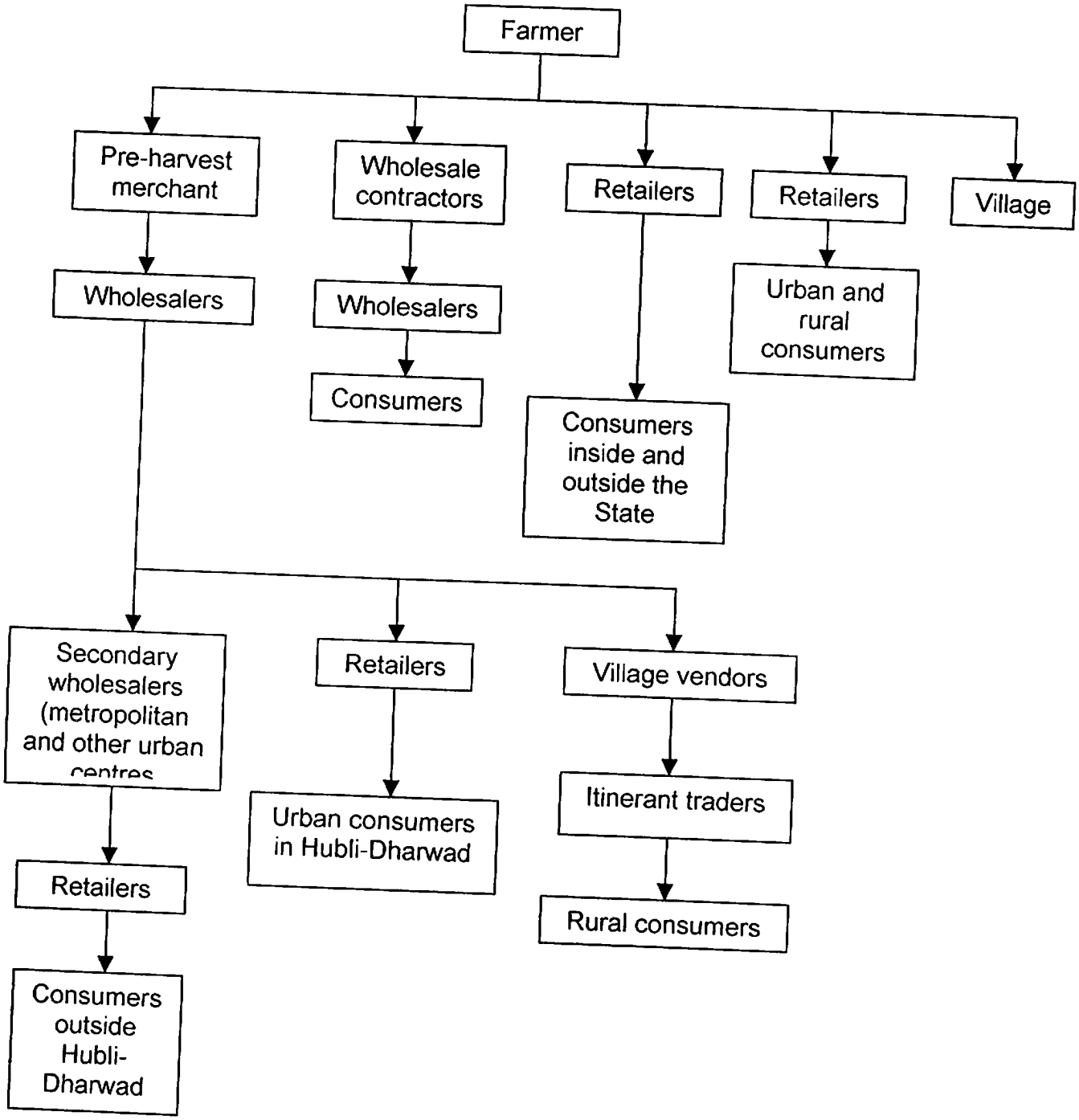


Table 4.8 Marketing Channels for Key Commodities

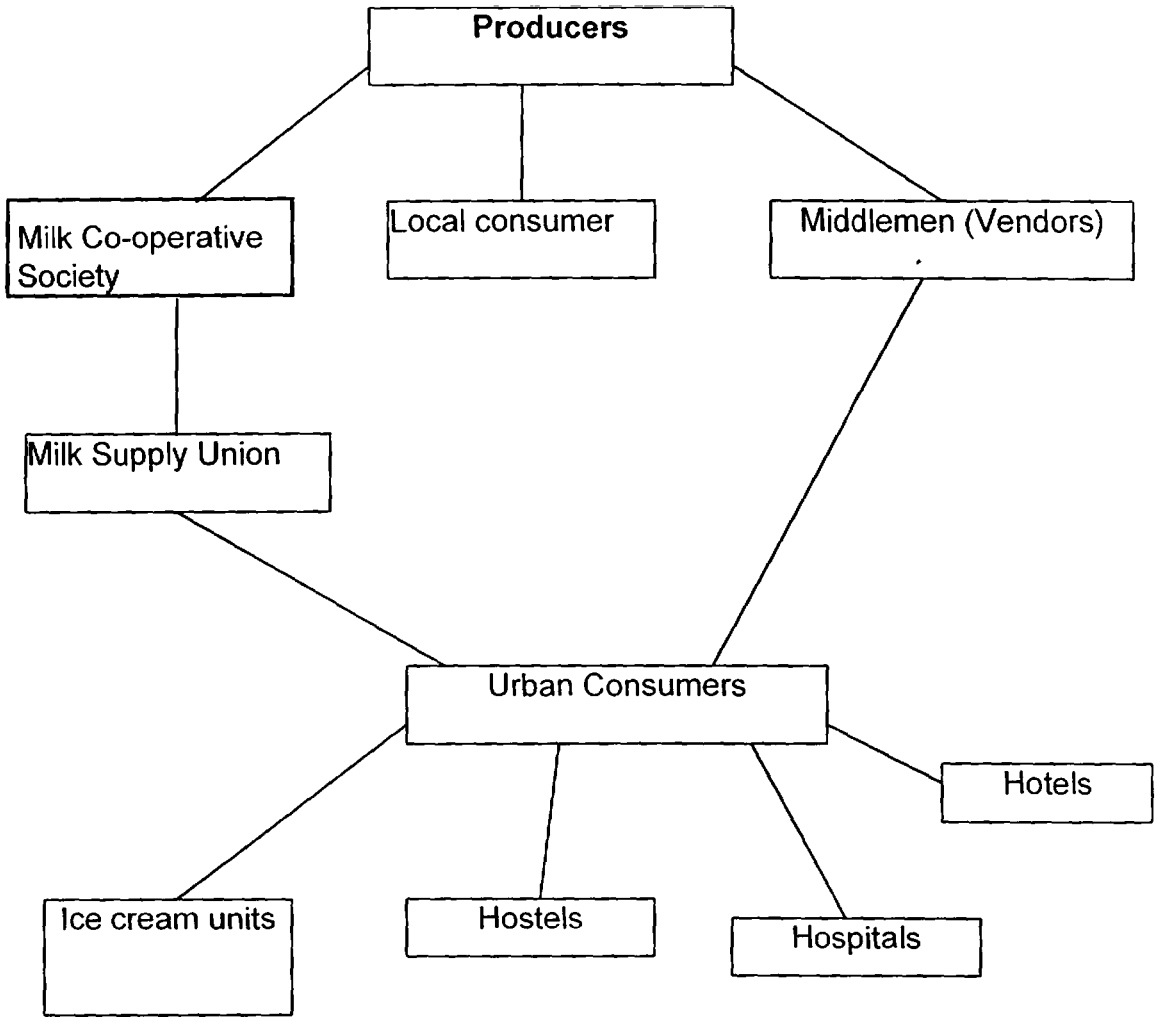
Marketing Channels				
Commodity	Village Merchant	Pre-harvest Contractors	Wholesalers	Retailers
Fruit				
Mango	15-20	50	25-30	5-10
Guava	10-15	40	40-50	5-10
Sapota	15	35-40	40	5-10
Flowers				
Rose	10-15	30-35	50-60	5
Jasmin	5	20-25	60-70	--
Gelati	--	--	90-95	5
Vegetables				
Vegetables	28	--	68	4

4.6.2 Small-scale producer marketing

Small-scale producer marketing is one of the responses by producers to the poorly developed agricultural produce market in the area. Farmers in villages within a 7-10 km radius of Hubli-Dharwad carry small quantities of produce into the city, often by bus, where they sell it themselves in the open market. Although this amounts to less than 1% of the total marketable surplus it is an important marketing route for marginal and small producers, who are likely to market between 75 and 80% of their vegetables in this way (Hiremath, 1997). Farmers slightly further from the city transport larger volumes by cart for sale to wholesalers. Produce marketed in this way amounts to 5-10% of the total marketable surplus *(ibid)*. Taking larger producers and village merchants together, up to 15% of marketable surplus (vegetables) is transported to urban centres for on-sale to wholesalers *(ibid)*.

Surprisingly, floriculture depends heavily on this type of marketing route with 80-85% of flowers being taken to market in Hubli and Haveri in small loads by bus, and only 5-10% being taken by carts and tractors (Hiremath, 1997).

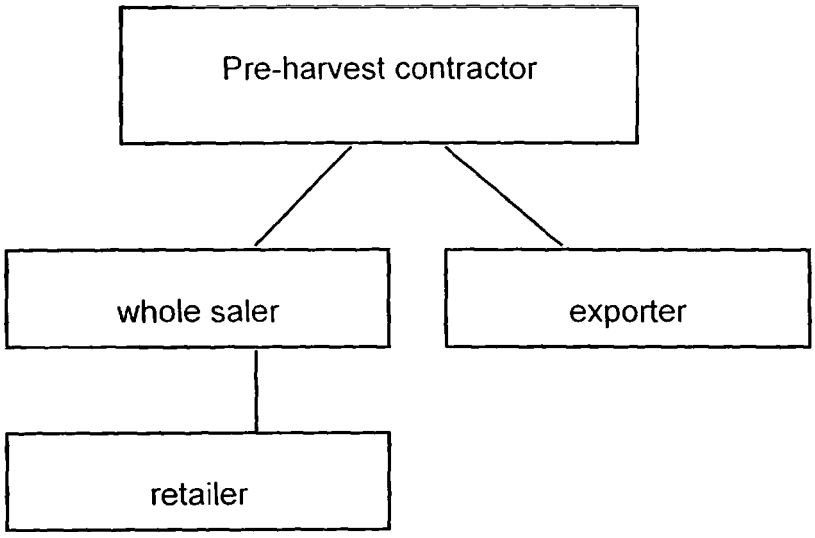
Figure 4.10 **Milk marketing channels**



4.6.3 Pre-Harvest Contractors

Pre-harvest contractors play an important role in the marketing channels of horticultural commodities, although insufficient competition may lead to them capturing a disproportionate share of retail price, and delaying payments. However, pre-harvest contractors are especially important in the case of mango, guava and sapota (see Section 4.4 on Mango Cultivation), where due to the risk of theft during fruit ripening, a lack of on-farm storage capacity, a lack of transportation services and the risk of price fluctuation farmers are likely to sell 40-50% of the harvest through pre-harvest contracts (Hiremath, 1997). The sale of fruit through pre-harvest contracting also reduces the risk of glut on the local market, as fruit sold in this way is likely to be marketed in distant metropolitan markets.

Figure 4.11 Pre-Harvest Contractor Marketing Routes



4.6.4 The regulated market

Despite widespread deregulation of markets in India, a regulated market still exists for some farm products with full Government support. There is a widespread system of commission agents who provide producers with a controlled price and a reliable outlet in return for deducting both an informal commission from the price they award to farmers and adding an officially sanctioned 2% commission to the retail price. In order to access the commission agents, producers must transport their harvest to commission agents located at Taluka Headquarters. Therefore those without transport or without sufficient labour may still prefer to sell to an intermediary prepared to make farm-gate collections.

In addition to the commission agents, there is a large network of State controlled milk producer co-operatives, and a small horticultural producer co-operative. However, there are problems with both these forms of regulated market, as illustrated in the boxes below on case studies of milk and horticultural marketing.

Box 4.1 Milk and Milk Products

Marketing routes for producers of liquid milk and associated products in the Hubli-Dharwad city region are extremely limited. The formalised market is dominated by KMF (The Karnataka Milk Federation), with alternative access to the market provided by gowlis. Market access is more difficult for rural milk producers than their urban counterparts, who may have established links to domestic households, peda producers and other intermediaries and manufacturers. This section of the report focuses on the role and procedures of the KMF.

The Karnataka Milk Federation [KMF]: Historical Context

The establishment of dairy co-operatives around India may be set in the context of the policy interventions around Operation Flood and the National Dairy Development Board (NDDB). Bilateral and multilateral donors have supported the Indian Government's objective of increasing the protein intake of the population and supporting the increased productivity of the Indian dairy industry. The EU (European Union) initially provided milk powder to supplement domestic production. This powder was routed through the NDDB who sold it onto local markets undifferentiated from local production. This aimed at avoiding heavy distortion of domestic supply and demand. The monetisation of food aid allowed the NDDB to invest in the organisation. However, there are criticisms that investment supported the central headquarters, investment in machinery and technology rather than starting new village level production co-operatives and supporting existing ones.

The establishment of milk unions fitted this policy of expanding milk production. The Dharwad Milk Union, a unit of the Karnataka Milk Federation was established in 1984. It has a devolved system of governance and is managed by farmers and their representatives. Approximately 2,500 villages are covered by its area of jurisdiction, which extends over Northern Karnataka and Dharwad Districts. Within this area there are over 600 registered village level dairy societies, of which 515 are functioning milk procuring units.

Financial support from the government has been declining since 1995 and is now minimal, despite some provision of grant support to village level societies. The organisation is in severe financial difficulties. It is unclear whether these are due to the policy of supporting both fanngate and consumer prices simultaneously or whether the problems are due to poor management and practice within the organisation. Certainly the form of farm-gate price fixing is likely to cause problems. Prices are set annually[8] and are therefore unresponsive to either shortage or surplus in supply or changing patterns of demand. In addition, there are problems with procurement practice which may dampen supply.

[7] Information is drawn from key informant interviews at KMF Dharwad and with a village level Society Secretary in the village.of Mugad, Mr P.B. Hanamu

[8] Prices are set on a sliding scale taking fat content into account. The minimum price is for Rs.7.25/litre for cows milk and Rs.9.00Aitre for buffalo milk.

Procurement

Producer-members[9] take marketable surplus to the village level milk society's procurement agent. The agent measures the milk, tests the milk quality and records the value of the sale in a ledger. Quantities as small as 100 grammes of liquid milk will be accepted, in order not to exclude marginal producers. The next stage in the procurement process is the transportation of milk to KMF Dharwad. The societies nearer to the city send milk to the headquarters using the bus system, while the more distant village societies have their milk collected twice a day and transported via one of the seven chilling centres (Sirsi, 1-lirekeru, Arveri, Ron, Naragund, Gadag and Mundagor).

Despite this well organised system, milk procurement has declined over the past few years. Taking a local example, despite cow and buffalo ownership and productivity increasing in Mugad over the last 13 years, procurement by the co-operative has declined. Rather than sell through the controlled market, many producers prefer to sell locally in the village and through intermediaries (including Gowlis) who retail the milk in Dharwad. At the central KMF plant in Dharwad this trend has resulted in an overall decline in procurement of over 10,000 litres between 1992/3 and 1997.

Average procurement	55,000 litres
March 1997	52,000 litres
1997 min.	45,000 litres
1997 max.	84,000 1 itres 10
1992/3 max	94,000 litres

The transfer to alternative marketing channels[11] appears to be largely due to delays in payment from KMF Dharwad, which are due to severe cash flow problems within KMF Dharwad. The frequency of payments has declined from twice to once monthly, or less. The impact of cash flow variability is likely to particularly affect small and marginal producers, and those for whom dairying foams a significant part of their enterprise mix. Despite the financial problems of KMF Dharwad, and the impact that this is having on producers, it is clear that the system works effectively elsewhere, as KMF in Belgaum and Bangalore make a consistent profit.

[9] Membership has a very low cost, at Rs.1.00 per year or Rs. 0.50 for six months, while the benefits include: sale of liquid milk through a reliable outlet at annually fixed prices; access to extension and other services, including a number of partially subsidised support activities, which are linked to the government's policies to increase milk production. These are artificial insemination, cattle feed, green fodder seeds, extension services, veterinary services, artificial insemination and animal loans.

[10] The min./max. range is due to the seasonal variation, with much less milk being available in the dry season, when fodder shortages reduces productivity.

[11] Gowlis pay Rs.2.00-2.50 less per litre than the KMFbut they pay on a weekly basis

.

Box 4.2 The Regulated Fruit and Vegetable Market[12]

Supporting Organisations and Policies.
The Karnataka Co-operative Act of 1959 and promotional activities by the Department of Agriculture and the Karnataka State Government have created an environment in which a producer-retail co-operative could be established and grow. More specifically the Marketing Department of the Government of Karnataka and the Karnataka State Agricultural Marketing Board have supported the society during its establishment and growth phase.

The Karnataka Horticultural Producer's Co-operative Marketing and Export Society was established in Hubli in November 1994 and started trading in December of that year. It markets less than 5% of the horticultural products produced in the area, due to a lack of capacity.

The society aims to provide remunerative prices to producers and good quality produce at reasonable prices to consumers. It purchases from farmers at 5-10% above prevailing farmgate prices and sells to consumers at 10% below the market price (Hiremath, 1997). Although the society currently has a very small share of the Hubli-Dharwad market, they may nevertheless be able to influence farm-gate prices and retail behaviour. In addition, the society believes that they have gained the trust of farmers and are capable of expansion.

Procurement
The co-operative purchases horticultural products (including fruit) directly from farmers, who are encouraged to become members of the society[13]. Produce is normally brought to co-operative headquarters in Hubli, however, regular suppliers within 5-10 km will have their produce collected. These suppliers can set the schedule for the collection (or sending) of produce and the collection of payment.

Due to the incentive of premium pricing and a closer location, producers of high value fruit crops (such as watermelon, high grade grapes and papaya) located up to 220km away now market through the society rather than in Bangalore.

In addition to offering producers a price premium, the society has a number of systems which are clearly seen as improving on those used by competing intermediaries. It has a policy of transparency and fairness which means that it prices products by weight not volume. Products ,are weighed in front of producers, or their representatives, and a slip is provided stating the weight. Immediate cash payment is provided based on the weight of goods and that day's product price, without any deduction of commission.

The Franchisees
Franchisees are encouraged to feel part of the society. As part of this they are invited to regular meetings at the society headquarters. They are also expected to sign a contract making a commitment to abide by the rules and regulations of the society and to sell produce at the prescribed prices. They provide a deposit of Rs. 10,000.

[12]This section of the report is based on key informant interviews in the village of Mugad and Dr Basauraj Humbarawadi of the Karnataka Horticultural Producer's Co-operative Marketing and Export Society Ltd. Hubli.
[13]A year's membership costs Rs.100, which can be deducted from produce sale if necessary. There are currently 236 members.

Retail
Produce is sorted and graded and delivered daily to the 23 franchised outlets in Hubli and Dharwad. An ordering system is used which avoids the need for telecommunications or IT, but provides franchisees with flexibility while giving the society's headquarters a solidly based stock control system[14]. Retail prices are set by the society on a daily basis. Cost plus pricing (procurement price plus 38%) is used with some adjustment following a survey of the range of local market prices. The `plus' element of the price is derived as follows:
• 10% society margin, to meet costs (staff, and other overheads)
• 10% wastage - high due to the perishable nature of the goods
• 10% commission/margin taken by retailer
• 3% margin for weight loss and shrinkage is given to retailer
• 5% transportation

The society has an anti-market philosophy, and ideally would like to construct a retail price based on production costs. The society would hope to work with UAS Dharwad researchers to discover the minimum marginal producer price for all the products in its range, 18% would then be added to each figure cover on-farm investment costs. This would result in a procurement price. Retail prices would then be calculated by adding the current 38% margin/overhead. They nevertheless intend to undercut local market prices on the full range of products by Rs. 0.5 (unclear as to whether this is per item or per kg.) and to maintain high quality standards.

Expansion/Co-operative Response to Competition

Expansion of formal franchises
The society hopes to expand the franchised retail outlet chain to 50 outlets. If establishment finance is forthcoming the expansion could be completed in under a year. The finance is required in order to cover the construction of outlets, on land leased by the society from the Hubli-Dharwad Municipal Corporation. The National Co-operative Development Corporation (NCDC) has already agreed to partially finance the expansion project, however, the full amount has vet to be obtained.

Fruit and Vegetable Export House
The society is also planning an ambitious fruit and vegetable export house, which would incorporate weigh stations, lorry parking sites, chill zones, open warehouses and wholesale and retail sale sites, rest houses and restaurants. A number of funding sources will be tapped for grants and soft loans to amass the Rs.4.5 crore necessary in order to complete the project.
1. A request for a Rs.73 lakh soft loan (4% interest) has already been submitted to the National Horticultural Board which is able to sanction funds up to I crore;
2. A request for a Rs.19.48 lakh grant has been submitted to the Spices Board, under their budget head for post-harvest management funding. Support likely to be forthcoming due to the region's importance as a chilli producing area;
The NCDC will be approached for funding. If awarded, they are likely to offer a loan at14.5% interest;
3. The Ministry of Agriculture (GoI) will also be approached;

Franchisees give a daily 'indent' stating the quality and quantity of produce required the following day. Indents can be delivered in person, or sent back with the driver of the delivery truck. Weekly indents can be used if preferred. These can be over-ridden at any time during the week, if necessary

.

It is anticipated that farmers will benefit from better access to export markets, especially for pomegranate; capsicum; grapes; sapota and chilli powder. The improvement in marketing routes, and the likely reduction in short term price variability should encourage a shift into these crops.

Total Turnover Figures.

199415 (only 3.5 months of business)	5 lakhs of business (I Lakh = 100,000?)
1995/6	53lakhs
199617	75 lakhs
199718	2 crore

The society sustained in the first and second year of business, and currently makes, a monthly loss of Rs.50,000. Management of the society believe that the expansion of its retail network is necessary if it is to achieve breakeven, as each franchised outlet brings in an additional Rs.2,000.00 per day in revenue, and a larger network of outlets would spread the administrative costs and create certain economies of scale. However, as the society is committed to being a non-profit organisation which takes a controlled margin of only 10% of retail price, the certainty that expansion will resolve all financial difficulties may be misplaced. In addition, a key constraint to the expansion of the organisation appears to be its determination to control both farm gate and retail prices. While controlling farm-gate prices at above market levels makes the society a preferred intermediary, the bottleneck created by limited retail outlets at which they can maintain premium prices limits the percentage of horticultural produce from tile HUbli-Dharwad hinterland that can be accepted, thus limiting market share. The society has limited access to markets outside Hubli-Dharwad, and no access to processing plants at all, although some produce is sent to Bangalore.

Possible research questions;
• Which producers benefit from the premium prices offered?
• Is there evidence of rent-seeking/corrupt behaviour resulting in benefits to large or high caste producers?
• Which consumers benefit most by the controlled prices - are the outlets located in a ranee of urban settings, or in mostly middle class neighbourhoods?
• Does government policy support the expansion of this type of marketing intermediary financially or through other forms of support?

4.7 Conclusions

At this stage in the research process conclusions about fanning systems are of necessity speculative since they are not based on adequate data. However, directions for further model building and data gathering can be discerned.

Under a purely physical model of urhan influence, areas near tlle city would be expected, other things being equal, to show evidence of change in the direction of more intensive landuse. However, the evidence is that in recent years the price structure has favoured staple and cereal crops. This has slowed the trend towards intensification of landuse which was evident up to 1990. There is no up-to-date and reliable information on crop yields.

Profitability, irrigation, rainfall, and labour availability are all perceived by farmers as drivers of changes in cropping patterns.

Major perceptible trends include:

*the expansion of mango cultivation since 1970, mainly in Dharwad taluk. A major feature of this is the emergence of contract labour as a risk-minimising strategy for producers and traders: labour contractors undertake to provide labour for guarding and harvesting orchards. Producers are also then protected from labour shortages, and can engage more fully in non-farm occupations. There is a distinct and relatively well organised local market, which helps to explain the growth of mango production. Smaller farmers who do not engage in labour contracts may face higher risks and lower or less stable returns.

*the development of floriculture, largely till now for the regional rather than national market. There are marketing, credit, irrigation and labour constraints to further expansion.

•mechanisation of cultivation. This was not studied in detail, however, casual observation suggests that villages in the black cotton soil areas have many operating tractors. This is linked with a decline in fodder availability for livestock and a growing tendency to stall feed buffaloes and cattle, due to declining availability (or non-existence) of common grazing. The consequences of changes in livestock holdings for milk production, FYM and soil fertility still need to be identified.

•the diversification of cropping systems in response to changing market conditions: this has been a widespread and general tendency as pressure on land has increased and farms have got smaller, the demands on them always growing.

*steady productivity increases have been achieved - although this conclusion can only be drawn with confidence at the level of the district - further work would be needed to discern specific peri-urban patterns.

The major production constraints were seen by interviewed farmers as: availability of labour (presumably at the right price), reliability of the electricity supply for irrigation, and the availability of irrigation. Others reckoned that fertility was a problem (scientists, but not farmers), and pests in cotton in particular.

Commodity markets are diverse, both in terms of location (they are not centralised in the city - see previous map showing the directions of marketing) and in terms of form of contract. State support for markets has been partial, and has not captured significant components of particular markets. The milk market, as elsewhere in India, is divided between local, urban producers who sell direct to customers and the co-operative system which buys exclusively from rural producers, but also imports dried skimmed milk. The co-operative system has been in deep trouble, financially, with substantial delays in paying

producers. The 'regulated' fruit and vegetable market requires substantial capital investment to make more than a marginal impact.

While in general free market conditions frame people's decisions about most agricultural products, there are some suggestions of market failures at the level of the local market which may be insufficiently institutionalised to provide outlets to meet growing local demand; and at the level of markets where state support has been significant. There is wastage of mango during the peak of production, the milk market is somewhat chaotic, and there are constraints of finance, and possibly information and management.

A number of indicators of change have been listed in Table 4.9 which would enable a process of tracking change in the peri-urban interface. However, few of these have ready made data streams, so a process of selection and prioritisation is still required.

Putting together the results of this chapter with those of the previous chapter leads to the tentative formulation of a model of agrarian change in the peri-urban interface. This is presented in Box 4.3.

Box 4.3 A model of agrarian change in the peri-urban interface

in terms of population the rate of growth of Hubli-Dhanvad was rapid in the 1960s and 1970s but has slowed since then. As in other medium-sized cities in India and South Asia growth is heavily constrained by infrastructural limitations. Some pen-urban satellite towns have grown dramatically since then, as have many villages, particularly in the small villages on the red soils immediately ’.vest and north of the city, where non-farm occupations have been increasing, especially for men. Elsewhere, on black soils, further from the city village populations have declined.

Rural women have a rapidly growing participation in the agricultural labour force, usually at low wages. Their increased participation may explain why wages have remained lower in the red soil areas; though other factors (eg crop productivity, creopping intensity and regularity of demand for labour) may also be responsible for the differential. Meanwhile men are moving into non-farminv occupations, especially industry and construction, and increasingly commuting to work outside the village. The development of labour contracting arrangements may be a response to these conditions in which male agricultural labour is increasingly scarce, and fernale labour is casual and depends on the rhythms and demands of rural households as much as the demands of the labour market. Contracting may be introducing an industrialisation of the rural labour force. Such arrangements are clearly linked to changes in land tenure, with new (urban-based) landowners coming into the picture, and smallholders seeking to minimise risks and improve security of market access. Land ownership is becoming harder to justify for poorly capitalised households living where there is an active land market. Who sells land and what happens to the proceeds are interesting questions which remain as yet unanswered. There may well be changes in input markets which are also prompting a process of commercialisation - these were not investigated. However, with apparently declining livestock numbers, reduced amounts of farmyard manure, increased dependence on bought in fertilisers and agro-chemicals, and the poor access of smallholders to credit and possibly information, it is likely that the more rapidly changing areas will continue to experience such commercialisation of production relationships.

The consequences for peri-urban households of such processes may be significant. Increasingly the agricultural labour market becomes the market of last resort: the fact that it is supplied mainly by women is a worrying, but probably almost universal trend in such areas India. On the other hand, institutional innovation has responded effectively to meet constraints in the existing labour market, and perhaps to ensure a greater degree of competitiveness between male agricultural and no-farm wages, without which the agricultural labour market would be under supplied.

4.8 General areas for research

The Baseline Study has allowed the research team to identify a number of changes in farming systems within Hubli-Dharwad's peri-urban zone. Further investigations are necessary to clarify the causes of these changes. In particular, more precise details of changes are required in marketing opportunities; in the resource base, including soil fertility and water availability, the availability of labour and draft power; and in biotic factors including pests, diseases and weeds which may interact or behave in a particular way in the peri-urban interface. With this type of data it may be possible to develop theories to explain changes and model and predict possible future changes. A further step in the research would be to assess the applicability of such theories or models to other peri-urban areas.

Further research to enrich our understanding of the attributes that distinguish the periurban system from other, more rural farming systems would be beneficial. An element of such research might be to define the size of the peri-urban footprint for different commodities, activities and resource flows, and provide information to those managing the peri-urban interface. This information should be sufficiently focused to enable municipal and panchayat union staff to develop appropriate policies and interventions. These may contribute to an environmental plan aimed at enhancing the positive effects and mitigating the negative effects of the interactions between dynamic urban areas and their rural hinterlands.

It is expected that technical research would ideally be carried out within a fanning systems perspective. It is proposed, however, that a greater degree of understanding is needed of the changing organisation of production and markets before technical research designs can be established which are genuinely responsive to peri-urban circumstances. However, the possible impact of such research and demand for it has yet to be assessed. There is a need to develop the understanding of farming systems in the peri-urban interface into a model which is capable of generating checklists of questions or criteria by which the relevance of technical research can be judged. This idea is taken up in Chapter 9.

A number of specific research proposals are made drawing on both primary and secondary sources.

1. Mango is increasing in importance, and is particularly suited to the soil and climatic conditions prevailing to the west of Dharwad. There is conjecture that this may be partly in response to shortage of labour (extensification), as well as exploiting a favourable tax regulation. However, there are problems with the crop, including irregular bearing, infection by downy mildew, and flower and fruit shedding caused by plant hoppers. Stated research requirements include:
   - Development and evaluation of varieties suitable for processing (pickle, juice, jam, dried);
   - Development of optimal inter-farming systems to make full use of available land (which may include evaluation of renting out land to itinerant goat and sheep herders);
   - Development of effective pest and disease management systems;
   - Development of a package to ensure regular bearing;
   - Evaluation of optimal rootstock/scion combinations.

2. Farming systems irrigating with sewage water. Some horticultural crop growers located at the outfall of untreated sewage pipes use this system, but aside from health issues, the crops are subject to increased pest attack and heavy weed infestation as a consequence the presence of certain nutrients in the sewage. Farmers combat pests with application of heavy doses of often toxic insecticides. Appropriate research programmes might be:
   - Investigation of recently developed systemic seed dressings with low mammalian toxicity. The sewage irrigated system would be a challenging environment in which to test the efficacy of these compounds.
   - A research project focusing on weed control in this setting.

3. There are a number of apparent trends which could be used as indicators of the peri-ttrban interface. Some of these could be used as indicators of the peri-urban effect. These include:
   - increased growing horticultural crops for urban markets (e.g. potato, brassicas),
   - increased growing of crops which are processed in urban areas (mango, tomato)
   - labour constraints stimulating the development of systems which can maintain productivity in the face of those constraints (e.g. incidence of contracting systems for orchard crops).

4. Characteristics which could be measured as part of the next phase of research include thosc indicated in the table below.

Table 4.9 Suggested indicators

Proposed indicators	Rationale for indicator
1. Range of crop species / km^2	Likely to increase near urban fringe, as land-use intensifies, and due to increased access to market for perishables.
2. Size of fields	Likely to decrease as part of intensification process. Possible sub-divisions due to sales of parcels of land: or mergers in order to achieve economies of scale (e.g. with Mango Orchards)
3. Diversity of crop species within fields	Likely to increase. Related to 1. above. Could be co-indicators.
4. Diversity of varieties within species.	More- due to better availability; higher (CB) ratio when using I-iYVs. Less - due to decreased diversity, genetic erosion. Requires research.
5. Prices fetched by crops sold	Higher in urban markets?
6. Diversitykomplexity of crop rotations	Related to 1. And 3. Above. It is known (from RRA) that cropping systems are diversifying - is this a general trend of a Peri-Urban effect?
7. Increased number of milch buffalo nearer town	Ready market for milk
8. Availability of common land.	Likely to be seen to be decreasing due to: • privatisation for cultivation • privatisation for housing - often low value housing in the area immediately around a village
9. Decreased availability of fodder.	Related to 8 above. Likely to result in: • increased stall feeding • reduced availability of oxen
10. Increased tractorisation.	Related to 9 above. Due to lack of oxen. Tractorisation may be more prevalent in the richer black soil areas. although tractor hiring schemes may occur in the poorer agricultural areas.
11. Magnitude/types of artificial inputs	Increased availability; more informed fanners; greater ability to pay, appreciation of higher CB ratio
12. Application of specifically urban inputs.	Sewage. composted urban wastes easily available only to those farmers in the PU1.
13. Fewer labour demanding crops	Increased wages rates commanded; less labour available (e.g. Mango). Related to 1, 2, 3 and 6.
14. Higher agricultural wages.	Related to 13. Will depend upon seasonal demand.
15. Rate of change of cropping systems	• Related to 13,6, and 13 above, but includes rate as a factor. • Response to changing markets; markets more in urban areas. • Research: development of a crop stability index over limo. • Development of a crop stability index.
16. Changes in fertility of fields	• Lower: mining of soils if building development likely in near future. • Higher: sewage and composted waste readily available.

Proposed `indicators	Rationale for indicator
17. Cooking fuel types.	• Fewer trees nearer towns? • More use of bottled gas due to availability or greater disposable incomes in PU zone? • Change in fuel type if area of cotton is declining in favour of lower inputtmore remunerative crops?
18. Fate of crops	More sold off-farm
19. Erosion of ITK	Farmers leaving land for urban work, taking expertise and particular local knowledge with them.
20. Household composition.	• Are younger men moving to urban areas to work?
21. Gender determined access to income.	• There is evidence of increased availability of waged employment for men in village based non-farm enterprises. (May indicated vibrant growth and diversification of villages within the peri-urban zone. while Hubli-Dharwad experiences constrained growth.) • Women appear to have greater involvement in the waged-labour economy, particularly as low paid farm-labourers in the poorer agricultural areas to the North and West of Hubli-Dharwad
22. Availability of labour for specific tasks.	On- and off-farm tasks may be rigidly allocated by gender. The availability of waged employment may cause a binding labour constraint, requiring changes in cropping decisions.
23. Travel to work area - daily/, weekly	Related to 20 above. Increasing as road network increases and frictional distance declines.
24, Diversity of occupations within PU village communities.	More crafts due to more demand nearer towns. or less diversity due to urban drift?

5. RENEWABLE ENERGY 5.1

Introduction

Hubli-Dharwad is very representative of medium-sized cities in South Asia whose growth is severely constrained by power and water shortages. The impact of structural adjustment has been felt more heavily in the power sector than anywhere else in the Indian economy, in the shape of constraints on capital investment for new projects. At the same time, the constraints on private sector involvement have not been removed, so the private sector also finds investment difficult.

A number of studies were undertaken in the Hubli-Dharwad city-region to generate baseline information on energy sources and consumption patterns. Information was collected on energy issues through the village surveys (see Chapter 1), on energy sources used in the urban areas through small sample surveys, and on the flow of fuelwood from source to consumption through key informant interviews. The findings from the surveys are discussed and analysed. Finally, a review of the potential for decentralised energy sources to be developed in Hubli-Dharwad is set out.

"These studies have indicated that the energy problems of HubIi-Dharwad will not be completely solved at a local or state-level. There are questions raised about the conditions for private sector, NGO or community investment in energy production. The scope for greater use of renewable energy and of implementing measures to improve energy efficiency has yet to be fully explored.

Tables 5.1 shows the level of expenditure on fuel used in rural and urban areas. The data is for the state of Karnataka and demonstrates the differences between the rural and urban areas, whilst recognising that within both areas, there are differences between types of households, as shown in the village and urban studies.

Table 5.1 Per capita expenditure on fuel and fight

	Average monthly per capita expenditure (Rs)		Percentage of average monthly expenditure (%)	
	Rural	Urban	Rural	Urban
Fuel and light	20.61	28.13	9.34	8.14

Source: Report on Consumer GxImnditure in Karnataka, 47th Round NSS
(US $ l :Rs 34 at time of survey)

5.2 The peri-urban interface perspective

The peri-urban interface perspective raises a number of issues concerning energy sources and consumption patterns. These include the production and distribution of

energy, labour requirements in collecting agricultural waste as a fuel and the impact these requirements have once more people take up urban employment, and, the scope for more decentralised electricity production to address power shortages.

Decentralised sources of energy are particularly relevant to the Hubli-Dharwad city-region due to widespread, rather than concentrated, urban growth. Growth is substantially concentrated in villages rather than in the city itself. This is, in fact, partly related to the inadequate power supply in and around the city. It is possible that decentralised energy would be cheaper to develop than linking villages to the grid.

The PUI perspective also raises issues about the use of fuelwood, the flow of fuelwood from forest areas and the footprint of the city in terms of impacts on forests. Demand for fuelwood has decreased, particularly in the urban areas, due to subsidised liquid petroleum gas (LPG) and increasing prices.

5.3 Village surveys

Firewood remains the primary source of fuel for cooking in nearly 90% of rural households in Karnataka. Kerosene and electricity are the main sources of fuel for lighting. Such energy use information was reflected in the findings from the surveys conducted at the beginning of this research project. The key findings include:

- Agricultural waste, such as cotton and chilli stalks, is the main source of fuel for cooking and heating water. Waste materials are also used by some occupational groups, such as carpenters and bamboo basket makers, for cooking.
- There are some energy intensive occupations in the communities surveyed, including brick making and lime kilns.
- Electricity and kerosene are used for lighting. Many landless labourers and some small farmers have access to electricity under the Bhagya Jyothi programme, operated by Karnataka Electricity Board (KEB). Under this programme, electricity is free for a certain period, after which time, the households pay a minimum of Rs. 10.
- Landless and some occupational groups spend 2 to 4 hours a day gathering agricultural waste from farmers' fields, village nalas and from forest areas. Most travel between 3 and 4 km to collect a sufficient amount of fuel. Land holders gather the agricultural waste to their homes for storage, and purchase firewood for between 6-12 months of the year.
- It was felt that there is a shortage of both firewood and kerosene, which is particularly acute in the rainy season, for which extra supplies are stored in homes.
- No significant changes in energy use have been observed over the last ten years.

The information on energy sources and consumption was collected through focus group discussions (see Chapter 1). The following tables provide information on energy needs, sources, consumption patterns and trends.

Table 5.2 Major needs and sources of energy in the sample villages

	Major needs and sources of energy		
Focus group	cooking	heating water	lighting
1. Landless labourers	cow dung cake agricultural waste* twigs, branches & firewood	cow dung cake agricultural waste twigs, branches & firewood	electricity and kerosene
2. Small landholders	cow dung cake agricultural waste twigs, branches & firewood	cow dung cake agricultural waste twigs, branches & firewood	electricity
3. Medium landholders	twigs & branches agricultural waste cow dung cake forest wood	twigs & branches agricultural waste cow dung cake forest wood	kerosene and electricity
4. Large landholders	agricultural waste twigs & branches	agricultural waste forest wood twigs & branches	kerosene and electricity
5. Occupational groups	cow dung cake agricultural waste twigs and branches artisan based waste horticultural waste**	cow dung cake agricultural waste twigs and branches artisan based waste horticultural waste	electricity

* Agricultural waste includes cotton stalks, chilli stalks, groundnut shells and maize cob.
** Horticultural waste: mango, sapota, guava branches, dried rose twigs, dried vegetable plants.

Table 5.3 Consumption pattern of energy among focus groups

	Quantity of fuel							
Focus group	Frequency of gathering fuel	Cooking kg/week	Heating water kg/week	Lighting units/month EL*	K*	Money spent per month El	K	W*
1. Landless labourers	daily	25	20	-	3-5	-	50	-
2. Small landholders	half yearly	35	20	25-50	3	50	12	-
3. Medium landholders	fortnightly	35	30	25-50	3	100	12	-
4. Large landholders	yearly	70	30	25-50	6	100	36	-
5. Occupational 8't ULlPa	weekly	20	20	25-	4	30	20	112

* E = electricity; K = kerosene; W = waste (horticultural)

Table 5.4 Shift in fuel usage among the focus groups

	Cooking		Lighting		Farming activity
	1987	1997	1987	1997	
1. Landless labourers	twigs & branches	agri.waste, twigs & branches	kerosene	electricity	-
2. Small landholders	agri.waste	agri.waste, twigs & branches	kerosene	electricity	animal power
3. Medium landholders	agri. waste	agri.waste, forest wood	**electricity**	**electricity**	animal and engine power*
4. Large landholders	agri. waste	agri. waste LPG	electricity	electricity	animal and engine power*
5. Occupa-tional groups	agri. waste twigs & branches, forest wood artisan-based waste	agri. waste, forest wood twigs & branches, artisan-based waste	kerosene electricity	electricity	-

* Engine power is ashy used by *a few* medium and big landholders

Energy consumption in the rural areas relies on agricultural sources and fuelwood for cooking and on electricity and kerosene for lighting. The use of liquid petroleum gas (LPG) for cooking is restricted to the large landholding households. The time that it takes for poorer households to collect fuel such as agricultural waste and twigs will become an important issue as more people find work in urban areas, reducing available time for such collection. This will lead to households needing to purchase firewood or other sources of energy.

5.4 Energy consumption in the urban areas

Two small sample surveys were conducted in the urban areas of Hubli and Dharwad. The first focused on fuel usage for domestic purposes, that is, cooking, heating water and lighting. A random sample of 60 middle income households (30 in Hubli and 30 in Dharwad) and 70 households in the poorer areas (35 in each city) were surveyed. The households were selected in different parts of the cities, covering four residential areas and five slun[g] areas in Dharwad and four residential and six Muni areas in Hubli. The second survey looked at energy consumption patterns in both domestic and industrial settings.

The key findings from the first survey include:

- On average, 1-2 cylinders of LPG are used each month for cooking and between 60-300 units of electricity for lighting and heating water are used in Dharwad and between 80-300 in Hibli, in the middle-income households. Kerosene

sawdust and firewood are used by a few households surveyed. LPG is supplied by local dealers and kerosene, firewood and sawdust are purchased from the Government. The number of households using electricity for heating water has risen over the last 10 years by about 25%. The delivery of LPG cylinders is often delayed because of shortages.

- There have been no significant changes in the types of energy used for cooking and lighting in middle-income households, but there has been an increase of around 25% in the number of households using electricity for heating water from ten years ago. Firewood and sawdust consumption has decreased by 16% over a ten-year period.
- The households surveyed in the slum areas of Hubli and Dharwad use mainly firewood, twigs and branches for cooking and heating water; 3--5kg are purchased a day. Kerosene is widely used for lighting, though about 20 to 40% had electricity. There have been no significant changes in fuel consumption patterns over the last ten years.

  Prices for kerosene and firewood have risen by about 10 to 15%, LPG by 10-30% and electricity by 10 to 20% over the last five years. Firewood is bought for Rs. 100-160 per quintal, whereas around 6 years ago it was Rs. 70-86. Head load sellers sell one head load for around Rs. 40-50, whereas around 7 years ago it was Rs. S.

The above information was collected from a small sample of households in the urban areas. The results show that LPG and electricity use is increasing in middle income households, but firewood remains an important source of fuel for the poorer households.

Table 5.5 Types of fuel used in Hubli-Dbarwad city

Purpose	**Type of fuel used (percentage)**				
	Types of fuel	**Hubli**		Dharwad	
		MIF	**FRS***	**MIF**	**FRS**
Cooking	liquid petroleum gas (LPG)	100.00	--	100.00	--
	Fire Wood	--	100.00	--	100.00
	Twigs & branches	--	30.00	--	20.00
	Kerosene	--	--	[illegible]	[illegible]
Heating water	Firewood	--	100.00	--	100.00
	Electricity	60.00	--	93.00	--
	Kerosene	30.00	--	13.00	--
	Firewood & saw dust	20.00	--	30M	--
Lighting	Electricity	100.00	20-30	100M	26.00
	Kerosene	Occasional	70-80	Occasional	75.00

Table 5.6 Change in fuel usage over the period of ten years

Purpose	Types of Fuel	1987			1997			% change
		Hubli	Dwd	Avg	Hbl.	Dwd.	Avg.	
Cooking	LPG	100.00	100.00	100.00	100.00	100.00	100.00	--
Heating water	Electricity	57.00	46.00	51.50	60.00	93.00	76.50	25.00
	Kerosene	19.00	35.00	27.00	30.00	13.00	21.50	5.5
	Firewood & Sawdust	4150	40.00	40.75	20.00	30.00	26.00	15.75
Lighting	Electricity	100.00	100.00	100.00	100.00	100.00	100.00	--

Note: FRS use firewood, twigs and branches for cooking and heating water and kerosene for lighting.

The second survey sampled 51 households. The data shows the differences in consumption profile of electricity in the all electric homes (AEH) and non-AEH consumers.

Table 5.7 Energy consumption profile in Hubli-Dharwad

Appliance	*AEH Consumers (%)*	*Non-AEH Consumers* (%)
Electric stove	7.72	0
Water heater	22.19	15.27
Television	9.26	9.16
Music system	0.64	0
Vacuum cleaner	1.13	0
Electric pump	6.17	1.53
Emergency I ight	1.13	0
Refrigerator	7.40	5.34
Lighting	44.36	68.70

The average consumption of electricity in the AEH homes is 106 kWh/ month and in the non-AEH homes, it is 38 kWh/month.

There are differences in energy consumption patterns between an average urban consumer in l981 and today. This is due to the fact that cooking, which was a major electricity consuming activity, has now shifted from electricity to gas (LPG). Televisions are now more common. Non-AEH homes do not use electric stoves for cooking at all and the majority of AEH homes have shifted from electric cooking to gas. LPG is highly subsidised, which has contributed to its uptake. This has resulted in a reduction of the total electric power consumption in total for the AEII homes, though the energy spent for each of the other appliances has gone up. In addition, appliances such as electric water pumps, which were not very prominent in 1980s,

are now more widespread due to water shortages and to high rise buildings requiring water to be pumped to the overhead tanks. Even for normal buildings, it is necessary to store water due to water being made available only once in two or three days. All this has led to an increase in energy consumption.

Although LPG has been heavily subsidised by the government, to help reduce consumption of wood by the poor and to discourage the use of electricity for cooking, the subsidy has only benefited the rich and urban, while the poor, who use other forms of energy for fuel, end up paying more.

5.5 LPG use and subsidy

One of the most prominent changes in the average household energy consumption is the type of energy used for cooking. There has been a drastic shift of energy source from electric to gas in the urban areas over the past 10 to 15 years. This is mainly due to the subsidy offered by the govermnent. LPG was subsidised under the assumption that households would stop using fuelwood and thus reduce deforestation. However, the delivery mechanism and the distribution agencies are all located in urban areas and whilst the average urban household enjoys the subsidy, rural households have started using biomass waste and not firewood which is too costly.

Table 5.8 Subsidy of LPG

	Centralised Gas	Private Gas company
Cylinder weight	14.20 kgs	12.00 kgs
Cost	Rs 130.00	Rs 190.00
Cost/kg	9.16 Rs/kg	15.83 Rs/kg
Subsidy	Rs 100.00 per cylinder	Nil

According to Table 5.8, a subsidy Rs.15 million is paid out by the government for LPG use, which is about Rs 180 million a year. There has been serious debate on whether the subsidy should remain. Considering the fact that most of the beneficaries are urban and that there are private gas suppliers servicing the urban areas, it may be reasonable to withdraw the subsidy on LPG use in urban areas.

5.6 Demand for fuelwood

Gas has substituted for fuelwood widely in the city. Timber extraction from the Western Ghats has declined to around one quarter of what it was ten years ago. Many fuelwood and timber depots and retailers have closed as a result. The major consumers are now small hotels - commercial gas connections are twice as expensive as dornestie. In the protected forest, local inhabitants can take firewood at subsidised rates.

5.6.1 Conservation and Production

The Forest Department has switched from a primary role in energy supply to one of conservation. Farm forestry has focused on supplying timber for the paper mill at Dandelly, 60km from Hubli. The factory has its own nurseries around 20km from Dharwad and guarantees to buy back from farmers. Tables 5.9 and 5.10 show the forest areas of Dharwad District and the areas lost due to different purposes.

Gomal (village common) land has been the focus for conflict - between the Forest Department wanting to plant trees, especially eucalyptus, and local people and NGOs who have protested and campaigned against eucalyptus in particular. *Gomal* land is now very scarce or non-existent and tree planting is very difficult to protect.

Table 5.9 Taluka wise forest area in Dharwad

TALUKA	LAND AREA IN HA	FOREST IN HA
Dharwad	1,11,788.00	14,304,0614
Kalaghatgi	68,757.00	19,525,3581
Hubli	73,707.00	2033,3478
Savanur	53,901.00	1,143,5688
Shiggaon	58,920.00	8,741,3285
Hangal	77,525.00	8,418,1880
Halyal and Yellapur	--	50,9903
Kundagol	64,859.00	
	5,09,457.00	54,216,9329

Source From Range Forest Office Dharwad Division

Table 5.10 The area so far lost from Dharwad forest division up to end of March 1996 for various purposes

Purpose	Extract of forest area lost up to end of 1995 (HA)	Area release during 95-96
1. Area under submission	173.47	-
2. For rehabilitation	345.89	-
3. For power line	161.40	-
4. Area given for cultivation including Hangami	222.45	-
5. Area gone under township	28.12	-
6. Area gone under mining	15.00	-
7. Area given for non agri.	50.12	-
8. Area given for UAS college Dharwad on lease	214.00	-
9. Area lost for Kalinadi	153.47	-
10. Area under encroachment	256.884	-

Source: Range forest office Dharwad division

5.6.2 Pressures on the forest

Gowlies and the forest - the government would like *gowlies* to leave, but they are not willing. They supply *kawa,* made using firewood to heat milk, to Hubli-Dharwad. However, there is an argument about whether livestock or wildlife do more damage in the forest, with the Forest Department taking a pro-wildlife, anti-gowli position. There has been a process of sedentarisation of the *gowlies;* they now graze their stock only 10-15 km from their settlements. Another source of pressure has been encroachment from poor cultivators at the forest fringe. The actual area of forest is far less than the statistics indicate due to such encroachment. The administration regularises such encroachment. Policy measures to prevent or control encroachment are very difficult to implement.

Leafplates supplied to Hubli-Dharwad, and from there all over India, form an important, usually secondary, source of income for many forest fringe farm households and *gowlies.* Other forest products are gums, wild fruit and bamboo, which is woven into baskets.

Joint forest management (JFM) exists far from the city, but is not problem free. Scheduled caste villagers have on occasion complained they do not get access to JFM products or income.

5.6.3 Existing Research at UAS

Agro-forestry: there are projects on *neem* (seed collection and evaluation), and on technology extension across North Karnataka. Teak is the main forest and farm forest crop benefiting from research. Sissoo and Prosopis are exotic species also being researched. There is considerable private sector investment in teak and *acacia mangium* for timber. Farmers by contrast are interested in multi-purpose trees for fodder, green manure and fuel - *sissoo, calendra* and *subabul* - as well as fruit trees especially mango and *ber.*

5.6.4 Resource flow of firewood

The flow of firewood into Hubli and Dharwad was traced through interviews with private firewood sellers and the Karnataka State Forests Industries Corporation (KSFIC), a state government organisation. KSFIC was established in 1972 and manages the government firewood depots. The KSFIC is allotted firewood by the Forest Department. Extraction areas, known as `coupes', are allotted to KSFIC, which cuts trees and converts them to timber and firewood and sells firewood to ration card holders.

There are around 50 private firewood dealers in Hubli and 20 in Dharwad, who buy from agents and from government auctions. Wood from Navalgund, Nargund, Savadatti and Ron is transported to Hubli bulking point, with around 50-100 tonnes sold each day. Around 40% is sold for domestic consumption and 60% for commercial consumption. Increases in transport costs and auction prices have led to increases in the price of firewood over at least the last five years. Firewood is also

sold by headload sellers, usually women, who bring dried firewood, sometimes collected illegally, from forest areas and farmland near to the city.

The Forest Conservation Act of 1980 contains a requirement that prior approval is required from central government for any non-forest activity within any forest area. There are exceptions to this where other activities or land use exist, such as villages and power lines.

5.7 Potential for decentralised energy production

There are a number of state organisations responsible for the generation and supply of electricity in Karnataka, including the Karnataka Power Corporation, which commissions power projects, and the Karnataka Electricity Board, which is responsible for the transmission and distribution of electricity and for the maintenance of the grid. There have been numerous studies undertaken on energy requirements in Karnataka, including a study undertaken by the Karnatak State Council for Science and Technology in 1991 which examined the potential for decentralising energy production and use in rural areas.

The shortages of electricity have led to several companies with industrial plants in the Hubli-Dharwad city-region examining the possibility of having decentralised power generation based on diesel. The state is heavily dependent on hydroelectric power and has paid too much attention to supply-side issues. A more decentralised approach has been advocated by a number of commentators.

Electricity consumption by domestic consumers has risen over the last few years in part due to the installation of water pumps. LPG is widely used for cooking and is subsidised by the government to help reduce the consumption of firewood by poorer households and to discourage the use of electricity for cooking. However, the subsidy has largely benefited the wealthier urban households, whilst poorer households have to pay even more for firewood.

Karnataka is one of the few states in the country seriously trying out various options to plug the widening energy demand-supply gap. The Central Power Research Institute (CPRI) situated in Bangalore along with other leading Institutes, such as the Indian Institute of Science, have been examining options with other private organisations and public bodies. However, Karnataka remains one of the least attractive states for setting up of new industries due to power shortages. The current situation is so bad that existing industries have started thinking twice about investing in Hubli-Dharwad. Some are also seriously contemplating disconnecting totally from the grid and developing decentralised power generation based on diesel generating sets.

There are many reasons for the current problems, including the dependence on hydroelectric power. Reddy and others (1991) have pointed out other serious lapses in the power planning process in Karnataka by stating that "the recent efforts at electricity planning in Karnataka in particular the May 1987 report of the Committee

for preparing a Long Range Plan for Power Projects in Karnataka 1987-2000 AD (LRPPP) are clear cut examples of failures of conventional consumption obsessed supply-biased approach to energy plartning". As a correction to this the same authors presented a new approach, called DEFENDUS. This approach shows that "establishment of decentralised rural energy centres in the villages, it [DEFENDUS Plan] comes out with energy and power requirements in the year 2000 which is only 38 percent and 42 percent respectively of the LRPPP demand".

5.7.1 Case for decentralised energy generation in peri-urban areas

There is much potential for the use of decentralised energy systems in peri-urban areas. The is because:

The peri-urban interface contains a number of major production systems, such as poultry units, piggeries and dairies, to support the demands of the urban areas. The close interactions between the urban and peri-urban areas, both in terms of raw material and finished product transfers, indicates strong links. This leads to the energy needs of the urban area being greatly multiplied to address the energy needs of the peri-urban production systems and the supporting civilisation.

2. The production system in the peri-urban interface generates sufficient organic waste which can be used to supplement energy needs. The wastes can be briquetted and used as fuel, for example. Dairy and poultry wastes can be used along with other urban wastes for digestion and energy generation.

3. Various reports have shown that taking the grid line beyond a certain radius may be more expensive than having decentralised power generation. This is the case even with a more capital intensive project, provided the interest on the increased capital is less than the increased cost of developing the grid.

4. Hubli-Dharwad as an urban area has severe power shortages leading to power cuts in the domestic sector and severe power shut downs and penalties for excess drawing of power, or drawing of power during other unfavourable times. This is felt more severely in the peri-urban areas.

5. If the severe power shortages leads to unplanned decentralised power production centres, it may upset the energy balance between urban and peri-urban areas and thus cause more serious problems, such as energy shortages for the rural poor and landless households in per]-urban areas.

6. Industrial estates are already suffering due to power shortages and are contemplating decentralised power generation using one of the many approaches available, as long as it is available at lower prices, irrespective of its macro impacts on the society and environment.

7. Population growth is dramatic in some villages. Increasing demand for electricity In growing villages is significant and supports the argument for investment in decentralised energy sources.

Box 5.1 Options available for decentralised energy generation and use in the peri-urban interface

Type	Availability of raw materials	Cost per kWhr (Rs)
Thermal power	Wood - from forests - availability would depend on conservation orders	2.50
Biomass gasifier	Wood - chips or woody biomass Sources - waste from saw mills; forests	1.34
Diesel engine	Diesel - imported?	3.24
Wind farm	Sites need to be carefully selected - selection has been made **in** Karnataka	5.24
Solar pond	Sunlight	4.40
Solar photovoltaic	Sunlight	171
Solar flat plate	Sunlight	2.01

To compare the options, the availability of raw materials, particularly in peri-urban areas, would have to be weighed up against cost per kWhr, employment opportunities and availability of the technology. Some of the technologies have been significantly researched

The prices in the table should be compared to the average grid price of Rs. 1.80 per M r . This is only more expensive than the biomass gasifier. However, areas that are currently not able to access the grid, may find many of the other options comparable in terms of cost, but also in terms of reliability.

See Appendix Mfor more details on the options for decentralised energy production.

5.8 Conclusions

The shortages in electricity are severe in the Hubli-Dharwad city-region, as in many other parts of India. This has constrained development in the peri-urban interface. Distributing and using electricity efficiently and making use of renewable sources of energy present avenues to address the power problems. The case for the increasing utilisation of decentralised energy generation technology is strong in the light of continuing difficiencies in electricity generation and fragmented population growth in the peri-urban areas.

A number of characteristics of energy consumption patterns were observed, including differences in types of fuel used between the urban and rural areas, and between households of different income levels. There have been no substantial changes over the 1987-1997 decade in types of fuel used (both rural and urban), though use of LPG is increasing. Agricultural waste, particularly cotton stalks, offers a cheap source of fuel for many households in rural and peri-urban areas. The time

taken to collect agricultural waste, firewood and twigs and branches does present problems when many members of households take up employment other than farming. This may have implications for fuel use in the future as the trend of taking up urban employment increases, as well as for female labour patterns, as women generally collect fuel, but are also increasingly entering the paid labour market.

A further issue concerning the reliance on agricultural waste, particularly cotton stalks, is the change in cropping patterns. The impact of declining areas given to cotton could be significant in terms of access to fuel and time spent collecting fuel. Availability for different types of households is also likely to be affected.

5.9 Researchable issues

A number of researchable issues have arisen from the studies. These include:

1. Conducting a more comprehensive study on patterns of energy consumption.
2. Explore the scope for developing more decentralised sources of power generation.
3. Explore the potential savings from increasing the efficiency of distribution and use of energy.
4. Develop a strategy to maximise the use of renewable sources of energy.
5. Explore the comparative advantages, in terms of costs, alternatives, effectiveness, impacts on different households and labour requirements (particularly women), of using waste as an energy source versus waste as a soil ameliorant.

6. WASTE AND POLLUTION

6.1 Introduction

The collection of data on waste management and pollution issues was hindered by the low level of academic activity in the city-region within these areas and the fragmented availability of information. However, sufficient data was collected to enable several areas for further research to be identified, which should contribute to the development of systems for information collection for waste and pollution in Hubli-Dharwad.

Data on waste was collected through two phases. The first phase consisted of key informant interviews to develop an overview of urban waste and village surveys to develop an insight into peri-urban waste generation and use. The findings of these studies led to the development of the second phase, which involved a more detailed study of the markets for urban organic waste and the utilisation of waste water for irrigation in near-urban areas.

Information on pollution sources and problems was gathered through interviews with the Karnataka State Pollution Control Board (KSPCB), with a non-governmental organisation, and with a resident in a village close to a distillery near Dharwad.

From these studies, a number of key themes and research ideas have been identified. These are discussed below. This chapter discusses the collection of data, a review of known sources of information and details the role of institutions and regulations concerned with waste management and pollution control.

6.2 The peri-urban interface perspective

The concept of the peri-urban interface highlights the flows of waste between the urban and surrounding areas, rather than focusing on the separate needs of managing urban waste and accessing soil ameliorants, fertilisers and animal feed in the urban, rural and peri-urban areas. The concept provides a different perspective to that of urban and rural development, emphasising a systems perspective which examines urban-rural interactions.

The use of the peri-urban interface as a framework for researching waste utilisation highlights the scope available for bringing a new perspective to managing waste in urban and peri-urban areas. There is a shift in emphasis from how to dispose of waste to how waste materials can be better utilised and what systems are needed to facilitate increased utilisation. The studies conducted to date in the Hubli-Dharwad city-region indicate that much waste has been viewed as a resource for many years, but that constraints exist to greater utilisation of waste by near-urban farmers.

The flows of waste and pollution in the Hubli-Dharwad city region include the auctioning of waste pits from the Dharwad dumpsite, the use of untreated waste water

for irrigation of horticulture and the contamination of drinking water by agricultural runoff. In turn, these flows point to a number of issues of concern, such as the health effects of using untreated wastewater on horticulture, the declining markets for urban waste and the potentially deteriorating quality of river water.

6.3 Municipal solid waste

The Health Department of the Hubli-Dharwad Municipal Corporation (HDMC) has responsibility for the collection and disposal of solid waste. It is estimated that around 50 tons of solid waste are collected in Dharwad each day and around 120 tons per day in Hubli. Each city has a dumpsite, though the HDMC is seeking to relocate the Dharwad dumpsite as the city has engulfed the present site.

The responsibilities of the HDMC regarding waste and sewage are set out in the 1976 *Karnataka Municipal Corporations Act.* The waste and sewage disposal section of the Health Department uses a fleet of 17 trucks to transport the waste, 5 in Dharwad and 12 in Hubli. Of these, 4 trucks in Dharwad and 8 in Hubli are hired at the rate of Rs 350 per day. Wards which are densely populated, vegetable markets and slums are visited once every day, while other wards are visited once or twice a week. However, not all of the waste is collected in Hubli-Dharwad. Much is eaten by roaming livestock, many materials are reclaimed for recycling and some waste remains where it is dumped.

There has been a tradition of selling the solid waste to farmers from both dumpsites, either through auctions, particularly at Dharwad, or by tractor-loads, taken by the farmers for a certain price. Selling the waste clears space for more garbage and raises revenue for the HDMC. However, the sale of waste from the dumpsites has declined in recent years, largely due to the changing composition of the waste. Other factors may include transport costs, availability of other sources of fertilisers, soil ameliorants and animal feed. It is unlikely that the cost of the waste is a constraint, as the waste from Hubli has been available free of charge at times.

The auctioning of municipal solid waste can be traced back to 1937. At that time, there was no underground sewerage system and nightsoil was carried on the heads of a class of people known as "Bungies". They carried the nightsoil from latrines and roadsides in baskets and dumped it in the municipal trucks, from where it was taken to the garbage pits. Mixing the nightsoil with the garbage improved decomposition and resulted in a very good quality compost. The absence of plastics and rubber, and the intensive sorting of the garbage, also contributed to a better compost than has been found in recent years at the dumpsites. As a result, there was a very good demand for auctioned pits and many villagers from the surrounding areas went to the auctions, and higher prices were obtained.

6.3.1 Changes in the composition of solid waste

When an underground sewerage system was constructed in 1965-66, the quality of the composted municipal waste declined, as insufficient nightsoil was available. In 1974, prohibition of the practice of employing people to carry nightsoil was imposed by national government. This lead to further deterioration of the quality of composted solid waste. However, sorting and separating of the garbage continued and much of the waste decomposed in the rainy season. Separation of the garbage was possible because there were sufficient labourers available, less waste was generated than at present, and there was little plastic or rubber in the garbage.

Milk once bought from traditional gowlies who used to supply milk in utensils or take the buffalo/cow to the consumers' house, is now often bought in plastic pouches. With the establishment of Karnataka Milk Federation, the usage of plastic pouches increased significantly. It is estimated that about 80-150 tpd of milk is being sold in the twin cities resulting in usage of at least 2 tons of plastic pouches per month. Most of these pouches are collected by pickers, but still, quite a few torn pouches find their way into the garbage.

Other changes in the composition of municipal waste include increasing amounts of construction waste, wood and glass. Increased consumption of vegetables and fruits give rise to a lot of waste consisting of packing materials such as banana tree sap. Dried hay, wood and glass, which are not easily compostable, are also increasingly ending up in the garbage system.

As a result, garbage now consists mainly of plastics, rubber, glass and building debris, with less compostable matter than previously. Due to a lack of labour and supervisory staff, the garbage cannot be separated. The dumpsites are not adequately maintained and improvements in garbage handling and sorting are not implemented. The lack of staff is in part due to a fall in HDMC revenue and because of a prohibition on the employment of new staff by the state government.

The garbage can no longer be composted into a good quality manure. This observation is reinforced by the fact that there are no farmers willing to take the garbage from Hubli dumpsite, even though HDMC has announced that they can take the garbage free of charge.

6.3.2 Recycling

Other waste materials are utilised through material recovery and resuse. Much of the waste generated at a household level is separated out for sale to itinerant waste buyers. All newspapers are sent for recycling, for which there is an efficient system of collection. A number of waste picking households operate in Hubli-Dharwad, an occupation based on community and caste. However, many waste pickers are women and children. Plastic bags and bottles, paper, milk pouches, tin and other metal, and cardboard are picked from bins alongside the roads and from the dumpsites. Table 6.1 shows the approximate quantities and prices obtained for the picked waste.

Table 6.1 Quantity and prices of materials recovered for recycling

Waste type	Quantity tons/annum	Price Rupees per kg	Where does it go?
Plastic bags	24	4	Bangalore
Plastic bottles	12	14	Bangalore
Paper	900	4	Recycled
Milk pouches	60	14	Bangalore
Tin and other metals	6	3	Hubli
Cardboard	6	1	Bangalore

As shown in Table 6. 1, much of the waste material goes to Bangalore, a much bigger city in south Karnataka, where there are more sophisticated waste markets. However, there is a need for more information on the waste streams and on the recycling activities in Hubli-Dharwad.

6.3.3 Municipal solid waste auctions

Records of the auctions of the dumpsite waste are available only for Dharwad auctions from 1986, and are not available for every year, possibly because auctions have not taken place every year. This is due to the pits not being sufficiently decomposed, and once, the auctions were cancelled because the bids were not at a satisfactory level.

The Dharwad municipal waste is better managed than Hubli's, and is separated into pits according to the following categories:

compostable waste, including household wastepaper and waste from slaughterhouses, such as offal, abattoir, excreta and dried blood.
commercial waste from the market area, including paper, plastic bags and banana tree sap, which cannot be easily composted. It is usually burnt after drying.
building debris from construction sites and suburban areas.

This type of separation is not carried out in Hubli, as there are no pits at the Hubli dumpsite, and the waste from slaughterhouses is used for municipal gardens only.

The dumpsite at Dharwad consists of 372 pits, which were dug in 1960. Over the years the pits have increased in size and at present have a capacity of about 10 to 15 tractor loads of garbage. At the Hubli dumpsite, the waste is dumped in heaps in marked areas and around 750 such heaps can be dumped at the site. It is estimated that Dharwad generates about 50 tons per day and Hubli about 120 tons per day of household waste.

In Dharwad approximately 100 pits are set aside for waste collection every year. The pits in which garbage has been dumped in previous years, and which have been ext)osed to at least one rainy season, are considered for auction. It is the duty of the chief Jatnadar to keep a record of the pits which can be auctioned and a report is

submitted to the Health Officer about the readiness of the pits for auction and, before the auction takes place, prepares them to be sold.

The Health Officer must seek the permission of the Municipal Commissioner for the auction to take place. The Commissioner gives permission, fixes the dates and appoints an officer from a department other than the Waste Services Department (WSD) department to be in charge of the auctions. The dates are usually fixed to include at least one Monday, as farmers generally take Monday as a holiday.

The auctions are advertised in local newspapers and pamphlets are distributed to villages and previous customers. The advertisement is made at least one week before the auctions and during the period of the auctions, advertisements appear for three continuous days. Announcements have also been made in the past on local broadcasting stations in programmes aimed at farmers. The auctioning is carried out according to the following rules:

I . Each pit is auctioned separately and the auctioning takes place at the pit.
2. After the final bid has been made for a pit, the buyer must immediately pay 25% of the auction price.
3. The standing committee approves the bids made, after which the buyer pays the remaining 75% of the bid and can take the waste away.
4. The buyer must arrange for loading and transporting the waste from the pit within 30 days of auction approval. Otherwise the 25% payment is forfeited.
5. If acceptable prices are not obtained, the corporation can postpone or cancel the auctions.

In 1997, the auctions in Dharwad were due to be held in May, but a date was not fixed. A shortage of labour has been blamed for the auctions not taking place. In addition, most of the slaughterhouse waste was not collected from a dump close to the slaughterhouse, resulting in lower quality compost at the dumpsite. It was proposed to allow farmers to pay a sum of Rs.50 for a tractor load of waste from the Dharwad dumpsite.

6.3.4 Who buys the municipal waste?

When the quality of the waste was good, farmers from villages such as Kadpatti, Halyal, Hebballi, Bidnal, Govankoppa, Gubbur and Navalur attended the municipal waste auctions. As the quality of the waste has deteriorated, they stopped attending. Farmers from villages located nearer to Hubli than Dharwad have particularly stopped attending the auctions, as at present, auctions are only held at Dharwad dumpsite. Farmers from Navalur, a village very close to Dharwad, the city itself and from Marewad are the main participants.

Usually farmers who have larger land holdings, about 20 acres and above, attend the auctions. Small farmers generally only use farmyard manure from their farms. The present municipal waste is said to be mostly used to grow potatoes, but other

vegetables and jowar are also grown using this waste. A number of factors are taken into consideration when bidding for the waste, including:

• the size of the waste pit to be auctioned;
• the amount of waste that can actually be obtained; •
the length of time the pit was exposed to rains;
• whether the pit contains any slaughterhouse waste; and, •
the number of bidders for the pit.

The municipal employees in charge of the auctions set lead prices for each pit taking into account the above factors, to initiate the bidding and create competition between the farmers to obtain better prices.

Farmers buy the waste mainly to use as a soil ameliorant, rather than for animal feed. After dumping the purchased waste, it is sorted once again. Sometimes the waste is dumped in their own compost pits if it is not sufficiently decomposed. If the bought pit contains slaughterhouse waste, special care is taken to see that it is further mixed with their own farmyard manure and composted further to ensure the waste is fully composted and does not present any health hazards.

Farmers do not get sufficient amounts of good quality waste and are willing to buy more. The main constraints are the availability and quality of waste, and the irregularity of auctions, which means that they cannot plan their fertilizer requirements properly. The farmers use other fertilizers in addition to the composted waste, including dung and other farmyard manure from their farm.

6.3.5 The prices of auctioned waste pits

The auction records for Dharwad from 1986 to 1996 are shown in the following table. The average bids have increased over the period of ten years, reflecting the fact that there are fewer pits being sold. This is probably due to the lower quality of compost.

The auction records indicate that there are many factors which contribute to the level of bids obtained. There does not appear to be a straightforward relationship between the number of pits sold and the level of bids obtained, though the number of pits available is a factor. This confirms the need to investigate more fully the preferences and needs of the farmers participating in the auctions, which contributes to the prices they are willing to pay, before action can be taken to improve the composting process.

Table 6.2 Auction records for Dharwad dumpsite, 1986 - 1996

Year/date	Total number of pits auctioned	Total revenue (Rupees)	Highest bid for a pit (Rupees)	Lowest bid for a pit (Rupees)	Average bid	Remarks
1986-87 1-3 April	74	64,415	950	625	870	Auction was conducted twice; some pits more than twice
1986-87 26-28 April	37	23,695	1100	480	640	Pit 129 was of large size
1987-88 April	95	96,276	900	620	1013	
1988-89 April	62	38,155	875	550	615	
1989-90 April	56	51,185	1020	650	914	
1990-91 18-19 June	29	38,257			1319	
1991-92 8-9 April	30	40,160	2110	850	1338	Large price for two pits of slaughterhouse waste
1995-96 10-11 April	35	57,730	2000	1260	1649	Prices were high as there were few pits, but many bidders

Exchange rate: US$1:Rupees 34 (approximately)

6.4 Agro-industrial waste

The main sources of agro-industrial waste in the Hubli-Dharwad city-region are dairies, poultry units, rice and oil mills. The piggery waste, which is a good manure, is not utilised as the pigs roam freely and do not usually have a specific place for penning. As a result their waste cannot be collected in significant quantities.

6.4.1 Dairies

The dairies in Hubli-Dharwad may be categorized as large or small on the basis of the number of animals maintained. There are around 20 large dairies with about 10 animals and 30 to 40 small dairies with between 2 to 10 animals. The waste obtained from the livestock is dung, urine and leftovers from the fodder. An average adult animal produces about 0.5 to 0.75 tons of dry dung per year.

The traditional gowlies and small dairy owners make dung cakes, as the gowlies do not have their own land, and market the dung cakes at the rate of Rs. 15 to Rs.20 per 100 cakes. The dairy owners with their own farms use the wet dung in their compost pits and convert it into farmyard manure. It is used for their fields or sold at a price of Rs.250 to Rs.300 per tons. A few large diaries use the dung to generate biogas. The slurry obtained is used as a manure. Most of the dairy waste is effectively used for their own internal consumption in the form of manure, biogas or fuel. However this quantity is very small.

6.4.2 Poultry waste

There are about 25 poultry units in Hubli-Dharwad, the 2-3 large scale units have about 20,000 to 30,000 birds, and the small scale units 5000-10,000 birds. The large scale units have their own farm lands and do not sell any waste, as it used for growing trees. The total number of birds on average is 6000 birds per farm, and for 25 farms would be 1,50,000. The excreta from an average bird is estimated to be about 60 gms a day, giving a total quantity of 9 tonnes/day. The excreta is highly organic and concentrated and can be used for growing sugarcane only under irrigated lands. If the land is not irrigated, the waste is converted to manure by mixing with soil in the proportion of 1:12 and then applied to trees. The sale value of 1 truck of concentrated waste is about Rs.3000.

6.4.3 Rice Mills

There are 8 rice mills in Hubli and 3 in Dharwad, and these operate seasonally. The average plant capacity is about 7 to 8 bags per hour. During the season 45-50 quintals of paddy is processed every day. The waste arising out of the paddy processing is bran, husk and broken rice. On average, 100 kgs of a good quality paddy yields:

65 kg to 75 kg of rice
5 kg to 6 kg of bran
2 kg to 3 kg broken rice
15 kg to 20 kg Husk

The processing is done on rental basis at Rs.25/bag or quintal and labour charge of Rs.2/bag.

The husk and bran is sold to

- Bran and husk merchants.
- Animal feeds agents.
- Husk is used for dung preparation.
- Hoteliers use it as fuel.
- As animal feed used locally.
- Bran is sold to oil mills.

The waste is purchased either weekly or monthly during the season and is transported by bicycles, carts, tractors or trucks.

6.4.4 Saw mills

There are 17 saw mills in Dharwad and 46 in Hubli. The saw mills obtain the wood from forest depots in Haliyal, Yellapur and Dandeli by auction. During the cutting of the logs, saw dust and small chips are produced as waste.

The saw mills do not operate continuously as they only work when they receive an order for cutting logs. Also, the quantity of wood they receive is not constant because this depends upon the auctions and quantity sold. Sometimes the customer brings logs which have to be sized. As a result, one cannot definitely determine the number of working hours or days. The saw dust powder is sold to householders, hoteliers, rice mill and puffed rice mill owners. Some industries use it as a fuel for their furnaces. The wood chips are sold to householders of lower middle income and low income groups.

6.4.5 Distillery waste

The S.L.N. distillery is situated near Garag, a village about 17 km from Dharwad. It has been in operation since 1996 and has an installed capacity of 30 lakh litres per day. At present it is not operating to its' total capacity. Molasses, obtained from various sources, are stored in separate tanks above the ground. This is later subjected to further treatment and distillation.

The waste generated is of two types: sludge and waste water, also referred to as spent-wash, which is generated at a rate of about 200 to 240 tons per day. Sludge is taken out at three different stages:

1. Yeast sludge, a good organic fertilizer, is obtained during the fermentation of molasses.
2. Sludge obtained after methanisation.
3. Sludge obtained after secondary aeration . This is supposed to be a good fertilizer as well as fish feed.

The sludge is pumped into aeration tanks and the settled sludge is taken and spread on to sand beds and dried. After drying, the sludge will be in the form of crystalline powder. The analysis of the calorific value and ash content of the dried sludge revealed that the sludge has a low calorific value of 3437.40 kcal/kg and high ash content of about 31.04%. The yeast sludge has a calorific value of 1241.16 kcal/kg and ash content of 54.47%. The possibility of using the sludge as fuel is low because of the high ash content and low calorific values. However the possibility of using this waste as fertilizers and fish feed could be investigated.

Box 6.1 analyses the role of pigs in consuming waste materials in Hubli-Dharwad and outlines their potential role in contributing to soil fertility and composting needs.

Box 6.1 Urban scavenging pigs: capturing waste to enhance peri-urban fertility

Many cities in South Asia have large herds of scavenging pigs about which little is understood by decision-makers, and against the largely poor and lower caste owners of which drastic actions are on occasion taken. These thousands of pigs, however, not only provide a livelihood for hundreds of families in many cities, they are also responsible for consuming a very substantial proportion of the rubbish generated by the cities' human populations. They perform a service in the city, one which would be hard to replace effectively in many cities. Pigs are generally only seen as a nuisance and/or a health hazard. Though they undoubtedly are, the degree to which they constitute a health hazard varies considerably. They also represent a source of cheap protein, for certain social groups which consume pork, as they rely on low cost sources of feed - street rubbish, waste from hotels and restaurants, soil and vegetation.

In Hubli-Dhar-wad there are around 20,000 scavenging pigs, owned by about 100 "collar" families, who live in particular localities (e.g. Saraswatpur). Herds contain between 10 and 500 pigs. There are about 10 "rich men" with 5004- pigs. Pigs are distributed throughout the city but especially in residential areas where rubbish is available. There is a management system in place, though it is not recognised as such by the authorities. Pigs (the variety is "Jowari" or local) are tattooed to distinguish herd from herd. They are in general left to wander, though their owners generally know roughly where they are. They are distributed in proportion to the feedsource. When a sow is close to farrowing, which happens about twice a year, she is brought near the pig owner's home if possible, and he will keep a close eye on events. She may be fed extra from hotel waste which is collected and delivered to the pigs by some pig owners. Young pigs are sold to merchants for about Rs 300; 2 year old boars are worth about Rs 1000. who transport them to the consuming markets in Goa, and at Hassan, Mangalore and Bangalore, in Karnataka. The pre-Christmas period is the busiest for sales. Hazards for pigs are: dogs, traffic accidents, and the skill of the pig owner in managing the farrowing sow. Male pigs are castrated, and boars are carefully selected for big cars, heavy body and thick legs. Females are generally kept, but those with good height and big udders and body are preferred.

The urban Environmental Health authorities have been attempting to shift hundreds of pigs out of the city for about 10 years. The pig owners' association went to the Iligh Court and obtained a "stay", but in 1997 the High Court revised its decision in favour of the Municipal Corporation. The municipality begun catching 50-60 pigs per week in 1997. This has prompted some pig owners to sell their pigs before they are seized. The Municipal Corporation responds to complaints from citizens: if there is a complaint a team is sent to round up the pigs. This exercise is being undertaken in Hubli and Dhanvad to reduce the "nuisance" caused by pigs: they spoil kitchen gardens, and present a traffic hazard especially for scooter and bicycle riders. Japanese encepalopathy - a disease carried by pigs but transmitted by a mosquito which lives in irrigated rice paddies - is not a problem in the city, as there are no paddy fields.

This is clearly a drastic solution; stall feeding pigs appears on the surface to be an option which could still make use of wastes, but would involve more labour fetching waste to the pigs. This would have a cost. Pig owners also believe that the variety of pigs would not thrive if they were stallfed. The market also prefers local pigs - the taste of pigs suitable for stallfeeding is inferior. However, stallfeeding is not being pursued as an option either privately or by the public authorities. There is scope for researching this as well as other options (e.g. relocation). Once pig manure can be collected it also becomes a valuable resource which can be used to enrich the urban compost sold to farmers. The feasibility of this, and its benefits in terms of fertility can also be researched.

Sources of information: Gangappa, pig producer; Suraj Patil, Municipal Corporator; Dr Sadasivappa, *Environmental Health 0fficer, Hubli-Dharwad Municipal Corporation*

6.5 Wastewater in the urban areas

6.5.1 Present situation

6.5.1.1 The sewage system

Wastewater is generated largely from domestic properties, but there are also industrial sources. The key issue at present is the inadequate sewerage infrastructure of Hubli-Dharwad. Presently, around 50% of the old city area in Hubli and 60% of Dharwad have an underground sewerage system. There are no sewage treatment plants in Hubli or Dharwad. The sewerage system in Hubli city was constructed in 1966 when the population was about 2.2 lakhs. The existing system is quite inadequate to handle the present flows generated. Areas such as Gokul Road, Krisnapur, Keshawapur and Gabbur are not sewered. In these areas, facilities are provided by low cost sanitation or septic tanks. There are about 12500 septic tanks on individual properties and 25 community septic tanks. There are no dry latrines. Nearly 21.32% of the population do not have latrines and about 13,000 people are served by public latrines constructed by HDMC, some of which present problems in terms of improper use and maintenance. The number of house sewage connections is estimated to be 40,000.

The sewage water is released directly into nallas; in Hubli this is Unkal nalla, which flows directly through the city. The outfall sewer flows alongside the nalla, taking advantage of the topography. However, the sewer crosses the nalla at a number of points and is damaged in many places. The sewerage system for Dharwad city was also constructed in 1966 for a population of 1,20,000. Dharwad is divided into four drainage districts, determined by the topography of the city: Madihal, Hirekeri, Narendra and Lakamanahalli.

The waste water from the two cities is also often used to wash vegetables in the market places, as the outlets form the most convenient source of water. Around 13 million gallons of waste water is generated in the two cities per day.

Box 6.2 Sewage-based farming system

The sewage is used downstream by farmers for irrigating their crops, by installing pumps on manholes. The water is generally used for horticulture, where bigger yields as well as bigger vegetables are grown. The area cultivated by sewage from Hubli was around 25 ha, according to 1989 data. The sewage pipes in the city are presently being cleaned out, the waste from which will be auctioned.
Around Dharwad, the raw sewage is used by farmers at Madihal (around 18 ha) and Hirekeri (around 17 ha), to grow vegetables, jowar, groundnut and chillies. Again, the sewerage pipes are damaged, and Hirikeri recreation tank is polluted by sewage. In fact, some people dig out the waste from the tank, which over time forms `islands', and sell this as a manure

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6.5.1.2 Community septic tanks

About 7500 people are served by community septic tanks. There are about 10,000 house connections to the community system and about 7000 septic tanks in the severed area. In the unsewered areas of Narendra and Lakamanahalli there are about 9000 septic tanks provided by individuals. Community septic tanks are provided by a housing society. HDMC collects the waste from the septic tanks at Rs 100 per 300 buckets of sludge. However, it takes many years for septic tanks to fill, as the material decomposes. When the tanks are emptied, the waste is taken to one of the dumpsites.

6.5.1.3 Industrial waste water

There are about 18 industries in Hubli and 5 in Dharwad and the water required by these industries is small. According to the Karnataka State Pollution Control Board (KSPCB), standards laid down demand that the water is treated before discharging it out into municipal sewer. However, the treatment of wastewater by industries has not been investigated in this study.

The Karnataka Milk Federation (KMF), as the single largest dairy in Hubli-Dharwad, also generates a significant amount of wastewater. During the season, September to February, KMF processes around 2 lakh litres of milk, and, at other times of the year, the quantity varies between 70 to 80 thousand litres. The quantity of waste water generated is estimated to be about 85,000 to 1.2 lakhs litre and is used for irrigation, partly on the premises itself for growing trees. The waste water is treated aerobically and, according to the staff in charge, the sludge generated is very small, of the order of 2 tonnes/year. The plant has treatment facilities, but, although these were installed around five years ago, they have only been working properly for the last 2 to 3 years.

6.5.2 Proposed sewage treatment facilities

A plan to improve the sewage system, bring in low cost sanitation and treatment plants was drafted in 1989. The plan was put to the World Bank as part of a state-wide Karnataka programme, but was not funded. The proposal has recently been taken to the Government of India for funding. *This* may take another 1-2 years to get approval. Feasibility projects have been undertaken to develop the proposals.

In Hubli, the proposed treatment plant will be situated at Gabbur and will be an aerated lagoon system, as this takes less land, which is expensive and in short supply near Hubli. It is proposed that there will be four treatment plants in Dharwad; Madihal (10m1d), Hirikeri (8.20mld), Narendra (12.75m1d) and Lakkammanahally *(3.90mld). These* will be oxidation ponds, as smaller capacity and less land is needed.

The proposal states that:

"The treated wastewater will be discharged into nearby nalas which flow away from the city. On the downstream side of the treatment plant, the farmers can utilise the treated sewage for cultivation purpose."

Pickford (1995) states that using treated wastewater increases agricultural productivity and improves food supply, as well as reducing environmental pollution. "Ponds with 20 days retention eliminate almost all bacteria and viruses, producing an effluent that is suitable for unrestricted irrigation of vegetables, providing the sewage does not contain too much industrial effluent with high concentration of heavy metals or toxic chemicals" (Pickford, 1995:96). This indicates that there may be scope for facilitating the effective use of the treated wastewater.

6.5.3 Studies on the health effects of irrigating with wastewater and on the composition of samples of wastewater

Two studies were carried out in May 1997 to look at the health effects of working in fields irrigated by wastewater in Madihal (Dharwad Taluka) and Gabbur villages (Hubli Taluka), and to analyse the microbiological content of the wastewater.

To assess the effects of using sewage water for irrigation on human health, a study was conducted jointly by the University of Agricultural Sciences and the Indian Medical Association of Dharwad. The study was conducted in Madihal and Hale Gabbur villages, located in Dharwad and Hubli taluka respectively. A sample of 25 farmers of Madihal and 15 from Hale Gabbur who volunteered for a medical check up were examined. All of them were men as women are not involved with the irrigation of crops. Their age was between 17 to 70 years, with mean age of 30.32 years of Madihal farmers and 18 to 65 years with mean age of 32 years of Hale Gabbur village. They had spent between 2 to 50 years, with an average of 16.5 years of Madihal farmers, and 2 to 52 years, with average of 15.5 years of Hale Gabbur village, working in farming. Almost all of them are tobacco chewers. Cigarette or beedi smoking is less common. Four physicians and a dermatologist examined these men of Madhihal and Hale Gabbur villages. Examination was done under three headings:

1. General examination
2. Systemic examination
3. Dermatological examination.

The findings are as follows.

Table 6.3 General examination

Disease	Madihal		Gabbur	
	Number	Percentage	Number	Percentage
Angular stomatitis	1	4	1	6.6
Pole conjunctiva	4	16	4	26
Pale tongue	4	16	4	26
Conjunctivitis	1	4	0	-
Icterus	0	-	0	-
Cynosis	0	-	0	
Ulcers in the m o u t h	0		0	
Fissure or lenkolalkia	0	-	0	
Clubbing of fingers	0	-	0	-
Varicose veins.	4	16	1	6.6

Anaemia was the commonest finding and was related to nutritional deficiency and to worm infestation.

In the detailed systemic examination, amoebic colitis and acid peptic disease was found in both the villages and their percentage of prevalence is as shown in the Table 6.4.

Table 6.4 Systemic examination

Disease	Madihal		Gabbur	
	Number	Percentage	Number	Percentage
1. Respiratory system				
a. Upper respiratory infection	0	-	0	-
b. Lower respiratory infection	1	4	0	-
c. Chronic obstructive pulmonary disease	0	-	0	-
d. Acute or chronic bronchitis	0	-	0	-
2. Cardio vascular system	1	4	0	-
3. Central nervous system neuritis	2	8	0	-
4. Gastro intestinal system	2	8	4	26
a. Acid peptic disease				
b. Amoebic colitis				

Detailed dermatological examination revealed that dermatoses, tineasis and fissure foot are common diseases found among the farm workers.

Table 6.5 Dermatological examination

Disease	Madihal		Gabbur	
	Number	Percentage	Number	Percentage
a. Skin				
i. Dermatoses	5	20	2	13
ii. Tineasis	2	8	3	20
iii. Hyperhydrosis	1	4	0	-
iv. Fisrmness	4	16	0	-
b. Mucous Membranes	0	-	0	-
c. Muco cutaneous junction				
i. Angular stomatitis	1	4	1	6.6
d. Nails Tinea Unguinum	2	8	0	-

Skin problems are more common in Madihal village as 15 out of 25 members are suffering a skin disease. Prevalance is 60% at Madhihal and nearly 40% at Gabbur. However, no comparative study was conducted on farmers not using waste water for irrigation. Such a control study would be needed to obtain a clearer picture of the health effects of working in sewage irrigated fields. Details of other epidemiological studies of the health effects of irrigating fields with waste water should also be sought.

The microbiological investigation of sewage water taken from Madihal shows the following growth of organisms in the culture media:

Table 6.6 Results of microbiological investigation

Pollution character	Total count/ml
Total bacterial growth	12.2 x 10/6
E. coli	4.0 x 10/5
Total fungi	2.8 x 10/4
Actinomycetes	-

Table 6.6 reveals that sewage water is contaminated with both bacteria and fungi. Further investigation to classify sewage as high, medium or low contamination could be conducted. Although the manifestation among Madihal farmers of bacterial diseases is low, they are more prone to fungal diseases, such as Dermatoses and Tineasis, which are seen at rates of 20% and 8% respectively. However the possibility of epidemics cannot be ruled out as bacterial pollution is at high rates.

The above study indicates that there are adverse health effects from using sewage water on health, both on skin and gastro-intestinal tract system. Amoebic colitis is more prevalent in Gabbur than in Madihal. Anaemia due to nutritional deficiency and worm infestation is present in both the areas. Skin diseases are more common at both places, but are highly prevalent in Madihal where nearly 60% of farm workers are affected. The study is not conclusive, however, as a larger sample and a control group would be needed to draw more definite conclusions.

6.5.4 Chemical analysis of the wastewater of Hubli-Dharwad

Chemical analysis of samples of sewage water was also undertaken, in areas not connected to the above studies. Samples of sewage water were collected from Govankoppa and Hosayellapur in Dharwad and Bidnal in Hubli taluk. The elements are expressed in ppm. The analysis of the sewage samples indicated that all the measures studied were below the dilution limits. Therefore the chemical content should not be harmful to human health since the pollutants are below the critical limit set out in legislation.

Table 6.7 Analysis of the sewage samples

	Govanakoppa	Hubli*	Hosayallapur**
pH	7.6	7.1	7.1
BOD	34	58	15
COD	122	237	52
SS	38	118	20
DS	1430	1144	780
CL	306	200	120
SO4	58	19	11
F	0.4	0.5	0.4
S	Nil	Nil	Nil
DS	0.58	1.00	0.37
DP	0.9	1.8	0.7
TKN	1.24	1.60	1.50
BDL	1.37	2.00	1.62
S	0.03	0.01	0.01
F	48	38	40
Cu	BDL	BDL	BDL
Ni	BDL	BDL	BDL
No	39	33	24
Colour	light	light	light
Odour	less pungent	less pungent	less pungent
Ca	80	78	80
Mg	49	34	24

* sample taken 3rd May 1997 (Bidnal) **
sample taken 6th May 1997

SS - Suspended solid BDL - Below delection limits
DS - Dissolved solid S - Sulphur
DP - Dissolved P F - Flouride TKN- Total Kjedal N

Box 6.3 shows the nutrient content of sewage water sampled from Haryana and comments on the application of sewage water for irrigation.

Box 6.3 Nutrient content in the sewage water of Haryana town

Element	Concentration mg V [1]		
	Range		Mean
Nitrogen	25.4	97.6	48.3
Phosphorus	4.34	12.7	7.58
Potassium	27.7	152.1	72.4
Sulphur	19.0	60.9	34.6
Zinc	0.13	0.90	0.34
Iron	0.59	21.8	10.8
Copper	**0.06**	0.61	0.20
Managanese	0.25	0.60	0.36

The nutrient content in sewage water varies according to source. That from Haryana towns was found to be higher in N, P, K, S, Zn, Fe, Cu and Mn than that from Calcutta, which was high in N and K but low **in** P and micronutrients (Gupta *et al* (1990), cited in Das & Kaul, 1992). In practical terms, five irrigations of 75 mm each would supply 181 kg/ha of N, 29 kg/ha of P, 270 kg/ha of K and 130 kg/ha of S to the soil. Thus, it is not surprising that farmers in Bidnal reported a problem of excessive weeds growth (Hunshal, 1997). Das and Kaul (1992) also reported that irrigation with sewage water increased succulence of vegetables and vulnerability to attack by insects and pathogens, though nematode populations decreased.

6.6 Waste in the rural and peri-urban villages

Most waste generated in the peri-urban and rural villages is organic and is composted in a pit on a household vegetable patch. The waste produced at a household level is not significant and the composted waste will be enough for use on the household vegetable patch only. Any recyclable materials which can be sold will be kept for itinerant buyers or taken to the markets.

Agricultural waste is used for either composting or fuel. Cotton stalks are an important source of fuel in the region (see section on renewable energy). Dung is also used for fuel, though some is used on the land.

6.7 Pollution

The key institutions involved in the monitoring of pollution sources and levels are the Karnataka State Pollution Control Board (KSPCB), which has an office near to Dharwad, and the HDMC, which has responsibilities under the Karnataka Municipal Corporations Act, 1976, to ensure that wastewater from industrial premises have been adequately treated prior to discharge to the underground sewerage system. Information on pollution sources and levels is therefore available from the KSPCB, HDMC, but also from the SDM Engineering College, which analyses some of the samples for the KSPCB, and the Central Pollution Control Board in Delhi, which collates much of the information collected at a state and local level, for example

through the Indian Water Management Programme samples taken of big water bodies to assess water quality. The Central Pollution Control Board collects all the information and keeps computer records. The KSPCB took the HDMC to court in 1996 over its lack of sewage treatment facilities, highlighting the polluting effects of discharging sewage directly into streams.

One other source of information is the Janapara Vignana-Tantragnana Samsthe, JVS (A People-Oriented Science-Technology Institute), which is a non-governmental organisation working on pollution and natural resource issues from an independent perspective. The organisation is based in Dharwad, but works in a number of states, and works in response to the needs of local people. JVS is an offshoot of Samaj Parivartana Samudaya (SPS), a pressure group which has been particularly vocal in raising concerns about the quality of the water in the Tungabhadra river due to the activities ofa textile factory.

There are two main industrial areas in the Hubli-Dharwad city-region. Bellur is an industrial estate north of Dharwad, of around 300-400 acres, which presently is only about 30% occupied, with more industries expected within the next one and a half to two years, including a textile plant, a thermal power station and one automobile plant. Presently there are a number of types of industry operating on the estate, such as stone cutting and polishing (granite), oil mills and tea-packing. The industries have treatment plants, for example, the granite cutting and polishing dries the slurry and disposes of it in landfill and the wastewater is settled in tanks, and recycled. The KSPCB is responsible for ensuring that the plants comply with relevant legislation on pollution, and believe that the estate has few problems.

The second main industrial area is along Gokul Road on the outskirts of Hubli. The area is a cluster of small industries, such as engineering, electroplating and chemical, where space is severely restricted. Some plants have treatment facilities, but generally the wastewater is inadequately treated. There are preliminary plans to develop communal treatment facilities, with a State Government subsidy, and KSPCB involvement. A society of industries has been formed to work on this, but many industries are unwilling to invest in pollution control as there are so many other expenses to be met. However, zoning of industrial areas is being introduced, with similar industries in one area, making it easier to introduce pipelines and treat the wastewater. The Gokul Road industrial area is being engulfed by residential areas making the need for adequate pollution control more urgent. Other sources of pollution include the Dandelli paper mill, in Karwar District, about 64km away.

Three Acts form the basis of pollution control legislation: the 1974 Water Prevention and Control of Pollution, the 1981 Air Prevention and Control of Pollution and the Water Cess Act, which collect tariffs of water use. The High Courts are coming down heavily on polluting industries.

6.8 Conclusion

The market for municipal waste has declined since the construction of the sewerage system and the changing composition of solid waste. In recent years, most of the garbage has not been as suitable as it was for use on fields and so, the auction system is not as effective as it was in past years. The management of municipal wastes at the dumpsites is minimal due to staff shortages and lack of finance. The increase in waste over the coming years will create problems in terms of its' handling and disposal. There is also the possibility that ground water is being polluted due to infiltration near the dumpsites.

The waste generated by the agro-industries is generally used in agriculture. The dung produced in the urban dairies is used either by the dairies themselves, or sold as dung cakes for fuel. There does not appear to be a market in selling dung for use on land. Poultry waste is either used on land belonging to the owners or is sold to large farmers. The use of waste from pigs is yet to be utilised in a systematic way because the pigs roam freely. Waste from rice and saw mills also appears to be sold efficiently. However, the potential for application of distillery waste both as sludge as well as spent wash is yet to be investigated.

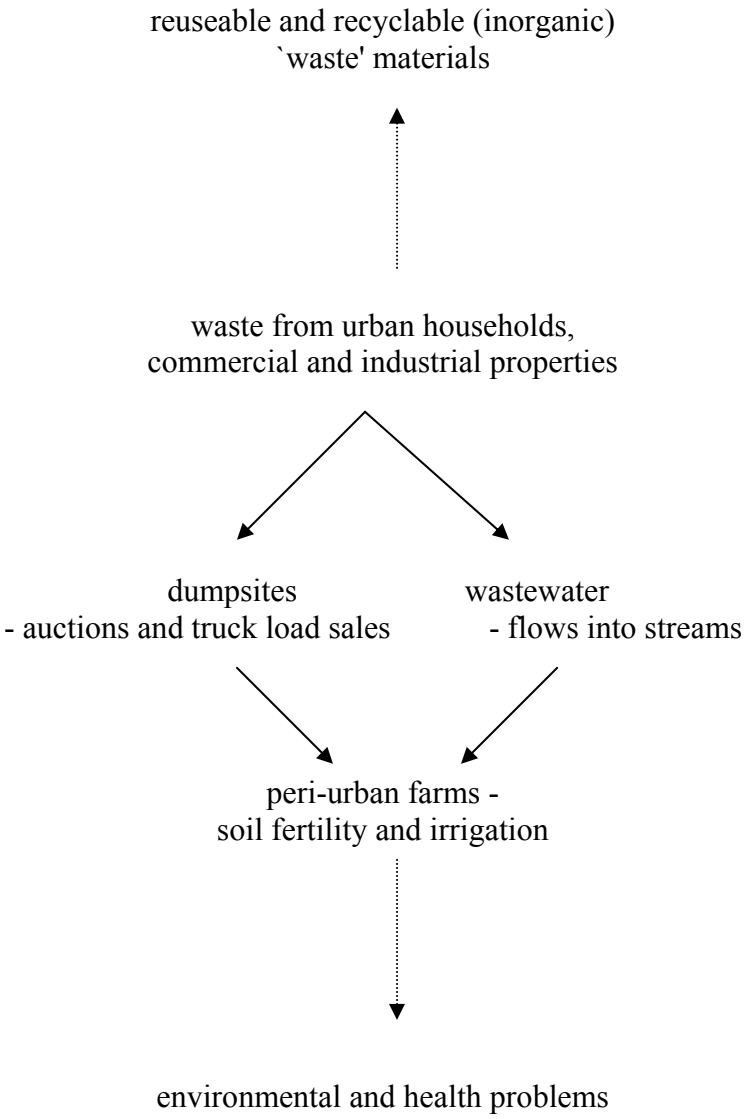
Agro-industrial wastes have potential to be utilised for decentralised energy production, for example, woodchips from saw mills and animal manure for biogas production. There may be conflicts between the use of waste for fuel and for agricultural purposes, both as soil ameliorants and as animal feed, but these can be analysed through research.

Urban waste water is used for horticulture, but is creating health heazards, as well as leading to more weeds and insect pests within the crops. This, in turn, leads to greater use of pesticides. However, this may be due to irrigation compared to rain-fed crops in most other parts of the peri-urban interface.

Figure 6.1 illustrates the flows of waste materials within the peri-urban interface perspective.

Finally, pollution sources and effects associated with the peri-urban interface have not been systematically examined. However, there have been a number of pollution incidents, such as that pursued by SPS, and the waste created by the industrial estates is a cause for concern.

Figure 6.1 Flow of waste materials



6.9 Researchable issues

A number of researchable issues relating to waste have been identified from the baseline study and with reference to the PUI logframe. These are:

1. Improve the utilisation of solid waste by near-urban farmers through:

- greater segregation of waste - trials could be set up to identify key points in the flow of waste at which there could be greater separation of waste materials;
- pig manure could be mixed with municipal solid waste to improve the composting process and the value of the compost.
- the marketing of the municipal solid waste should be reviewed, including the auction system to determine whether this is the best mechanism for both the HDMC and the farmers. The auction system may not be the best mechanism to sell the waste if small farmers are to access the waste. Transportation costs are a key constraint to buying waste, though it is likely that there are others, including access to other inputs and the low quality of the waste.

The examination of the scope to improve the composting process of municipal waste should be conducted in conjunction with a study concerned with gaining a better understanding of soil fertility issues and access to soil ameliorants in the Hubli-Dharwad city-region. In examining soil fertility issues, attention should be paid to differences between small, medium and large farmers constraints, needs and preferences.

The role of women in using composted waste on the land should also be explored, including whether it would lead to additional work and health impacts. The existence of taboos and acceptability of certain waste materials (particularly nightsoil) should be investigated. The scope for creating additional employment through segregating waste, composting and utilising urban waste should be considered. One further point to consider, is whether the occupation of `bungies' still exists, particularly in villages, where they take the nightsoil and what is done with it.

2. Examine the potential for the use of more environmentally sensitive methods for controlling the incidence of pests and weeds in crops irrigated by waste water. This is put forward as a researchable issue in recognition that it will be a number of years before the waste water treatment infrastructure is in place, once funding is secured.

3. There is scope for greater investigation and understanding of pollution issues in Hubli-Dharwad. Pollution sources that affect the peri-urban interface include the contamination of drinking water sources from agricultural runoff, untreated wastewater, the lack of management of the dumpsites and industrial emissions.

7. WATER RESOURCE ISSUES

7.1 Introduction

Water resource issues in the peri-urban interface concern the provision of water to urban areas, of sufficient quality and quantity, for use by domestic, commercial and industrial users, and use of water in rural areas for domestic uses and agriculture. The supply of water to Hubli and Dharwad is generally only available every three days, and even then the supply is available for a few hours, perhaps as much as eight. This is as much to do with the availability of power as of water.

In the rural areas, farmers either grow rainfed crops or rely mainly on minor irrigation works for their crops. Insufficient supply means that the farmers' land is rarely completely irrigated and so, farmers generally do not pay the complete amount of water tax. In many areas around the Hubli-Dharwad city region, groundwater is brackish. A programme of `Integrated Rural Water Supply and Sanitation' has been initiated with Dutch support in North Karnataka to address this issue, amongst others.

7.2 Urban water supply

There are a number of public sector agencies involved in the supply of water to Hubli and Dharwad. The State Irrigation Department owns the major reservoir, Malaprabha, from which water is drawn for the two cities; the Karnataka Urban Water Supply and Drainage Board (KUWSDB) is responsible for maintaining the Malaprabha and Neersagar reservoirs, treating the water and bringing it to the urban areas; and the Hubli-Dharwad Municipal Corporation (HDMC) is responsible for distributing the water, collecting the tariff and maintaining the distribution infrastructure.

There are two main water sources for Hubli and Dharwad:

- Malaprabha reservoir, around 40km from Dharwad, serves both Hubli and Dharwad. The treatment plant at Saunbatti has two units of capacity 7.5 million gallons per day (mgpd) each. This reservoir has been supplying water since 1983, at a present rate of around 10.5mgpd. The reservoir is owned by the State Irrigation Department, to whom HDMC pays for the cost of taking the water. HDMC also pays for the maintenance and power supply of the reservoir, but maintenance is carried out by KUWSDB.

- Neersagar reservoir, around 16km from Dharwad, mainly serves Hubli, and has been supplying water since 1955. The water flows to Hubli by gravity and the treatment plant is situated at Kanavihonnapur, which has two units of capacity of 4.5 mgpd each. The reservoir was designed to supply 9mgpd, but the present abstraction is 7mgpd. This reservoir is owned and maintained by KUWSDB, to whom HDMC pays 2 rupees 40 paise per 1000 litres.

There is one other reservoir from which drinking water is drawn. This is at Unkal, a few kilometres from Hubli, which has a purification unit. Up to Imgpd can be drawn from this source. This reservoir is maintained by HDMC, but the water has recently become too polluted by nearby industry to be used for drinking purposes. It is hoped that after the rains, water may be drawn in late 1997. Water was last drawn from the reservoir in June 1996.

Some areas of the cities are still served by borewells, where distribution by pipes is a problem. There are around 800 borewells in the cities, 50% of which have potable water. Of the borewells used for drinking water, 127 have power pumps and 169 have hand pumps. These serve a total population of 70,000 and are mainly in areas of unauthorised settlements. There is no charge to the public for the use of public borewells. Some of the borewells, which have potable water and a good yield, are linked to the distribution network. There are also around 1050 public taps. KUWSDB also supply water to industry around Hubli and to South Central Railways. The industrial estate at Bellur uses borewells but the companies on the estate are planning to develop their own water supply system.

The Department of Mines and Geology and KUWSDB advised HDMC not to use borewells because of depletion of groundwater. Many borewells go dry in the summer because they have not been recharged. It has been suggested at a national level that there should be legislation to register borewells, to control the extraction of groundwater.

The Geology Department of Karnatak University has conducted a number of studies on the quality of groundwater in Hubli and Dharwad. Their results suggested that although most of the groundwater sources are potable, around 20% of sources exceed permissible limits of calcium, total dissolved solids, chlorine and total hardness (Hegde, 1991; Hegde and Puranik, 1994). A further study in Hubli city revealed that wells located in the vicinity of sewage courses contain water with seriously deteriorated quality (Hegde, 1991; Hegde, Puranik and Abbi, 1992).

For about the last year, the urban water supply has only been available every 3 days, with, officially, sufficient quantity for three days supply. Prior to this, for about 10-12 years, the supply was available every other day. The supply lasts for between 2 and 8 hours, at fixed timings, provided HDMC receives bulk supply from KUWSDB, which in turn depends on there being adequate electricity. Water used to be supplied on alternate days, but the unreliability of the electricity supply made this difficult. The intermittent power supply damaged pipes. Now, although the supply is less frequent, the supply is reportedly more reliable. How the public feel about this change in supply, has yet to be independently investigated.

There are 55,000 connections in Hubli and Dharwad. The supply is around 20 gallons per capita per day, but this is not uniform throughout the cities. The total amount available to supply is 35058 million litres per year. There are 28 reservoirs in Hubli, Dharwad and in-between, each with a 10 million gallon capacity. In Dharwad, the water is pumped to one reservoir in the city, which then distributes to the other 13 reservoirs. Almost all the water supply of the city is served by these reservoirs. In

Hubli, nearly 70% of the water supply is served by reservoirs, but some areas are fed by pipes (direct feeding) as it is difficult to connect pipes to reservoirs in these areas. The extension areas of the cities will require the construction of more reservoirs.

Twenty of the reservoirs were constructed in a `remodelling of distribution system', which took place in 1991. This remodelling scheme was carried out by KUWSDB and financed by HDMC. Around 13 crore Rupees have been spent, with another 50 lakh yet to be spent. HDMC borrowed money for the scheme and had a State Government grant. The repayments, together with normal running costs, amount to expenditure of 14 crore rupees annually. The revised water rates will provide an annual income of just 4.5 crore.

The customers in the cities are categorised as domestic, non-domestic (which essentially refers to construction operations) and commercial/industrial. Until recently, the tariff was around 15 rupees per month for non-metered users, but a resolution was passed at Central Government level to increase the tariffs. The water charges were changed on the 1 st April 1997, as the charges were far too small, and in Hubli-Dharwad are as follows (rupees per 1000 litres):

Domestic	
0 - 10000 litres	1.26
10001 - 25000 litres	1.66
25001 - 50000 litres	2.66
50001 - 75000 litres	3.66
75001 - 100000 litres	5.16
Above 1 lakh	6.16
Non-domestic	
0 - 25000 litres	3.32
25001 - 50000 litres	4.32
50001 - 75000 litres	5.32
75001 - 100000 litres	6.32
Above l lakh	7.32
Commercial/ industrial	
Any amount	8.64

Around 60% of connections pay the charges regularly. If the bill is not paid, the connection gets a notice after 15 days. The flat rate charge is doubled after non-payment for 3 months, and tripled for non-payment after 6 months. After a year, the supply is disconnected.

The official current estimate of transmission losses is 10-15%, which is lost through leakage. However, other estimates have been put at between 35 and 50%, if not more. Six villages between Suanbatti and Amminbhai, a distance of about 30km, have been taking water from the pipes from Malaprabha reservoir which serve the cities. The villagers threatened to break the pipes if they were not given permission to take the water. They now take water from the pipes for drinking and are charged for it. Their

previous source of drinking water, groundwater, is brackish and so the treated supply for the cities is an improvement.

7.3 **Irrigation**

Information on irrigation is given only for Dharwad District. There are 390 tanks irrigating an expected 55,575 hectares in the District, 31 lift systems irrigating 12,004 hectares and 15 barrages irrigating 4098 hectares. These are minor irrigation schemes, which provide a total of 434 sources and 71,678 hectares of anticipated irrigation each year. Plans for a further 6 tanks have been sanctioned by the State Government, but the construction process will take at least 3 - 4 years. A further 9 barrages are also planned. These additional constructions will increase the availability of water and increase the area over which irrigation takes place. The minor irrigation schemes are around 14 km, and beyond, from Dharwad.

The heads of each taluka records information such as the name of the farmers, crops grown and areas irrigated, and use this information to gather the water tax for the Revenue department. The water tax pays for the maintenance of the tank, or other source, and for the field worker, and varies according the type of crops grown. Water for cash crops is charged at a higher rate. Some of the rates are:

rice	87 Rs per hectare
cotton	100 Rs per hectare
sugar cane	400 Rs per hectare

These charges were set in 1985 and have not altered since then. This is due to resistance from the farmers, particularly as the water sources are not always reliable and not all of their land can necessarily be irrigated. The insufficient supply also means that the fanners do not always pay the tax and that they generally pay less than the set amount. The state government pays for the construction costs of each system.

There is an Irrigation Committee in each taluka, which decides when to let out the water after the rainy season. An assistant executive engineer from the Minor Irrigation Department is secretary to the committee. This assistant is responsible for letting water from the tanks into the fields. All of the tanks are rainfed.

Borewells are generally used for drinking water. Borewells for scheduled castes are being sunk by Jilla Parishad, a government organisation with an office in Dharwad. These may be used for irrigation, but are generally used just for drinking water. There has to be a four inch `yield' in the borewell for irrigation purposes, which will irrigate 7 hectares.

There have been problems with getting sufficient water at the correct times, with maintenance of structure and sharing the water fairly. Excess use and misuse are also problems, resulting in salinisation and other problems. Central and state level governments are trying to develop a solution to the problem of getting farmers to share the water fairly, through Participatory Irrigation Management (PIM).

Many farmers in India are forming Water Users Associations from each outlet. These are co-operative societies which must be registered under the Co-operative Act, and their aim is to work out a way to share the water between the farmers. The farmers are billed through the Associations. The Government fixes the rate and the association pays. The Irrigation Act is being changed to allow for this system. The Government subsidises irrigation schemes for 2-3 years at the beginning. There are no known examples of such Associations in the Hubli-Dharwad city-region.

7.4 Conclusion

The number of public sector organisations involved in water resource management activities means that there are a number of information sources, leading to fragmented collection of data. However, it is clear that there is information available on the amount of water going into the urban areas, but insufficient information has been collected on the distribution of water to the peri-urban and rural areas.

The information collected to date provides a rough picture of the issues, including the inadequate supply of water to the urban areas, in part due to the unreliable power supplies, the brackish nature of much of the groundwater in the rural areas and the insufficient availability of water for small irrigation schemes.

7.5 Researchable issues

The brief overview points to a number of areas where further studies could lead to more detailed understanding of the situation. These include:

- the availability of drinking water in the urban areas. How satisfied are people with the current service? How much would people be willing to pay for an improved service, if the service can be improved bearing in mind the power problems? How much water is extracted between Malaprabha and Hubli-Dharwad and how much is lost through leakage?
- the responsibilities and co-ordination of the institutions involved with the provision of water to the rural and urban communities, for domestic, agricultural and industrial uses. Is there scope for improved co-ordination of water use and treatment?
- the availability of water for irrigation purposes. What are the constraints to providing a better service and what would farmers be willing to pay for an improved service? What is the scope for encouraging the creation of Water Users' Associations by farmers using irrigation services? Information could also be gathered on other Districts around Hubli-Dharwad.
- sources of pollution, especially the Unkal tank. What are these and what preventative action can be taken?
- the quantity and quality of groundwater in Hubli-Dharwad. What are the trends in abstraction and the sources of pollution? What can be done to address over-abstraction and pollution?
- trends in the location and use of tanks within the city-region over the last twenty years or so, and a review of plans for the future.

8. GOVERNMENT PLANNING

The Hubli-Dharwad Urban Development Authority (HDUDA) currently covers an area of 430 sq. km., but within this, the Hubli-Dharwad Municipal Corporation (HDMC) is responsible for implementing urban plans. The Municipal Corporation area is 190.94 sq. km, and the boundary currently corresponds to the built-up area. About 40-45% of the conurbation land is currently developed.

This chapter provides an outline of the planning institutions at the urban, district, taluk and village levels. The different approaches taken to planning by HDUDA is contrasted with the approach taken by its rural equivalent, the Dharwad Zilla Panchayat (DZP). The chapter discusses the potential role of the new Joint Planning Board, which will provide a degree of co-ordination between HDUDA and DZP.

8.1 Urban planning

8.1.1 Early Plans

A Masterplan for Hubli and Dharwad was prepared in the 1940s by the Bombay State Government. Following the merger of Hubli City and Dharwad Municipality to form the Hubli-Dharwad Municipal Corporation in 1962, an outline development plan was prepared in 1963 by the State Planning Department. The Town and Country Planning Act 1965 came into existence in Karnataka, and town planning functions started in Hubli-Dharwad in 1966. An Outline Development Plan was produced in 1966, although it was not approved by the Karnataka State Government until 1975. At this time the Hubli-Dharwad Planning Department was just a planning agency with no implementation powers. The City Improvement Board had the responsibility for implementing plans, and maintenance was left to the Municipal Corporation. In 1970 a plan was prepared by HUDCO for Navalnagar, a new township along the National Highway between Hubli and Dharwad - pockets have been developed by the Municipality and contains government offices and an industrial estate between the National Highway and the railway.

8.1.2 Comprehensive Development Planning

In 1988, under the Urban Development Authority Act, the Planning Department and the City Improvement Board were merged to form the Hubli-Dharwad Urban Development Authority. The Comprehensive Development Plan was approved in 1988. This is primarily a zoning plan up to the year 2001, based on a population projection of I million, and an assumed population density of 125 persons per hectare, with land required for various land uses based on this figure. The 1991 actual population, however, was less than the predicted figure for 1991, since less industrialisation has taken place than expected. Tax concessions had been offered by the State to attract new industries, aiming to relieve pressure on the Bangalore Metropolitan Area. Electricity shortages, partly stemming from inadequate hydro - electric power generation

due to a reduction in rainfall and problems with siltation, meant that industries had not come to the area.

The Plan did not able to take environmental aspects into consideration, although it did contain a designated green belt, earmarked for agriculture. It also set aside industrial land so polluting chemical industries could move out of the city to Belur, about 10 km north-west of Dharwad on the National Highway. A by-pass for the busy National Highway 4 (Bangalore - Poona, Mumbai), which currently passes through both Hubli and Dharwad and is heavily used by local traffic as well as long-distance vehicles, has been planned to the west of Hubli and Dharwad, but only about 10 km out of the 20 km have been completed.

A Revised Comprehensive Development Plan, essentially a roll-forward to the year 2011, is currently being developed, with submission to state government expected within one or two years. If the Comprehensive Development Plan finds that insufficient vacant land exists, then it will extend the local planning area, although this will ultimately be a political decision. The first step, the preparation of a digital base map, has been completed by local computer engineers, Vision Solutions. The central areas of the cities are covered by land records, but beyond this, the records are maintained by the Dharwad District Revenue Department. The available maps have been scanned, jigsawed together and assembled using the AutoCad software package to produce base-maps at an initial scale of 1:8,000 so that current and proposed layouts and land uses can be plotted, printed and displayed. Currently, however, the Town Planning Department has no computers and appears likely to have to rely on external assistance to prepare land use overlays and arrange colour plots of the maps.

Despite these technical improvements, however, the revised plan is likely to have similar weaknesses to the existing plan. There are no signs that there will be any real concern to promote a more sustainable city by making efficient use of renewable natural resources, or taking environmental considerations into account. Regional planning for the city region is neglected but is very much needed to provide a more coherent approach to the city-region's development. There are no statutory controls beyond the local planning area. Wider perspectives are inadequate since there is no interaction between physical and economic planning in the area.

The current Urban Development Authority Area, covered by the 1988 Comprehensive Development Plan, contains 18 villages:

<u>Hubli Taluk</u>
Anchatgeri
Agranar Timmasagar
Kotagundahunsi
Rayanal
Tarihal
Gangiwal

<u>Dharwad Taluk</u>
Belur

Hiremallligawad
Itagitti
Jog Yallapur
Kanari Honnapur
Kelgeri
Mansur
Manmigatti
Narendra
Salakinkoppa
Yankoppa
Nuggikeri

The green belt and these villages remain under the jurisdiction of the local gram panchayats and the taluk panchayat, so difficulties have emerged in enforcing the 1988 Comprehensive Development Plan. Some industries, for example along the Karwar Road in Anchatgeri, were there prior to declaration of the green belt. Private developers are prepared to pay 4 - 5 times the amount paid by the Development Authority for land. Unauthorised constructions have taken place on about 1,500 acres scattered in the agricultural land, some in the local planning area and others just outside. The Development Authority has enforcement powers, but enforcement is often politically unacceptable. Nevertheless, demolitions over a recent six month period have taken place on 60 - 70 acres of illegal, unauthorized layouts, using Corporation manual labour to knock down foundations and walls.

Contrary to the plan, some developments have received formal permission from the local panchayats where land is cheaper and applications for planning permission are avoided, but under the Town and Country Planning Act notices are now being issued to stop this, although developers can appeal against a notice in the courts. It is also possible to apply to the Deputy Commissioner for change of use from agricultural to non-agricultural; he seeks the opinion of the Development Authority, then the Development Authority prepares the layout plan. The Urban Land Ceiling Act permits 1,500 sq. m of land to be held for non-agricultural use, but above this level land has to be surrendered to government or get exemptions from government. In 1997, however, a more lenient view was taken of land held for group housing projects. It is possible to apply for conversion of land under the Karnataka State Revenue Act; if in the green belt, this can be refused.

Individual speculators (not development companies as it is not worth losing their reputations) may offer half of the market value to farmers, put in inadequate roads and sell to low income groups. After 5-10 years these areas become classed as slums as they have no infrastructure, roads, water, sanitation, or electricity, and pressure is exerted on the Slum Clearance Board to declare the whole colony as a slum so that services have to be provided. One or two pockets along the by-pass, for example Ayodhya village or the small town of Nokarnagar, are trying to get themselves declared as slums. Under the provisions of the Regularization of Unauthorised Construction Act, 1995, unauthorised activities have been encouraged. Illegal activities have to be surveyed, given planning approval and incorporated into the base map. Under recent instructions from the Deputy Commissioner, the Village Accountant in the Revenue Department is responsible for

notifying illegal developments which violate the Revenue Act, Urban Land Ceiling Act, Town and Country Planning Act and Urban Development Authority Act. Since the start of 1997, the Development Authority has started meeting with the Municipal Corporation, Police and the Dharwad District Deputy Commissioner to take combined action to stop this.

8.2 District and Taluk planning and policy-making

Under the Karnataka Zilla Parishad Act 1983, which did not come into force until 1985 and only started working after elections in 1987, local government in Karnataka State operates as a decentralised system with three tiers: the Zilla Panchayat or district level of government, the Taluk Panchayat or block level of government, and the Gram Panchayat covering a village or several villages. None of them are concerned with physical or land use planning, however, but confine their activities to economic planning, the allocation of resources or implementation of schemes.

8.2.1 Zilla Panchayat

The Dharwad Zilla Panchayat covers the entire district and the Zilla Parishad has 67 elected or nominated members, one per constituency of roughly 30,000 - 40,000 population, chaired by an elected leader for only 20 months; at least 25% of the seats are reserved for women, scheduled castes and scheduled tribes. The technical staff are headed by the Chief Executive Officer, a senior administrator, who has a Chief Planning Officer taking responsibility for the preparation of plans, and a Deputy Secretary (Development) whose responsibility covers the implementation of schemes but who also plays a co-ordinating role between departments. There is also a Deputy Secretary (Administration) who looks after the establishment, staff, consumables, etc, and an Accounts Officer, responsible for budgets and funds who acts as the finance controller.

The zilla panchayat has no local revenue raising powers but relies on the central and state governments for resources. It is responsible for allocating these funds to the taluks according to a formula, largely based on the numbers of scheduled castes, scheduled tribes and those below the poverty line (classed as family income below 1,800 rupees per year). The zilla panchayat sets targets and allocates funds, which are distributed to each department, in accordance with central and state plans, by the elected Planning Committee, following the advice of the officers. Construction projects are allocated on a step by step basis, with priority being given to uncompleted projects. Priorities are determined for a single year only, and are allocated until funds are exhausted. The previous year's outlay tends to be the major influence on the next year's budget for each sector. The Planning Officer's tasks are simply to receive information from each department or requests from the lower levels of government to prepare a budget allocation plan. The infrastructure and amenities in each village are taken into account but are used to indicate minimum needs and priorities. Indeed, the simpfv mean that the village has to wait its turn to receive other facilities or services. No attempt is made to engage in identifying problems,

setting objectives, devising strategies for achieving these targets, or evaluating the impact and effectiveness of implementation policies. Consequently no decisions are made about spatial or sectoral priorities since the interpretation of socio-economic planning by the zilla panchayat is simply the compilation of activities from below. The emphasis is on the allocation of resources rather than on planning.

The largest spending is on health, education, and public works - roads, water, buildings, but the zilla panchayat is split into 33 departments (see Appendix N). Each department has their own sources of information which are not shared with other departments, and each has their own separate linkages with other levels of government. The Chief Executive Office is responsible for co-ordination, and together with the Planning Unit and the Deputy Secretary (Development) appears likely to be able to facilitate contacts with stakeholders in the district.

A District Planning Board is being constituted to bring together elected members from the urban and rural areas, with an elected chairman. It is not yet functioning and the State Government has not yet made a policy decision on its duties and responsibilities, or what committees are to be set up. It is likely to have its own officers, and although expert planners may not be involved, the Planning Board will be briefed by professional officers. This is a new and promising development which may help to integrate urban and rural plans, resolve rural-urban conflicts, link physical with socio-economic planning and promote improved land use planning and co-ordination, including better use of scarce renewable natural resources in the peri-urban interface.

8.2.2 Taluka Panchayat

The taluka panchayats serve a sub-district or block and the zilla parishads have a minimum of 12 elected members, each representing a population of about 10-12,000, with an elected chairman serving for 20 months, the same as in the zilla panchayat. The taluka panchayat elections are also contested on a party basis like the zilla panchayat. The Executive Officer is responsible for co-ordination, and there is a full range of technical staff, with many of the same departments as the zilla panchayat. There is, however, no town planning officer so physical planning and land uses are neglected at this level. As at the zilla panchayat level, planning at the taluk level is interpreted as nothing more than short-term resource allocation.

Although a taluka panchayat raises some of its own resources from stamp duty, it tends to work under the zilla panchayat. It receives requests from the village level gram panchayat and allocates resources according to priorities among villages within its area. It is the taluka level officers, however, who provide technical guidance and advice to the gram panchayat members rather than the zilla panchayat officers. Many of the detailed records and maps are held at this level, particularly for the watershed level; each taluk generally has 3-4 watershed projects identified by the taluka departments concerned with agriculture or engineering. The watershed development programme covers a cluster of villages in an area of at least 500 ha, selected by the technical wings of the taluk and zilla panchayats but administered by non-governmental organisations. For these selected areas, maps show details of the

phasing of each 3-year project. It is perhaps particularly significant, however, that the most up-to-date information held on taluk level statistics by the zilla panchayat planning unit is for 1988/89, suggesting that flows of information between the two levels of local government are limited.

8.3 Village Planning

8.3.1 Gram Panchayat policy-making

The Gram Panchayat covers a single village or two smaller villages, and consists of at least 12 members, elected for 5 years, with seats reserved for scheduled castes, scheduled tribes, women, and poor classes (landless and those with less than 5 acres of land). Voting takes place in wards, but everyone has votes for candidates for the reserved seats. The Chair-person of the Gram Panchayat is drawn from the general category (high or middle classes) or one of the reserved groups identified as a priority for each taluk. The organisation is headed by an appointed administrator and secretary, and it employs clerks, labourers, sweepers, watermen, lightmen, etc. The District Revenue Department of the State Government posts a village accountant to each village.

All members participate in the Policy Committee, but each Gram Panchayat has three sub-committees, each with at least one woman and one scheduled caste/tribe member:

1. Production Committee - this consists of not less than 3 persons and not more than 5 members, and is responsible for collecting funds for the Gram Panchayat.
2. Facility (Village Development) Committee - also with at least 3 members but not more than 5 members, chaired by the same person as the Production sub-committee. This takes decisions on the allotment of facilities to people and what facilities are to be built on common land.
3. Social Justice Committee - consists of one woman and one scheduled caste or scheduled tribe member, with the vice-chairperson of the Facility Committee becoming the speaker of this committee, which tries to solve the social injustices done to any categories of people in the village

Although the bulk of its resources are central or state funds allocated through the Zilla Panchayat, the Gram Panchayat obtains incomes from various taxes or charges, such as house tax, water tax, traders' licences, which are collected from the villages but given back by the Zilla Panchayat. Each panchayat is provided with 100,000 rupees in funds for development activities, and Rs. 150,000 for construction works. The Gram Panchayat is responsible for:

• discussing villagers' problems and needs,
• taking decisions about the planning and siting of facilities,
• maintaining facilities when these are built by the Zilla Panchayat, and •
collecting any charges imposed on the users of the facilities.

The Village Development Committee, which makes these policymaking and planning decisions, meets every six months, and appears to be the key stakeholder in the village. An agenda is normally sent to the taluk, with an invitation to attend sent to the taluk chairman, so taluk members or technical officers can attend to give advice. All villagers would be able to attend a gram sabha meeting to decide on a site for a facility. Siting decisions would normally look at the common land first, but if necessary the taluk will be informed about preferred locations so that the government can purchase land from farmers; the construction will be undertaken by a government contractor, or if it is preferred, the Gram Panchayat may appoint its own contractor. For janata housing (for low income groups, scheduled castes and scheduled tribes), the Gram Panchayat Policy Committee responds to requests from these target groups, made in a public meeting to show no favouratism is involved, and sends a list of the names of people in need of houses to the taluk panchayat office, which decides on the number of houses to be allocated to each gram panchayat. The Iocation of the housing depends on the availability of land, but the houses are normally built in rows as an extension of the existing village, although it is left to the zilla panchayat contractor to produce the layout plan. The zilla panchayat may provide building materials for self-building of the janata houses.

8.3.2 The role of village institutions in the RRA villages

In order to find out more about the activities of these villages institutions and their role in planning, a study was undertaken in the four villages selected for Rapid Rural Appraisal. Only Mugad has its own Gram Panchayat, but Kotur is combined with Singalli, while Devargudihal is part of Rayanal Gram Panchayat; Hale Gabbur was incorporated into the Hubli-Dharwad Municipal Corporation 25 years ago and so has no Gram Panchayat. Mugad has 11 members (4 from the General category, 2 Scheduled Castes, 1 Scheduled Tribes, and 4 from the Lower Income Groups), Kotur sends 6 members to its Gram Panchayat (4 General, including 1 woman, 2 Lower income, including 1 woman, 2 Scheduled Castes, including 1 woman, and 1 Scheduled Tribes). Devargudihal sends 3 members to the Rayanal Gram Panchayat (2 General, including 1 woman, and 1 Scheduled Castes). Hale Gabbur is part of a large ward of the Municipal Corporation.

The findings on the amenities and facilities provided in each of these four villages are summarised in Table 8.1. Hale Gabbur stands out as having poorer facilities than the three villages with Gram Panchayats - piped water is provided by the Corporation but there are few individual connections due to expense and high water charges, drainage facilities are described as poor, and there are few septic tanks. The Corporation builds and maintains new roads, but there are only mud roads within the village. There is no janata housing colony in the village. All taxes are at the urban rate, and electricity and water charges are also at the urban rate. There are health problems due to the use of drainage water for cultivation, and visits have to be made for health check-ups at the municipal hospital. Veterinary doctors are not available in the village. It was claimed that it is one of the most neglected villages in Hubli Taluk, and the corporator of the ward (the elected member of the Corporation representing them) hardly visits the village to solve their problems.

Table 8.1 Summary of Facilities in the four RRA Villages, 1.997, in the Hubli-Dharwad City Region

	Mugad	Kotur	Devargudihal	Hale Gabbur
Population	4,181	3,145	980	2,000
Village Area	1,311.07 ha	1,666.81 ha	1,063.68 ha	1,087.4 ha
Common land	42 acres (3 kin away)	30 acres (2 km away)	90 acres (1 km away)	3 acres (nearby)
Water	2 borewells 20 communal standpoints 110 individual connections	1 borewell 40 communal standpoints; 55 individual connections	1 borewell 7 communal standpoints 6 individual connections (new)	HDMC piped 3 communal standpoints; 25 individual connections
Drainage	10% connected	Poor	None	Poor
Latrines	45 septic tanks - GP dumps solid waste 0.5 km away	60-70 septic tanks (subsidized by TP)	3 latrines	4 septic tanks
Electricity	90% houses 84 street lights	96% 75 street lights	80% 20 street lights	100% (almost) 13 *street* lights
Bus *services*	Good (1 per hour) Rs.2.50 to Dharwad	Poor (1 per 2 hours) Rs.3.50 to Dharwad	Fair (1 per 1.5 hours except afternoons) Ps.2.50 to Dharwad	Poor (2 buses only morning, evening) Rs.1.50 to Hubli
Telephones	4 public 35 private	No public 10 private	No public 9 private	None
Janata blousing	140 houses *on 3.5 acres*	300 houses *on 2 acres*	38 houses on c. I acre	None
Anganawadi	Started 1975	Started 1977	Started 1978 (no building)	Started 1993
Adult Education	199012 only	1982191 only	199415 only	1989190 only
Library	Started 1994	Yes	None	None
Meeting place	Sanaj Mandir (SCs) Parties	None (Temple used)	None (School used)	None (Temple used)

All villages have good access to electricity, although some provide a better coverage of street lighting than others. Differences also exist among them on the number of Janata houses provided. Drinking water supplies appear sufficient in all villages, apart from during

the dry season. The costs for individual connections vary according to the distance from main pipes in the different villages, and some villages charge deposits or water charges at higher rates than others. The scheme in Devargudihal is new, however, which accounts for the small number of individual connections. Drainage is generally poor: about 10% of houses in Mugad appear to be the only ones connected to a public drainage scheme. Individual septic tank latrines are relatively rare since the taluk contribution for their construction requires a substantial individual contribution for the building and maintenance expenses. In Mugad, the Gram Panchayat collects and dumps the solid waste from these septic tanks at a site 0.5 km from the village, and farmers then take this waste to the fields; in Kotur the drainage channels are cleaned before the rainy season and some farmers take this material from the waste dump to their fields. In almost all cases the roads within the villages are mud, the sole exception being the tar roads in the janata housing areas in Mugad. The amounts of common land available, whether in small pockets or in a block, also show substantial variations between the four villages.

On the whole these villages do not appear to have close contacts or links with technical officers from the taluk or zilla panchayats: Mugad has a veterinary hospital, and a veterinary doctor is present in Kotur, but the only other service related to renewable natural resource use which was mentioned were the visits by the Agricultural Assistant (seasonal guidance in Mugad, every two months in Devargudihal or Hale Gabbur), or the limited help on aquaculture given by the fisheries department to the traditional fishing community at Mugad. The Forestry Department also has a limited involvement: there are no forests around Mugad or near Hale Gabbur in the city, and the forests 3 km from Kotur grow mainly eucalyptus species, but village children are allowed to collect wild fruits in the forest at Devargudihal.

None of these four villages make use of a village plan, which limits their involvement in land use planning. The only village with a relatively recent village plan is Mugad; this map, at a scale of 1: 7920, was prepared by the Land Records Office, Bangalore, and the Gram Panchayat looks after it, and the Agriculture Assistant makes use of it. In Kotur, the village plan prepared before Independence has been misplaced and is obviously not used. The Devargudihal village plan, also prepared before Independence, has not been updated. The Hale Gabbur village plan, prepared during the same period, is not updated, but the Revenue Department are reported to make use of it still, even though the Corporation now takes decisions about the planning of facilities.

Non-governmental organisations do not appear to be active in any of the four villages sampled for more detailed analyses. Mugad and Kotur have farmers' co-operative societies. The organisations which are active in all four villages are womens groups, youth groups and bhajana mandals: each village has a womens group and Mugad has two groups; all four had youth groups, although Kotur has four youth groups and Mugad has two groups. Kotur has 5 bhajana mandals and there is one each in Devargudihal and Hale Gabbur, although there are none present in Mugad. Mugad, however, has various trade societies, including a potters society, fishers society, basket makers society and a milk producers society.

Villagers in focus group discussions were only satisfied with the representation and leadership in Mugad. In Kotur they wanted the number of representatives to be increased, and they were not happy with the leadership provided by the Secretary of the Gram Panchayat, a government appointed employee. They were not satisfied with the representation or with the leadership in Devargudihal. The most vocal criticisms, however, were provided in Hale Gabbur, which has no Gram Panchayat since it is now part of Hubli-Dharwad Municipal Corporation area. Villagers were most unhappy indeed with the absorption of the village into the Municipality, and felt that their problems were not being addressed and they received little interest from their elected representative.

8.3.3 Experiences of peri-urban villagers absorbed into the city

A special study was commissioned into the reactions of other villages which had been incorporated into the Hubli-Dharwad Municipal Corporation. Village focus group discussions were carried out in 13 selected suburbs which had previously been under the jurisdiction of a gram panchayat. Three were absorbed because they are close to the route of the proposed new by-pass (Itagatti, Jogayallapur and Nuggikeri in Dharwad Taluk), three were incorporated into the Hubli-Dharwad Municipal Corporation in 1962 as they were contiguous to Hubli and Dharwad (Sutagatti, Amargol and Sattur in Hubli Taluk), Yattinagudda in Dharwad Taluk had land taken for the University of Agricultural Sciences, and Keligeri (Dharwad), Tarihal, Rayapur, Gamanagatti and Tadasinakoppa (Hubli) were required for industrial areas. The functions of the Grain Panchayat were never replaced by effective municipal institutions, even though the Corporation now performs the functions of birth and death registration, health and hygiene, immunisation, vaccination, schooling, water supply, drainage and cleaning. Water supplies were felt to be unsatisfactory, and villagers were very unhappy with the cleaning work by the Corporation. In most of these suburbs the corporation employees were referred to as `bad workers', because they do not give attention to development activities such as road construction, street lighting, water supply, drainage, health and hygiene. A general feeling of ui-d2appiness was also expressed over their elected representative's non-availability and lack of attention to village works, as well as corruption. Over 60% of the villagers felt that they want some ward-level organisations or associations such as citizens' forums or societies to assist in the development of their villages.

There were misgivings about the role of political parties in the villages, previously hidden or absent in the former Gram Panchayat. Villagers felt that there were too many parties and these generated unnecessary competition and divided the villagers along party lines which even affected their social and domestic lives. Although there are now some elected women representatives from the lower castes, over 80% of the ward leaders are still members of the higher castes and 18% are from the lower castes, but only 2% of them are women. Most of them are high-school educated and belong to big land-owning or business categories.

None of the villagers had pushed for incorporation of their area into the Corporation and were unhappy about the decision of the government. The gram panchayat consisted of villagers, who were very accessible, and the officials were available and

accountable to them. The Corporation, on the other hand, is perceived as a remote, unknown, corrupt, unconcerned organisation, more interested in making money than addressing villagers' needs. It was referred to as "land-grabbing" and almost all the villagers expressed unhappiness over the tax. rates, asserting that there was a big difference between the tax systems of the Gram Panchayat and the Corporation. Incorporation also meant that they lost access to funds and agricultural subsidies under various Government schemes meant for rural/village development. Most of the people in these peri- urban areas, if given a choice, would prefer to return to the rural self - governing institutions.

8.4 Village land records

Information is available on each individual plot of land within a village (Khuntia et al. in Aziz and Krishna, 1997). These land records are based on the surveys undertaken during 1840-1863 in the Bombay Presidency area, which have been periodically updated every 30 years. The Revenue Department and the Survey, Settlement and Land Records Department are jointly responsible for the maintenance of these records, but the Village Accountant plays an important role in handling the land records. The most important of these documents, which are hand-written in Kannada, are:

Record of Rights, Tenancy and Crop Inspection (RTC), which contains particulars on the survey number, area, name of owner(s), rate of assessment, soil type, sources of irrigation, number and types of trees, tenancy details (if any), and the area sown for each crop, together with the estimated production level. The original is retained by the Village Accountant, and constitutes proof of ownership, with a duplicate held at the taluk office. Crop particulars are written every season in the RTC so the entire sheet is changed periodically, generally every 5 years.

Village Map which delineates different survey numbers, and is particularly important in resolving boundary disputes. This document is maintained by the Survey, Settlement and Land Records Department.

Khata Register, a ledger showing the amounts of land revenue, cess, water rates and other government dues paid in each year for all the plot numbers owned by each cultivator. The Village Accountant maintains these records.

Akarband Record, shows the extent, type and land revenue assessment for each survey number in the village. The Village Accountant keeps a copy of the original held by the Survey, Settlement and Land Records Department, in order to cross-check the accuracy of the RTC form.

Mutation Register, shows any changes in land ownership through sale, inheritence, gift, partition, mortgage, etc. Proposed transactions are recorded by the Village Accountant who puts up a public notice and serves notices to interested parties, asking for objections to be lodged within 30 days. If the Revenue Inspector is satisfied that there are no objections and the change is genuine, the change is certified. The Village

Accountant changes the RTC and notifies the taluk office for amendment of the duplicate RTC; when subdivisions occur, the Survey, Settlement and Land Records Department makes the necessary changes to the village map.

Certified copies of the RTC are made available to landowners when requested, but criticisms of the land record procedures have been made. Copies are not always issued promptly, particularly when Village Accountants live elsewhere and only make occasional visits to the village and the copies are not always accurate or legible. The use of handwritten, manual records does not readily lend itself to improved analysis and management at the village or taluk levels. The creation of computer records on land holdings would enable accurate and legible copies to be provided very quickly to landowners, and the resultant computer files would enable the rapid identification and analysis of trends to be made by policymakers at the village, taluk and city region or district scales. Research and practical planning or environmental management activities would be strengthened.

8.5 Conclusions

While planners are clearly not the only stakeholders concerned with the development of the per)-urban interface of Hubli-Dharwad, they are in a position to assist in the future co-ordination of the sectoral policymakers in the various departments at the different levels of government involved in the city region, and to actively involve community groups, non-governmental organisations and other bodies.

Planning in the Hubli-Dharwad area is currently divided between HDUDA and DZP. Each operates under a different interpretation of planning, however. The HDUDA is concerned with physical or town and country planning; its priority is to engage in forward planning, leaving the HDMC responsible for the implementation of these plans, although the HDUDA can also engage in enforcement of these plans. In contrast the DZP is concerned with socio-economic planning and has virtually no concern with land-use decision-making or physical planning. There appears to be no attempt to engage in strategic spatial planning or to develop settlement planning for the parts of the district beyond the HDUDA. The Village Development Committees of the Gram Panchayat are also concerned with socio-economic planning and the allocation of resources to specific projects. Again, there appears to be little attempt to engage in physical or land-use planning.

Given these contrasting approaches to planning, it is not surprising that regional planning is neglected, though some strategic, long-term, broad-brush approach appears essential to form a framework within which these land-use or socio-economic plans could operate. The situation may change once the proposed Joint Planning Board is operating. However, this body may focus on controlling housing allocations in the villages surrounding the HDUDA. This may perhaps help to check the leapfrogging of housing beyond the HDUDA's green belt, but it may be no more successful at checking the emergence of unauthorised housing colonies in these areas than the HDUDA has been in areas under the jurisdiction.

What is clear is that the present planning systems lack effective means of co-ordination. Spatial allocations of infrastructure facilities or services do not necessarily go to those areas of greatest need or which are distant from reasonable access to services in neighbouring areas. Problems arise from the limited inter-institutional co-ordination between the urban-based, medium-term, physical planning approach of the HDUDA and the rural-based, short-term, socio-economic and non-spatial planning approach of the DZP. In addition, each sector or department in both institutions engage in sectoral decision-making and there is a danger that spending priorities may conflict. The lack of data and absence of a more analytical approach to planning adds to the deficiencies of the planning approaches of the two organisations.

The lack of co-ordination between HDUDA and DZP is reflected in the lack of institutional capacity to adequately address the needs of the villages which have been incorporated into the HDMC's area. Once villages become part of HDMC's responsibility, the villagers appear to feel that decision-making is distant from their concerns and that the officers are not as approachable as they were under the gram panchayat system. There may be specific issues regarding the needs of certain groups within the villages that are neglected due to the distancing of decision-making.

8.6 Researchable issues

A number of deficiencies of the planning approaches of the HDUDA and DZP have been noted above. Several researchable themes emerge from the discussion:

The role of the proposed new Joint Planning Board. Research on how to better understand and address environmental issues and the use of renewable natural resources would assist in the activities of the Board. There is also a role for providing research support and policy advice to the Board from the findings of future research on the PUI of Hubli-Dharwad.

2. Exploration of alternative options for institutional mechanisms for incorporated villages, so that more specific needs can be better addressed.

3. There is scope for working with planners of both the HDUDA and the DZP to generate greater understanding of change in peri-urban areas, and to respond to such change.

9. RESEARCH DIRECTIONS

The philosophy of the DFID Natural Resources Research Programme is that it should be demand led. An attempt was made to focus on the problems and needs of development organisations and communities in the peri-urban area through interviews and participatory exercises conducted together with NGOs. These helped to identify the following information gaps, problems and researchable issues.

9.1 Key Natural Resource Indicators

The creation and subsequent institutional ownership and maintenance of a set of natural resource indicators for the peri-urban interface of Hubli-Dharwad should draw on the natural resources profile developed in Section 2 of this report. A potential institutional home for such a set of indicators could be the new Joint Planning Board, set up to co-ordinate areas of planning between the Hubli-Dharwad Urban Development Authority and the 7111a Panchayat. However, there would be a need for more widespread institutional involvement and ownership of the indicators as natural resource use and management falls within the responsibilities of many different institutions. A further option would be within Karnatak University, or the District Statistics Office, with the involvement of other stakeholders, who could perhaps sponsor such a project. Mechanisms for developing inter-institutional co-ordination, for example, forums which could include NGOs and representatives of the private sector and local communities, would strengthen the effectiveness of the indicators.

From Section 2, a number of potential categories of natural resource indicators relevant to the Hubli-Dharwad city-region can be identified. These are s h o ʳn in Table 9.1.

Table 9.1 Potential Natural Resource Indicators

Category	Indicator
Farming systems	• move towards less labour demanding craps • rate of change of cropping systems • utilisation of artificial inputs
Land	+ pressure on land, e.g. hectares per household • land values • land sales • land ownership/tenure • agricultural productivity
Timber and fuelwood	• tree cover • fuelwood prices
Energy sources	• renewable energy sources • energy prices
Waste and pollution	• pollution incidents • sales of municipal waste
Water	• quantity - available for drinking water and irrigation, from different sources • quality • price

9.2 Information gaps

Table 9.2 below illustrates the kind of natural resource information gaps identified in the studies of the institutions studied.

Table 9.2 Information needs of institutions with NR responsibilities

Institution	Information needs
HDMC	• alternative sewage treatment options • effects of not treating sewage on human health and the environment • impact of dumpsites on groundwater • alternative management methods for dumpsites • lack of detailed information on waste generation role of pigs in local economy
KSPCB	• interaction between pollution, natural resources and productivity in the PUI
HDUDA	• interactions between physical and economic planning
KUWSD	o condition and quantity of water bodies
Zilla and taluka panchayats	• mechanisms to improve co-ordination and information sharing between authorities • quantity of common property resources left, how they are used and by whom
District Planning Board	• growth of villages compared to growth of the city and mechanisms for responding to such growth
Forestry Dept.	• effects of peri-urban expansion on the forest fringe
UAS and other natural resource researchers	• information about likely impacts on organisation of production, demand for labour and wages of technical innovations • information about real constraints faced by peri-urban farmers • information about the impact of agricultural trends on natural resources e.g. on land, soils, water, air

These information gaps should be linked to the development of natural resource indicators, so that future research contributes to a greater understanding of natural resource degradation and use within the peri-urban interface, and the consequences for productivity.

9.3 Research needs of particular communities

Table 9.3 shows the types of research needs identified during the participatory exercises conducted in four villages of the city-region. Details of the exercises can be found in Chapter 4.

Table 9.3 Research needs identified in RRA exercises

Community	Problems identified	Researchable issues
Gabbur	1. heavy infestation of weeds and insect pests in sewage irrigated land, leading to intensive use of chemical pesticides 2. village panebayat yet to be established 3. shortage of drinking water and electricity	• alternative sources of irrigation water • treatment of wastewater • environmentally sustainable strategy to address weed and pest problems • assessment of institutional arrangements in the peri-urban interface . assessment of availability of water resources • scope for developing more decentralised electricity generation
Kotur	4. Tanks need to be repaired 5. Some labour shortages in agriculture 6. Seeds not available when needed 7. Fertilizers	• condition and number of tanks in city-region in relation to need • operation of labour markets
Devaragudihal	S. Access to APMC - no direct road 9. Shortage of labourers during harvesting of groundnuts 10. Shortage of electricity	• assessment of labour market • potential for more mechanisation • scope for developing more decentralised electricity generation
Mugad	11. Labour availability 12. Finance 13. Electricity shortages 14. Costs of inputs to agriculture	• assessment of labour market • potential for more mechanisation • credit schemes • scope for developing more decentralised electricity generation • alternative schemes for buying inputs

The table shows that a number of research priorities were identified through the exercises, most of them particularly pertaining to the purposes of the PUI Production System Research. These include:

- addressing problems relating to the use of wastewater from the urban areas for irrigating crops;
- assessing the development of institutional arrangements within a dynamic peri-urban system;

• the potential for addressing electricity shortages through the development of more decentralised production; and,
• the need to gain a greater understanding of changes in the labour markets, the implications of them and potential responses.

9.4 Research priorities identified at the workshop

A large number of researchable issues were identified at the workshop. Some sifting was done using a set of criteria (see below). Table 10.3 identifies the researchable issues which seem most appropriate to given the criteria used. Issues which were not researchable, where the benefits of research would be too long term or doubtful, issues which were not specifically per-urban in character have been excluded.

Table 9.3 Research priorities identified at the July Workshop

Field	*Priorities identified**
Farming Systems	Reported low soil fertility Moisture conservation, including use of waste water Weeds and pests in wastewater systems Poorly articulated labour market (high wage disparities, labour scarcities) Local marketing of key products e.g. mango, milk, vegetables
Energy	Survey scarce waste material available for decentralised power generation Scope for community biogas for power generation
Waste	Health and environmental problems (weed and pest incidence) due to waste water use for vegetable production Alternative uses of urban waste (including pig manure and human septic tank nightsoil) (characterisation of wastes, identification of demand) Decline of municipal compost auction system
Environmental Management	Peri-urban Institutional Vacuum

*Not in any order of priority

There is a clear overlap here between the farming systems identification of soil fertility as a researchable issue and the availability of underused urban waste. The basic energy issues are either dependent on change in subsidy policy, or capable of being included in a farming systems study. Other researchable issues identified in the chapters in Section 2 of the report interlink with the issues in Table 9.3, for example pollution and water resource concerns interact with institutional arrangements for environmental management.

Many other research ideas were discussed in Section 2 of this report. These include:

Poverty issues
- increasing female participation in low wage farm employment, due to uptake of more urban work by males;
- identifying coping strategies adopted by farmers to compensate for the loss of their farmland when it is sold or when family labour is lost due to a shift to non-farm activities or out-migration;
- small farmers' marketing opportunities and access to labour;
- wage differentials.

Remote sensing and GI.S
- strengthening local capacity for GIS capabilities;
- application of remote sensing techniques to research on the effective use of environmental information for natural resource management in the Hubli-Dharwad peri-urban interface.

Institutional vacuum
- mechanisms to improve co-ordination of planning strategies between the Zilla Panchayat and the Hubli-Dharwad Urban Development Authority through the proposed Joint Planning Board;
- analysis of institutional arrangements necessary for the development of environmental management plans, including the involvement of all stakeholders.

9.5 Criteria for selection of priorities

The criteria used in the workshop to select key researchable issues (mainly in the field of energy) were the need for:

- long term relevance;
- a positive impact on a large population deserving help;
- potential to be self-sustaining;
- potential to help women;
- socially acceptable; and,
- within manageable financial limits.[1]

Another list of criteria was presented to the workshop in the workshop overview paper (Shepherd, 1997):

- urgency: the problem should be seen as urgent by those concerned
- the knowledge generated by research should clearly fill a gap
- users' demand for the results: there is clear, articulated demand for the results of research

[1]This list was presented by Professor. M.S. Subhas, Karnatak University

- priority: policy-makers and researchers see the project as a high priority for them
- degree of fit with PUI programme objectives: the project should fit well with PUI goal and purposes
- in particular, the research should have a strong peri-urban element
- feasibility within the period: the research proposal should be researchable within the period, with results available to users by the end of the period.

In preparing the next phase of the research programme, some additional criteria have inevitably been applied:

- the research proposed should not repeat work already done elsewhere
- the research proposed may be more easily funded through another programme.

9.6 Research recommendations

The recommendations are broadly for two research projects. The first focuses on the potential fruitful interactions between farmers' demand for soil ameliorants and the need to dispose of urban organic wastes safely. This brings together the incompletely identified demand for increased soil fertility (so far identified by UAS scientists, but which needs to be firmly established and disaggregated with different categories of farmers) with the identified potential for processing urban solid waste as fertiliser.

The research would aim to provide a framework for marrying the needs of both the farmers and the municipality. The present situation of selling the waste to the farmers is proving inadequate, partly due to increasing contamination of urban waste by plastics. Other factors need to be clearly identified and understood. Recommendations on strategies to improve the segregation of waste, composting methods and the marketing of composts should result from the research.

The second focuses on the development of a model of peri-urban agrarian and natural resource change to feed into decisions about resource allocation for technical research, policy support for market development and to the development of institutions and processes for environmental management. The public understanding of the nature of the peri-urban interface is weak: this understanding needs to be strengthened and mechanisms for disseminating the understanding to policy makers found before more appropriate resource allocation, policy and environmental management strategies can be designed.

As this research proceeds, results would need to be fed into policy makers' fora. Gradually, the research output would begin to have an impact on key decisions about the management of the peri-urban interface. The ultimate result would be to sensitise decision makers to the specifics of the peri-urban interface and to advocate the development of activities, processes and institutions which specifically take it into account.

Table 9.4 Potential research projects

Research Project	Potential source of funds
Urban waste and soil fertility: techniques and systems to improve the utilisation of urban waste by near-urban farmers	Peri-urban Interface Programme
Reduction of crop losses due to pests and weeds, particularly on crops irrigated by waste water	Crop Protection Programme
Institutional development for environmental management	ESCOR

9.7 Conclusion

Preliminary analysis of the information collected during 1997 suggests that there are a number of researchable problems with a short pay-off period. The most obvious of these is the question of whether alternative systems and techniques for processing urban wastes can be harnessed to reduce the soil fertility constraint identified in peri-urban agriculture. Other short term farming system improvements which may be researched include the management problems of peri-urban farms using untreated sewage water and the "problem" of urban piggeries.

It may be that the most significant research will be done in the medium-longer term on issues which are at present not clearly enough perceived: the rapid and seemingly irreversible erosion of knowledge about natural resource management; the substitution of integrated pest management for toxic agro-chemicals in field horticulture; the development of new peri-urban institutional arrangements for managing development and natural resources; the development of strategies which permit higher wages and the conservation of small scale peasant farming; and, the search for appropriate modalities for *local* market development. Although researchers will initially be addressing issues with shorter time horizons, the short term research should as far as possible retain space for consideration of these significant and specifically peri-urban issues.

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