Natural Resources and their Management in Deogad Block: Trends, Possibilities, and Lessons

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Preface and Acknowledgements

The Resources and Livelihoods (ReLi) Group of Prayas has been working on providing 'theoretical' support to various organizations working at the grassroots level in Konkan region. But its work has mainly been concentrated in the northern part of the region. 'Gramodaya Prathisthan' which is active in the southern part of the Konkan region approached ReLi with a specific request for support.

The Zilla Parishad (ZP) of the Sindhudurg during the past few years initiated some innovative projects for water harvesting and management. This initiative included modernizing traditional structures, and also reviving and rebuilding some old tanks and other structures. The President / Secretary of Gramadoya Prathisthan (GP), Shri Madhav Bhandari, was associated with this initiative. In November 2000, GP invited the ReLi Group of Prayas to undertake a study of the impact of this initiative in the water resources sector.

After initial discussions, GP also requested ReLi Group to conduct a rapid assessment of the natural resource situation in the Deogad Block where GP is planning to undertake comprehensive activities. Researchers from the ReLi Group made two field visits to Deogad block and visited a number of sites of physical works recently undertaken for water harvesting. They also held meetings and discussions with villagers and government officials. Data and information gathered through the field visits was supplemented by secondary data collection. GP extended full co-operation in the fieldwork and also helped in the drafting of the study report.

On behalf of the ReLi Group, we are glad to present this report to a wider audience for discussion and debate. We have tried to highlight the major problems related to natural resource management in the Block, especially related to the water resources in the block. We have also tried to discuss some strategies to address these problems. It is hoped that further work will be done on these strategies as part of the efforts to usher in equitable and sustainable NRM practices in order to simultaneously ensure economic prosperity and ecological stability in the block.

On behalf of the ReLi Group, we thank all persons and organizations who have offered their co-operation in conducting this study. This includes members of GP, staff of Sindhudurg Zilla Parishad, and the local villagers.

Members of the ReLi Group, Prayas, Pune

SECTION I: INTRODUCTION

1. Background

As humankind steps into the twenty first century, the debate on sustainable development and poverty, which has emerged on a global scale in the last two decades of the twentieth century, has now reached a crucial juncture. While, on the one hand the proponents of sustainable development are still at loss in evolving a broad consensual understanding and approach to sustainable development, the detractors too seem to be equally confused, as compelling evidences of environmental degradation and increasing levels of poverty and deprivation come to the fore with every passing day. Thus, even after two decades of intense social action and much academic inquiry, it appears that humankind has still a long way to go until some convergence about the notion of sustainable development among the masses, leaders, and thinkers emerges. While we await this to happen, conflicts between the sections of the society who are ‘beneficiaries’ from the 'dominant' development approach and those who are 'victims' are accentuating leading to increasing social and political strife. This strife is most evident in the rural areas. Even today, the majority of the global population resides in the rural areas, and they continue to depend on natural resources, such as land, water, and forests for the fulfillment of their livelihoods needs. However, with the rapid degradation of these precious natural resources, due to a multitude of factors such as industrialization, urbanization, and rapidly increasing chemical intensive mono-crop agriculture. This degradation of the natural resources has resulted in threatening / destroying the livelihoods of the rural masses, especially the poor. The rural hinterland is now therefore turning into a theatre of intense human misery, which is leading to different kinds of struggles.

This struggle is intensifying not only for political and economic reasons, but also because the human mis-doings against nature, especially through a series of destructive agricultural practices. The impact of these practices has now reached such epic proportions that nature seems to have overcome its capacity of bear the burden of our mis-doings and is now responding in her own way. Sometimes the response is disastrous leading to immediate loss of human life and property (as in the case of floods, epidemics etc), but often the response is slow and hidden. The destruction of forests for agriculture, over-exploitation of water and ‘chemicalization’ of nature has reached dangerous proportions. How to revert this series of un-sustainable practices and move towards harmony and sustainability is the question, which the present and the coming generations have to address with sincere earnest, in the interests of the ‘greater common good’.

The following is a study of a small area of about ninety villages, called a ‘block’ of 'taluka', in administrative parlance of the Government of India. The block studied, is called 'Deogad', and is located in Sindhudurg district, in the State of Maharashtra. This study of Deogad block, which documents the growing unsustainable Natural Resources Management (NRM) practices and its effect on nature and human is located in the larger context discussed above. The negative impacts of the green revolution have been well studied and documented. This study shows that it is not just specific ‘Green Revolution’ packages that disturb the nature-human relationship through modern agriculture, but there are many other economic and social forces, which cumulatively impact upon the agrarian society, which tends to promote forms of agriculture, which can lead to irreversible ecological damage. These damages could prove to be the harbinger for a more pervasive disruption of the social and human lives. These economic and social forces which are beyond the control of the rural society often impact it in so many 'hidden' ways that, measures to remedy their negative effects do not find space and scope in state policies and intervention. This is because these 'hidden forces' impact the weak and vulnerable sections of the society the most and these sections do not have sufficient political voice to influence state policies. State policies are often driven by political choices, which are mediated through popular demands voiced by the economically and politically better off.

While the paper tries to look at these negative aspects of the development process, it also tries to locate, analyze, and understand the ways and means through which these negative impacts can be overcome - the future "rays of hope". These ways and means are not necessarily 'packages' of technology and information, rather they are lessons from the past, especially about traditional ways of managing resources, which complemented with insights from the contemporary research, and appropriately contextualized could help us to develop a perspective for sustainable development. While this alternative perspective to the present 'dominant' one is very much rooted in the realities and contradictions of 'today', it tries to look beyond, for a better 'tomorrow'

2. Objectives and Methodology of the Study

The study had three objectives, namely:

1. To study the impact of newly created / rejuvenated water harvesting structures.
2. To prepare a discussion paper for wider consultation on resources and livelihoods issues in the taluka.

3. To learn from the grassroots situation to inform the process of articulation of a ‘Sustainable Livelihoods Perspective’.
4. To server as a precursor to a possible more detailed study on resources and livelihoods issues.

The present study was initiated with an immediate objective of investigating the impact of the intervention for water harvesting undertaken in the past two to three years with the specific objective of increasing ground water recharge. However, during the initial stages of the study, many broader issues related to water but within the realm of NRM came to the fore. Therefore, the researchers in consultation with the local organization decided to resist the temptation of undertaking a quantitative investigation of the socio-economic impact of the new water harvesting structures in the command areas. Thus, instead of limiting the scope of the study, it was thought that it would be more beneficial and insightful to probe and understand the broader issues related to NRM. Hence, a study on NRM, especially focusing on the social and ecological concerns of the current approaches, and then locating the understanding thereby gained in the context of the larger debate on developing sustainable development strategies, was thought as the most appropriate course for the study.

This, it was felt would also contribute to another related aim of the study, which was to understand the inter-linkages between water management and other NRM practices in the block, and its effect on the local economy and ecology. This approach would therefore contribute to the fulfillment of the second and the third objectives of the study. Therefore, many of the generic issues discussed in this paper have already been highlighted in various literatures on sustainable development. In this paper, we have tired to locate these issues in the given context, without probing their conceptual and theoretical roots. The idea therefore is that this document should be used as starting point for a wider discussion and consultation on some of the key issues related to natural resource management and livelihoods in the specific context at hand.

As regards the fourth objective the methodology adopted in the study has helped us to give crucial inputs to designing a methodology for investigating livelihoods situation at the household level. This design has been presented in a separate paper. A broad study like this would be helpful in delineating some of the key issues that need to be investigated at the household level with respect to the resources and livelihoods situation. The generic methodology could then be adapted and applied in the specific context, with such a broad understanding of the context as an effective background.

The study began with preliminary discussions between members of ReLi and GP. This was followed by a field visit in December 2000 for a period of seven days to Deogad block. In this field visit, the investigators visited about twenty different sites and met the local officials. In the second field visit in February 2001, for another seven days the focus of investigation was not only on water related issues, but also to understand the agricultural practices being practiced in the area and the status of the environment especially in the hill slopes and other uncultivated areas. In this visit, data, information, and views and opinions relating to the above areas were sought from different stakeholders such as local village communities, politicians, and government officials. The data and information gathered from the field visits were supplemented with secondary data, obtained from official government reports such as the District Statistical Abstract, the Census data, and other Departmental Reports.

This paper is divided into four sections. The first section gives a brief background to the study, discusses the objectives and methodologies of the study, and gives an overview of the geographical area of the study. The second section deals with the natural resource situation of the block. It discusses the various issues, which came up while analyzing the secondary data, information obtained from interviews, and the observations made by the researchers during the field visits. All the issues raised and observations noted are not substantiated by quantitative data, since often-such data is not available or the available data appeared to be un-reliable. Though this impedes the process of gauging the magnitude of the problems presented, it does not imply that the issues raised and problems presented are trivial or localized. In fact only those issues are discussed which seem to have a wider spread and appreciable intensity. These issues were reflected in the interactions with the people and officials and were expressed explicitly.

The third section is devoted to the study of water management approaches. The distinctive topographical and geological features of the region make exacting demands on the water management approaches and techniques. This situation has therefore given rise to a variety of techniques for water conservation, harvesting, and storage. Though the present study has not been able to undertake a very detailed and exhaustive analysis of all the techniques encompassing all its technical and operational aspects, an attempt is made to present a comparative picture of the major techniques, using data and information at our disposal. However, the abstinence from engaging in the technical aspects of water-management is deliberate, with the intention to focus attention on other substantive aspects, especially the

social and ecological aspects, which for too long have been neglected in the mainstream discourse on water and irrigation management.

The fourth section analyzes the findings presented in section two and three. Also a discussion on possible approaches and strategies for future course of action especially for developing sustainable approaches to NRM and development is taken up. The paper concludes that even in the existing situation, which is rapidly deteriorating, if concerted efforts are made to save the environment and move towards sustainable NRM policies and practice, then a new beginning could be made towards ushering in a sustainable development strategy in the context of the Deogad block. The section end with a small comment on what are the learning the study has given, especially based on the prevailing situation at the grassroots, for developing and articulating the 'Sustainable Livelihoods Perspective', which is being undertaken by the ReLi team as a separate task.

3. The Data Base and its Limitations

Before we proceed to present an analysis of the data, some qualifications regarding the nature and accuracy of the data need to be furnished. The land-use and agricultural data presented here has been extracted from the District Statistical Abstract (DSA). The data in the DSA is complied by the District Statistical Officer (DSO). The DSO obtains this data from the respective functional ("line") departments in the Zilla Parishad (ZP). The DSO obtains data on land-use and agriculture from the revenue and agriculture department. The officials of these departments in turn collect data from the village level officers. The village level revenue officer is called the 'talathi'. Since the 'talathi' is entrusted with the task of both maintaining revenue records and also revenue collection with a jurisdiction of approximately three to four villages, he is not able to compile land-use and cropping data through a detailed physical survey every year. Hence, he mostly relies on past data and his general observations about the area, coupled with feed back from farmers. However, in compiling the data in this manner, only major shifts and changes are noted. It is generally observed by senior officers and experts that the accuracy of this data is suspect and hence the analysis and interpretation of this data has to done cautiously. In our present analysis, some visible discrepancies were observed in the data. One way of overcoming this deficiency was to take at large time-series and then discerns the trend, instead of attempting rigorous quantitative analysis of the data. This is what we have attempted in this study. We have tried to present the available data in a coherent and graphical form. In these graphs, the linear trend lines have been plotted which help in understanding the behavior of the variable over a time period of about 35 years, from 1962-63 to 1997-98.

In spite of these limitations in the data, we have tried to search for meaningful interpretations for the trends observed and co-relate them with other data sets and field observations. Hence, it is necessary to qualify at this juncture that these interpretations and the understanding developed there-upon are not complete. There are many gaps both in the data and observations. Obviously, filling these gaps would require more information and also primary data collection through extensive fieldwork. However, given the limitations of time and resources available for the study, we have tried to build a broad picture of the natural resource situation in Deogad taluka and there from develop a perspective from which the past developments and future strategies could be understood and analyzed.

4. The Research Area

The Konkan Region

The Konkan region has a unique topography. The range of mountains forming the Western Ghats (mountain ranges) lines it on its eastern boundary, while the coast of the Arabian Sea forms its western boundary. The hill spurs originating from Western Ghats and spreading towards west, covers the major part of the Konkan with little room for the plains. Konkan is bestowed with evergreen and deciduous forests on its hill slopes and also with coastal and estuarine vegetation in the creek shores and seashores.

Konkan gets the first shower of the South – West Monsoon entering Maharashtra. Due to the hilly terrain, it experiences very high yearly rainfall that extends up to 3000 mm. The rainy season is limited for four months of the year. A number of rivers originating from the Western Ghats flow at a high speed through the hilly terrain of Konkan traveling a relatively short distance before meeting the sea. This limits the formation of deposition rich delta regions. Instead there are number of brackish water estuaries all along the narrow Konkan strip. This forms the inter-tidal zone highly influenced by the tidal movements. Due to the proximity to the sea, Konkan experiences high humidity. Hilly terrain, high rainfall, high humidity, and highly influenced inter-tidal zone are all factors which contribute to the formation of highly specialized ecology and a fragile natural resource base of the region.

Sindhudurg District and Deogad Block

The Sindhudurg district is located in Konkan region of Maharashtra State. The district is located in the southern most tip of Maharashtra. Deogad taluka is located in the northwestern part of the Sindhudurg district (see map). The name of the district has been adapted from the famous sea fort of Sindhudurg built during the period of emperor Shivaji. The district has a seacoast of about 121 kilometers. Hills, valleys, and narrow river plains that fringe the coastline characterize the topography of the district. Most of the surface is hilly, but the district has some plains as compared to other districts of the region. Lateritic soil is pre-dominant, and extensive spreads of lateritic hard pans are noticed throughout the district. However, the sub-surface is highly impervious. The total annual rainfall in the district ranges from 2500 to 3000 millimeters.

The Sidhudurg district comprises of seven blocks, namely Kudal, Malwan, Deogad, Kankavli, Sawantwadi, Vengurla and Vaibhavwadi. The district is the second smallest district in the State of Maharashtra in terms of size and population. The population of the district is 8.32 lakhs (1991 census) of which 92 percent are living in rural areas. The population density is very low, i.e. 160 persons per square kilometer as compared to the state average of 257 persons per square kilometer. There are a total of 736 villages, all of which are inhabited. Most villages comprise of a number of hamlets (wadis), ranging from about one to twelve. Thus, the district is characterized with typically small and scattered habitation, which is also a feature of the entire Konkan region. The sex ratio is 1137 females per 1000 males, which is higher than the state average of 934, indicating a greater incidence of male migration. This also indicates a greater incidence of women headed households in the rural areas. Scheduled castes form about five percent of the total population. The population of scheduled tribes is less than one percent.

The economy of the district is mainly dependent on agriculture, horticulture, and marine fisheries, which engages 73 per cent of the working population. The main food crop is paddy. The district is famous for its horticultural crops, namely cashew and mango. The total area of the district is approximately five lakh hectares, of which about 40 percent area is under cultivation. Of the cultivated area, only about two percent of the land is under irrigation, mainly well and river irrigation. Sixty one percent of the main workers are cultivators and only twelve percent are agricultural laborers, the rest seventeen percent are engaged in other occupations, mainly fishery, mining, and artisan work. Most of the cultivation is in the form of small and marginal holdings. Sindhudurg does not have a major presence of industries, as is the case of the other three districts of Konkan, viz. Thane, Raigad, and Ratnagiri.

SECTION II: THE STATUS OF NATURAL RESOURCES IN DEOGAD BLOCK

1. Land Use Pattern

Deogad block is located at the northern end of the Sindhudurg district. Towards the west of Deogad is Kankavli block towards south is Malwan block, while towards north is the Rajapur block of Ratnagiri District. To the west of Deogad is the Arabian Sea. The total area of the block is approximately 77,800 hectares. The land-use data based on the six-point classification available in the DSA has been compressed into the following three broad categories for the sake of simplification in analysis, as follows:

(a) Net Sown Area: Total area sown with crops and/or orchards (counting the area sown more than once in the same year only once)
(b) Fallow Lands: Consisting of all fallow lands, i.e. both current and other fallows.
(c) Land Not Available for Cultivation: This includes cultivable waste and barren and uncultivable land.

The pattern of land utilization based on these categories for the period 1962-63 to 1997-98, i.e. a period of about forty years, is shown in Graph I (all graphs are appended at the end of the document). The graph shows that the net sown area has remained all most constant. As a percentage of the total area the net sown area has been varying from fifteen to nineteen with an average of seventeen percent. However, the trend line of the fallow land and uncultivable lands in the graph show that the fallow lands are on the increase and uncultivable lands are on the decrease.

This increase in fallow lands indicates that hill slopes, which were covered with forests, are being increasingly cleared and brought under cultivation. However, they are then not cultivated regularly and often kept fallow. Field investigations have shown that there are two major crops that farmers cultivate on the hill slopes. These are coarse grains such as millets and fruit trees such as mango and cashew. Until the late seventies, the preference was for the former. This was because as compared to developing mango orchards growing millets was easier and required less investment. There existed three to four types of different millets, and this contributed to their food-stocks. However, from the late eighties onwards the preference for coarse grains was given up, and instead farmers took to developing orchards. This was facilitated by (a) more investments being made in horticulture by remittances from migrated

members of the household and, (b) government subsides (especially from the early nineties onwards). Hence, forests have been regularly cleared to make land available, initially for agriculture and then for horticulture. Population trend shows that the increase in population is the block in not appreciable. Therefore the effect of increasing population on land is not a major factor for clearing forest land as is often the case.

Though we have not been able to confirm the practice of shifting cultivation, a practice similar in nature but of lesser intensity was being practiced. Actually instead of shifting from one site to another, the farmers preferred to keep these clear-felled lands fallow for two to three years. When the soil regained fertility they again cultivated these lands. Shifting cultivation was not possible since all the land on hill slopes and covered by forests were privately owned. Hence, while on the one hand the clear felling did not increase the net sown area in a big way it did add to the chunk of fallow lands, while small patches within this chunk being cultivated intermittently.

2. Cropping Pattern

Analysis of the data on gross cropped area (i.e. net sown area plus area sown more than once) as shown in Graph II, indicates that the acreage of crops such as paddy, pulses, oilseeds, and spices has remained fairly stable. The main pulses grown are chawali and kulith (peas) and oilseed is Groundnut. Earlier, Sesame was also cultivated but is not grown now. Groundnut is mostly grown in the late winter season.

The acreage of cereals other than paddy and other non-food crops (mainly fodder crops) has shown a drastic decline in the last thirty-five years. Though, this decline was steady till the early eighties, the decline was rapid in the post-eighties. This decline in coarse cereals and other fodder crops was compensated by the increase in acreage of horticulture crops especially mango and cashew. In this too, the increase was gradual till the eighties after which it accelerated. The growth of horticulture was particularly rapid in the nineties with the advent of government-supported scheme of subsidies for converting un-cultivable lands into plantations. This issue is discussed in further detail in section IV.

3. Food Production

The impact of this decrease in acreage of food crops is reflected in the overall food grains production in the block. The trend in food grain production is shown in Graph III. The food

grain production data shows that food grain production was fairly low, i.e. around 1.5 lakh tons in the sixties and early seventies. However, production increased in the seventies and reached up to 2.32 lakh tons in 1975-76. The composition of the food basket was however changing. Rice production was increasing and this was mainly because of the new package of inputs (mainly fertilizers and high yielding variety of seeds) that was being supplied to the farmers. Coarse grain production fell drastically in the period 1979-80 to 1980-81 and never picked up after that. The gain in food grain production was mainly due to the increase in productivity of rice. Though during the past thirty-five years the food grain production trend shows only a marginal decline, the gain in paddy has been at the cost of local millets some of which are now almost extinct and some are on the way to extinction. Since rice requires high inputs and is also more prone to pest attack, farmers say that, now even rice cultivation is becoming economically un-viable.

However, the marginal lands have now been converted to orchards and farmers cannot now supplement their rice crop with coarse grains. Also, coarse grain yields appear very low as compared to the improved rice yields and therefore farmers feel that it is not viable to go back to coarse grains. They are now in a peculiar situation, while the new crops do not appear economically viable, reverting back to old crops also does not seem to be viable. They also concede that food 'insecurity' has increased. Earlier, for a small farmer the grains he used to cultivate (consisting of both rice and coarse grains) used to suffice throughout the year, however farmer's now complain that the stocks are sufficient only for six to eight months. The increase in population could be one of the reasons for increased demand for food grains. The decrease in diversity has also increased the vulnerability of their food-security due to the sole dependence on rice.

The gain in rice production has mainly been made possible due to the increase in productivity with high external inputs. This is directly evident from the data of the yield for rice reported by the agriculture department. The trend line of the increase in the yield of rice as shown in Graph IV indicates that the productivity has almost doubled, from about 1000 kilograms per hectare to 2000 - 2500 kilograms per hectare in the past 35 years.

4. Water Resources

Deogad block can be geographically divided into four major river valleys formed by the westward flowing rivers viz.:

1. Waghotan River Valley**:** Originating from the Western Ghats, the Waghotan river flows on the boundary of Sindhudurg and Ratnagiri. The southern half of this river valley forms the northern part of Deogad Taluka.
2. Deogad River Valley**:** This river also originates in Western Ghats in the Kankavli Taluka and passes through Deogad before meeting the Arabian Sea.
3. Annapurna River Valley**:** This is a local river originating in the Kinjavade village in Deogad and flows into the Arabian Sea.
4. Achra River Valley**:** Originating from Western Ghats, the river forms the southern boundary of Deogad Taluka, sharing its water with Malwan Taluka. The northern half of the valley region lies in Deogad.

Among the four river valleys, three rivers get their input while flowing down the Western Ghats while one is a local river. Thus, there are three major and one minor estuary formed by these rivers. Besides these estuaries, considerable amount of land is flat plateau composed of thick laterite rock with exposed hard-pan. The river valleys generally are narrow. There are numerous streams that originate from the local hills and form tributaries of these rivers. These streams are locally called “Wahal” (rivulet), the network of which is spread all around the region. Due to high gradient, the water in the streams flow at a high speed during rains, thus causing excessive erosion. Normally the streambed is of pervious Latteritic rock thus making it difficult to retain water in the stream by any methods of damming it. In spite of this if the river is dammed often it is said that the cracks in the substrate get activated due to the pressure of the stored water, thus giving way for the water to seep into the ground. Hence, most of the new sites taken up for damming, where traditional water harvesting is not being practiced have not yielded much success. These and other issues relating to water management have been discussed in-depth in section III of the paper.

5. Irrigation

Canal Irrigation

There are no major irrigation projects in the block. The largest reservoir in the block is a tank constructed in 1984, in village Shirgaon. This tank is also referred to as a Minor Irrigation (M.I.) tank. The word 'minor' is used in a comparative sense, i.e. as compared to 'large' dams. Hence, in the sixties and seventies the only source of irrigation was open wells and private canals, which drew water from temporary dams constructed across the streams. Farmer’s groups constructed the private canals and they used to draw water from temporary water

harvesting structures constructed by the farmers themselves across streams and rivulets. This system (about which a detailed discussion is presented in section III) was thriving during the sixties. In the year 1970-71, about 1932 hectares of land was irrigated (i.e. about thirteen percent of gross cropped area) and approximately more than seventy percent of this was from private canals. However, a number of social and economic factors led to the decline of the traditional irrigation systems. In the subsequent years, the area under irrigation dropped to four percent of the gross cropped area. This never picked up after the seventies and the average area under irrigation in the post seventies ranged from three to seven percent.

Thus, in the pre-seventies period, the average area under irrigation was eight percent whereas in the post seventies it decreased to five percent. Data indicates that, in the recent past too the percentage area under irrigation is decreasing. This is because the gross cropped area is continuously increasing on account of increasing mango plantations and these are not considered as irrigated farming. Also the traditional water harvesting systems is rapidly collapsing and only the permanent structures created by the government now provide canal irrigation.

Well Irrigation

Well irrigation is mainly restricted to the mango plantations in the hill slopes. All the crops in the valley region, especially seasonal crops such as cereals, pulses, oilseeds, and vegetables, are irrigated mainly through canal irrigation. Hence, the decline in the total irrigation area is mainly due to the decline in canal irrigation. Though the numbers of wells in the block have increased most of these wells are classified as homestead or domestic wells. They are not recorded as irrigation wells. This is also because with the increase in mango plantations, the framers have decided to live in farmhouses located within the plantations. This has dispersed the habitat to a large extent. Hence the households now prefer to have a well near their homes for assured water supply. However, this water is used for both domestic purposes and also for the orchard.

6. Livestock

A preliminary analysis of the livestock data shows that the livestock population in the block has increased gradually. In the sixties, the livestock population declined and reached the lowest level of 39,950 (bovine) in 1971-72, the year of the severe and historic drought in Maharashtra State. However, after that, in the seventies, the population was stable. It increased

in the eighties (by about 8000), presumably due to greater penetration of new breeds and veterinary services. Similarly, the population of goat and sheep has shown a marginal increase in the nineties.

7. Human Resources

The human population in the block has increased by approximately 19,000 persons in the past thirty-five years. In the decade 1961-71, the population increased by five percent and by three and nine percent in the subsequent decades. The sex ratio shows that due to out-migration of the male population the female population is higher than the male population.

Year	1961	1971	1981	1991
Female per 1000 Males	1260	1271	1226	1124

However, the data shows that this ratio is declining in the eighties. This corroborates with the observation that there is an in-migration of males in this period, which is seen from the change in the worker population as shown below:

Year	1961	1971	1981	1991
Male Workers	20759	18921	20794	27595

In the decade 1961-71 there was out-migration, mainly by male primary workers, especially to the city of Mumbai. In the seventies, this migration was very marginal. However, in the eighties reverse migration began and picked up in the mid-eighties following the closure of textile mills in Mumbai. This contributed to the increase in the number of workers. Of this, the maximum increase is seen in cultivators who form about sixty four percent of the worker population. The increase in agricultural laborers and other workers has been marginal. However, the increase in non-agricultural workers in the eighties is mainly due to the influx of migrant laborers in the fishing, quarrying, and construction sector mainly from the State of Karnataka. The increase in agricultural laborers is due to the increased employment available in mango and cashew plantations.

SECTION III: WATER RESOURCES MANAGEMENT IN DEOGAD BLOCK

1. Approaches to Water Management

The Deogad block records a high rainfall, which lasts for about four months. Hence, maximum utilization of this rainwater is made through paddy cultivation. Much of the rainwater flows into the sea. Hence, the main challenge for the local people is to conserve and store water for the post monsoon period.

In the block, water for domestic use is available through wells. Hence, the critical question was that of water for agricultural use. In order to conserve and store water for use in the post monsoon period, the local people had devised a number of indigenous techniques. These techniques were small in scale and used local material and labor for construction of water harvesting and storage structures. Though these methods may not have been useful for creating large storage structures, they served the needs of the local people. Also, the water harvested was sufficient to irrigate the rabbi crops.

Since the lateriate rock, which mainly forms the riverbeds, is impervious water can be stored only if the river is dammed at select locations to create reservoirs. The local people have discovered such locations where the water does not percolate and can be retained throughout the year through methods of trial and error, over the generations. All the knowledge about the appropriate sites, the type of storage structures required at the site, the quantity of water that can be harvested and how the water could be collectively used has been passed down the generations through traditional means i.e. oral, observation, and also by experience.

A brief account of some of these traditional methods, which are still being practiced, is presented here. In this discussion, we have classified the entire range of water management techniques in three categories, viz. water conservation, water storage, and water harvesting techniques.

2. Traditional Methods of Water Management

Kond - Rahat

At many sites there are natural depressions within the stream/river bed. Some of these depressions are deep and have impervious substrate. Such depressions enable the storage of large quantities of water in a natural way throughout the year. This forms a major source of water (both for domestic and agricultural use) during post monsoon and the dry season. Locally, such water sources in the stream or river are called “Kond”. Some Kond are said to be perennial. Local people give specific names the Kond, e.g. “Brahman Kond”, “ Nach Kond”. This practice reflects the importance given to the Kond. The Kond has been an important natural water source for the local people for a long time. Water from bunds or konds in riverbed was lifted by a traditional lever- mechanism, fabricated using local bamboo/wood called the ‘Rahat’. People still lift the water from such konds, however now they use mechanized pumps provided by Government under schemes for developing 'lift irrigation'. This is a unique combination of a traditional technique for water storage and a modern technique for water harvesting.

Earthen Dams

This is a traditional water harvesting and storage technique. In the post monsoon period, the local people build small bunds (Bandharas) on the streams. The dams are built using locally available material such as stones and soil with branches and twigs of trees as reinforcement. The locations of the dams are normally near a Kond, so the water impounded could be retained throughout the year. The exact locations where such bunds are built are determined by tradition. Earthen canals are built on the downstream side of some of these bunds. Water is carried to fields from the reservoir, created by the bunds through the canals. All members of the community, men and women participate in building the bunds. It is normally done at the end of the monsoon when the water flow slows down to its lowest level. With the onset of rain the dam gets washed away along with the silt accumulated in the bed. In this way, the silt deposition in the beginning of the next monsoon in the kond is controlled and the water holding capacity of the kond is maintained. The bund is rebuilt every year.

Traditional Village Tank

Village tanks (Gaon Tale) are some of the oldest water storage and conservation structures to be found in Deogad taluka. One such village tank located on the upland plateau

used to serve as the main source of water to the village of Tale-Bazar. Over the years, due to lack of maintenance, the capacity of the tank has decreased due to siltation.

The village tanks were a direct source of water. However, some tanks were built especially to recharge the natural springs that served as the natural system of water delivery. One such tank in village Salshi is made of stone-walls and built along the streambed. The stream flow is diverted around the sides of the tank walls and channeled back to the main flow. The tank stores rainwater flowing through the steam. This helps to retain the water in the tank even in the dry season. The main function of the tank was to recharge the spring in the downstream so that the stream flows in the dry season as well. Hence, strictly, water is not drawn directly from the tank. Effectively, the tank served as a percolation tank. The location of such tank must have been based on traditional wisdom and knowledge about the local watershed. The whole idea of recharging the natural springs by building village tanks suggests that the people had a long-term and sustainable approach to water conservation.

Erosion Resistant Walls on the Sides of the Streams

Water in the streams in the Konkan region flow with high velocity in the monsoon due to the highly undulating topography and high rainfall. In addition to these factors, scarcity of plain agriculture lands force people to take their fields right up to the stream bank, leaving no place for the protective vegetation on the stream banks and also wide river banks, as is the case in the plains. The loss of vegetation along the stream, which provides natural protection, causes scouring along the banks resulting in loss of precious land and soil. This leads to excessive erosion of the banks and also siltation of the streambed and the Konds. Repetition of this phenomenon year after year leads to increasing erosion of precious land. The only option to prevent this is to build stone walls along the stream bank that will resist the erosion. Traditionally the community and also individual farmers built such walls using huge and uneven latterite stones, which caused good locking and hence could, sustain for a long period of time. These walls are an example of the traditional methods of soil and water conservation methods used by local people to protect their precious agricultural lands. One such old bank stabilization wall built around a hundred years back in Village Teliwadi Dabhole is now falling apart because of lack of maintenance and repairs. It was stronger than the newly built walls.

3. Modern Methods

The traditional methods are now giving way to modern ways of water management. Modern methods can be classified into two broad categories, (a) Methods adopting flow irrigation approach; and (b) in-situ moisture conservation (watershed development) approaches.

In the first approach the idea of the ‘big’ dam for flow irrigation is the most dominant. In keeping with this line of thinking, the first ‘modern’ intervention, which is seen in the block, is the dam built in village Shirgaon. This is also referred to as a minor irrigation (MI) tank. There are very few suitable sites for dams in the block given its hilly terrain and narrow valleys. The other modern interventions, which have been taken up in the recent past, are the Kolhapur Type (K.T) weirs and lift irrigation schemes. Watershed Development approach is being undertaken in small areas scattered in many villages in the block. These approaches are briefly discussed below.

Flow Irrigation Approach

Canal Irrigation

Canal Irrigation is implemented through a combination of dams and flow irrigation canal network. However, due to the narrow valleys in Deogad, there are very few sites that offer the prospect of building dams with a catchment area that can collect water to irrigate a large area. Also, if larger dams were built in these narrow valleys, they would result in high level of submergence, especially of the scarce agricultural land and also habitat areas. Hence, in-spite of the high rainfall and presence of a number of valleys, the 'large dam' approach to water harvesting has little relevance for the topography of Deogad.

The MI tank of Shirgaon was built in 1984, and has a command area of 70 hectares. It has a watershed area of 1.15 Sq. Km with total storage of 56 MCFT (million cubic feet) of which 50 MCFT is the usable water storage. This is the largest water storage and harvesting structure in Deogad and has been built by the Irrigation Department of the Maharashtra State. The Command Area Development Authority of the State Government had undertaken a project for forming the Water Users Association of the farmers in the command area and also for developing the command areas. Maintenance of canals, distribution of water, and crop selection are some of the area of work of the association.

Kolhapur Type Weirs

Kolhapur Type (KT) Weirs are small dams, which irrigate an area less than hundred hectares. These structures are characterized by sluice gates which are opened at the onset of the monsoon rains so that it makes way for the washing out of silt deposited in the reservoir and also discharge the excess water without impacting the structure. Towards the end of the monsoon, the gates are closed, as the velocity of the water flow decreases. To avoid collection of silt, the seal level of the weirs is designed at the streambed level. Earlier iron gates were used in Deogad. But, heavy rains and high water speed led to cracks in the joints of the gates. Besides this, the iron gates get rusted due to high humidity. Hence, now wooden planks in combination with soil are used as gates. K.T Weirs are either storage type or diversion weirs depending on whether the stored water is used to irrigate field up-stream by pumping it or diverted to fields down stream by canals based on gravity flow. Considering the limitations on the storage capacity of the streams and rivers in Deogad, most K.T. Weirs are now becoming popular as diversion weirs. These KT weirs are mostly being constructed at locations where traditional Bandharas were being constructed. However, storage type weirs facilitate in recharge of wells downstream.

Lift Irrigation

In Deogad, lift irrigation schemes for water harvesting are built on a kond, on flowing rivers, reservoirs created by K.T Weirs, or on open wells. The Z.P. Irrigation Department offers a ‘Small Irrigation Scheme’ in which a group of minimum five farmers can jointly avail of hundred percent subsidy for pumps (up to the capacity ten-horse power) along with the required pipes and accessories. There are about 150 such schemes in the Deogad block. However, almost thirty-five schemes out of the 150 are presently inoperative for a number of reasons, the prominent being the lack of co-operation among the farmers in the group.

Watershed Development Approach

The approach of micro watershed development involves various treatments to the land from ridge to the valley. It involves an integrated approach that encompasses development of the catchment area ranging from 500 to 5000 hectares. Watershed development is an approach to water and soil conservation. It also includes development of small water storage structures. The various structures that form part of the watershed development approach are Continuous Contour Trenches (CCT), Gully Plugs, Loose Boulder and Gabion Bunds, Earthen Bunds, and

small Cement Concrete Check Dams. The present guidelines of the Government of India does not include water harvesting techniques such as building canals/water channels, or developing lift irrigation as part of watershed development. The watershed development approach has not been successfully implemented in Deogad due to many problems, which are discussed subsequently.

4. Ground Water Management

Considering the geographical limitations posed on storage of surface water, ground water forms an important source of water both for domestic and agricultural use in the block. Ground water is harvested from natural springs, open wells, and bore wells. Ground water is still considered safe and assured option for drinking water as compared to the tap water supplied by the Government Agency-'Maharashtra Jeeven Pradhikaran', which manages the piped water supply system for Deogad Taluka.

The Ground Water Survey & Development Agency (GSDA) is the agency of the State Government for surveying, monitoring, and dissemination of information about the status of ground water situation. GSDA maintains 42 observation wells in Deogad, which are monitored four times a year. There are about 5000 wells in the block as per DSA data. Records of the ground water level from 1989 have been maintained. These observations are made manually, however recently Piezometers have been installed at some of the observation sites. This has added to the accuracy and mechanization in the process of recording. The results of the data analysis indicates that in the case of some wells ground water levels are increasing, while in some other wells it is decreasing. When readings of groundwater levels in wells are taken manually, the time of the day at which the reading is taken becomes critical, for e.g., if the reading is taken just after the water has been withdrawn for use, the reading will be far below the average. Such variations in readings occur because readings are taken at number of observation wells situated at different places, and fair amount of time is lost when the investigators move from one well to the other.

The political representatives as well as the local irrigation engineers suggest that the ground water table has been falling at an alarming rate in Deogad. At the same time, withdrawal of the ground water has been increasing sharply over the years. However, GSDA report concludes that the status of the ground water is ‘Stable’. They feel that the propaganda on decreasing water table is nothing but an excuse for politicians to demand allocation of more funds for water conservation and storage works.

5. Present Status of Irrigation

As we have seen in section I, the percentage of land under irrigation has been decreasing. Two reasons could be attributed to this: (a) the overall increase in the gross cropped area due to increasing area brought under horticulture; and (b) the decrease in traditional structures due to which seasonal irrigation has decreased. The irrigated area consists of two components well irrigation and canal irrigation. The area under well irrigation is fairly static and has been estimated to be around fifty percent of the total area under irrigation. If we consider the period from the post seventies to the present, the average area under irrigation is approximately 640 hectares. This is also corroborated by the 1991 census data. Hence, if we assume that fifty percent of this area or approximately 300 hectares is under well irrigation, then it implies that approximately 300 to 350 hectare lies under canal irrigation. It is this component of the total area under irrigation that is decreasing. This analysis is confirmed by the fact that, in the recent years, the area under irrigation from private canals is rapidly decreasing. The causes for this are discussed below.

6. Issues and Problems in the Different Approaches

Decline of Traditional Approaches

Kond

Kond being a natural phenomenon has no recognition in any of the government schemes, especially for its protection and maintenance. Konds are facing the problem of high silt deposition and hence loss of water holding capacity. As a result, they are drying up earlier than they used to. The Konds are a form of common property resource but the traditional management systems associated with them are disappearing and community regulations breaking down. This has affected its protection and maintenance. Widespread use of such Konds for washing cloths and utensils is affecting the water quality. Konds are the lifelines of the communities as an important water source, especially during the scarcity seasons, and for the communities residing on the riverbanks. There are cases of the water supply schemes using such konds for lifting water in the seasons of water scarcity. No system of protection, alternative to the traditional systems, managed either by the state or community, have so far been devised, Protection, conservation, and rejuvenation of Konds need to be taken up urgently.

Earthen Dams

About ten years ago, a minister who had been elected from the Konkan region, in a populist move introduced a new policy to provide financial assistance to the village communities for building the Bandharas. However, instead of acting as an incentive to build more Bandharas this move actually made people move away from their tradition. First, the government assistance was routed through the Gram Panchyat (Village Council). Since the Gram Panchyat consists of representatives from different hamlets and since almost each hamlet had its own Bandhara, quarrels and conflicts in Gram Panchyat increased on this account and community solidarity were affected. Also, subsequently the farmers became dependent on this government assistance, and this killed their own initiative to mobilize resources. Earlier, they use to contribute sums ranging from rupees five hundred to rupees thousand for this exercise, whereas the government assistance was only in the range of rupees three hundred to rupees five hundred. In the recent years, the number of traditional Bandharas has declined rapidly. A number of reasons could be attributed to this phenomenon. As discussed above one of the reasons is the un-wanted government interference, which has resulted in destroying the community initiatives. Another major factor is the increasing dis-interest on the part of the small farmers in growing rabbi crops, due to easy availability of wage employment in the Mango plantations. Other reasons such as non-availability of materials, especially soil and wood, erratic rainfall, and general tendency on part of the workforce to shun hard physical labor has contributed to the decrease in the number of Bandharas and, therefore, the area irrigated by these structures has reduced.

Village Tanks

Village Tanks can be considered as one of the oldest structures built with traditional wisdom and sustainable approach to water conservation. Naturally, because of their age, they have been filled with heavy silt deposition, which might have been augmented by the reduction in vegetation cover. But, it is surprising that this traditional system has been neglected by the later generations to the extent that they could not even maintain the old tanks, leave aside building new ones. The Zilla Parishad is now taking interest in reviving these tanks. One such tank has been revived in village Salshi. There are twenty-three such tanks in the Block that need to be revived.

Erosion Resistant Walls on the Sides of the Streams

The erosion resistant walls are again a common property resource. One individual farmer cannot build these walls or maintain it. Over the years, due to neglect, these walls have become weak and have crumbled at some places. Their repair is now even beyond the capacity of the local community. Hence, the ZP assisted some communities to rebuild these walls through the Employment Assurance Scheme (EAS), a scheme sponsored by the Central Government. The ZP has considerable flexibility in the works to be undertaken in this scheme. However, due to limited availability of funds, this program could not be taken up in a big way though the demand for the same exists. Unfortunately, this specific work is not included in the work-code of the Maharashtra governments Employment Guarantee Scheme. This is a stark example of centralized and bureaucratic program design, which does not consider local situations and needs.

Limitations of 'Modern' Approaches

Watershed Development

The topography and social situation in the block has put several hurdles in the smooth implementation of the watershed based soil and water conservation activities in Deogad, in spite of the urgent need for the same. The undulating topography, steep slopes, high rainfall and heavy runoff, hard latterite rock, lack of soil on up-land plains, narrow valleys, limitations on size of catchments, and inaccessible areas are some of the geographical factors that make it difficult for the existing government machinery to carry out the watershed activities. Government officers are hesitant to spend money on watershed work because of the high risk of failure of the physical works due to the above-mentioned physical constraints. In the year 1997, only about rupees twenty five thousand were spent on watershed development works in the Block. It was only in 1998-99 that the Agriculture Department of the Sate Government, which is spearheading the watershed development program, decided to go ahead with this approach in a serious manner. They completed works estimated at approximately rupees twenty-five lakhs in two years, which still accounted for just fifty percent of the value of the planned works. Some of the reasons cited for the failure of the watershed program by the officials is: (a) people are not ready to co-operate in carrying out any watershed works on their agricultural land; (b) in the post treatment phase, to maintain the structure, farmers are required to effect some changes in their agricultural practices and the farmers are not forthcoming to do this; (c) at the policy level no separate guidelines for watershed development have been prescribed for such a peculiar

geography. Thus, the difficult terrain along with the high labor rate increases the cost of watershed work much above the norms laid down and therefore, getting the estimates sanctioned becomes difficult. All these problems have cumulatively acted as a major deterrent in adapting the integrated watershed based approach for development natural resource management in Deogad block.

7. Institutions and Agencies for Water Resources Management

The above discussion illustrates clearly the multitude of approaches as well as the problems associated with it. This makes it difficult to evolve any one approach as an 'appropriate' approach to water resource management in the area. Another factor, which complicates this scenario, is the plethora of agencies and institutions involved in water resource management. The accompanying diagram below shows a schematic presentation of the various agencies involved in water resources management.

Since the size of the physical works is a crucial factor, which dominates the ‘modern’ thinking on water management the division of agencies for planning, design, construction, and administration of dams is also made on this basis, i.e. separate agencies/departments manage structures of different sizes, such as 'minor', 'medium', and 'large'. However, over the years it became evident that certain important aspects in the management of water resources, such as the soil conservation in the catchment areas, water distribution in the command area, and management and estimation of ground water have been neglected. To overcome this limitation, the Government set up a number of functionally specialized agencies such as the Command Area Development Authority for command area development; Watershed Directorate under the aegis of the Agriculture Department for soil and water conservation in the catchment areas; Groundwater Survey and Development Agency (GSDA) for ground water management; and Maharashtra Jeevan Pradhikaran (MJP) for installing and managing drinking water schemes. However, this has given rise to the problem of excessive specialization at the cost of integration and co-ordination.

Also with a view to involve the local self-government the ZP and Gram Panchyat have been given specific roles. However, when compared with the total quantum of the resources that need to be developed and managed, the proportionate allocation for the local self-governments appears to be miniscule. Also considering the fact that the local self-government are at the last wrung of the administrative hierarchy they need to be the most empowered based on the principle of decentralization. However the ground reality is just the opposite in spite of all

the rhetoric among the planners and politicians about decentralization and ‘power to the people’. The political leaders and bureaucracy at the State level are un-willing to empower the local self-governments. This is aptly seen in the presence of the Revenue and Irrigation Departments (which manage land and water resources) up to the taluka level. Recently, a move was made to transfer bulk of the functions of the Agriculture department to the ZP. However, the elected representatives at the State level are opposing this move.

8. Generic Issues in Water Resources Management

The following analysis draws from the above observations and tries to identify some of the generic issues relating to water resource management in the context of the existing situation in Deogad block.

Planning and Designing

It is clearly seen that there is a wide gap between the approach to water management in the traditional methods and the modern methods. The traditional methods had been developed and designed locally. The communities, who are the actual end users, were involved in the planning and designing process. Hence, they display a sense of familiarity and ownership for both the knowledge and methods and also of the assets created. This builds in accountability and drives them to construct and maintain the system, which is capable of performing to deliver its desired output. However, in the case of modern methods, persons who are not end-users of the system prepare the design. They work through agencies, which are external to the communities. Hence, though at times their technology is 'superior', the capability of the system as a whole to deliver its desired output is suspect.

In the case of a KT weir, in one village, it was observed that the local people's choice for the site of the structure was completely ignored. Instead, the ZP engineers decided on another spot and also resorted to blasting the streambed with explosives for foundation work. This disturbed the delicate sub-strata, which developed fissures and ultimately the structure failed. However, if they had taken into account the local people's knowledge and constructed concrete pillars at the location indicated by the local people, the need for the local people to build a temporary structure every year could have been obviated. It would have been a good example of blending traditional knowledge with modern engineering. This is the need of the hour in Deogad. This can be achieved only when the methods for planning and designing are not rigid and techno-centric, but create enough space for the local people to participate and make their

contribution in a meaningful way. This, in turn, would require a 'catalytic' agent with adequate social sensitivity and concern and who is also technically sound so as to facilitate the adoption of a people-centered approach.

Technology: Traditional Vs Modern

While it would be incorrect to make a sweeping judgment regarding the superiority or otherwise of the traditional or modern approaches, there are certain positive and negative elements in each approach which need to be carefully understood. In the case of traditional technologies, because of their localized evolution process the technologies were not standardized and were developed to suit local conditions. Further, since their scale is normally very small they did not create large disturbance in the local eco-system. On the other hand, the modern technologies because of their rigor and excessive emphasis on standardization tend to become ineffective in peculiar social and physical conditions. How the modern methods could overcome these limitations and be blended with local wisdom to evolve more effective technologies is the crucial question that the future resource managers and designers must address.

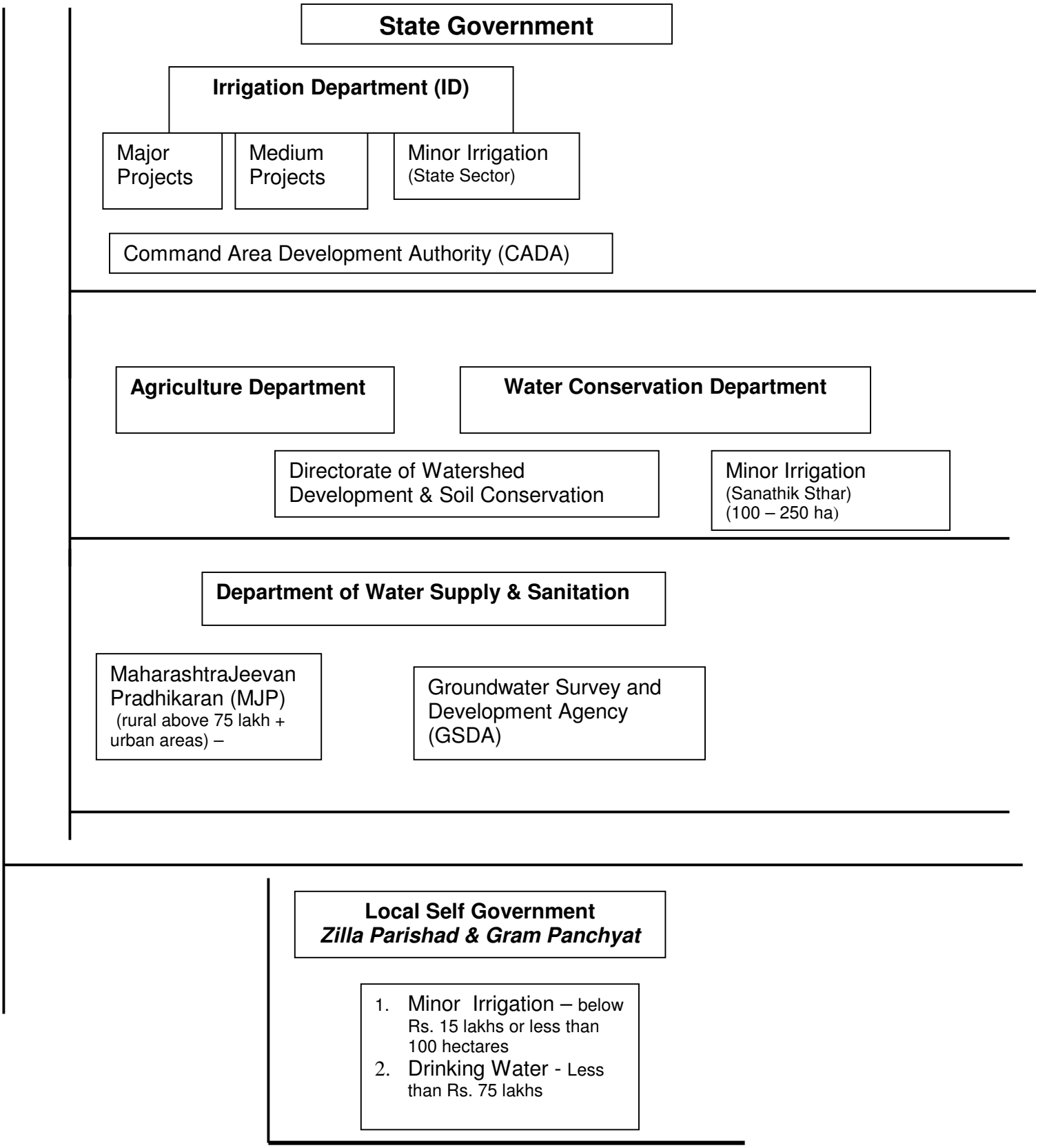
Operations and Maintenance

The problems faced in the operations and maintenance of the systems is a direct result of the lack of feeling of ownership among the communities for the assets created. In the Deogad block, KT weirs are the largest in number, as compared to other water harvesting structures. Also, they are easy to maintain. Yet, it is observed that handing over the weir to the Gram Panchyat does not ensure its proper maintenance. This is because the Gram Panchyat waits for grants from the ZP and hires labor for removing and fixing the wooden gates. This approach is distinct from the community-based approach of building the bandharas in which all the members of the community participate and contribute their labor voluntarily (shramdan). Thus, though the government officials feel that handing over the assets to Gram Panchyat solves the problem of centralized management, in reality it does not. As far as the community is concerned, vesting of the task with Gram Panchyat still implies that it is a job to be done by the Government (sarkar) in which they have no role. Further, the distribution of the village population in small hamlets in the Konkan further complicates the situation, because the village community does not reside at one location and it is not homogeneous. Thus, the local politics and in-efficiencies inherent in the Gram Panchyat could mar community efforts. Hence ways and means have to be found

either to make the community the direct owner or rejuvenate the Gram Panchyat's so that they perform their tasks more efficiently.

Institutional Issues

The preceding discussion on the institutions and agencies involved in water resources management show that there are four State Government departments involved in water management, i.e. the Irrigation Department, the Water Supply and Sanitation Department, the Agriculture Department and the Water Conservation Department. Besides this, some of the smaller works have been handed over to the ZP. Each of these departments has their own agencies and staff. Hence, co-ordination among the various departments and their staff is the major problem. This was confirmed by field observations. For example, while siltation is on the increase due to increasing deforestation and destruction of natural watersheds, the entire irrigation department is fully engaged in building storage structures, which are being heavily silted. To prevent this, watershed development has to be undertaken urgently in the catchment areas of the structures, however the agriculture department, which is vested with this task, is yet to get on its feet. Also, the few watershed development programs, which it has initiated, have no connection with the minor irrigation works being undertaken by the ZP. The diagram below shows the multitude of agencies involved in water management.


State Government
Irrigation Department (ID)
Major Projects
Medium Projects
Minor Irrigation (State Sector)
Command Area Development Authority (CADA)
Agriculture Department
Water Conservation Department
Directorate of Watershed Development & Soil Conservation
Minor Irrigation (Sanathik Sthar) (100 – 250 ha)
Department of Water Supply & Sanitation
MaharashtraJeevan Pradhikaran (MJP) (rural above 75 lakh + urban areas) –
Groundwater Survey and Development Agency (GSDA)
Local Self Government
Zilla Parishad & Gram Panchyat
1. Minor Irrigation – below Rs. 15 lakhs or less than 100 hectares
2. Drinking Water - Less than Rs. 75 lakhs

Water Vs Other Resources – Need for Integrated Approach

The various approaches to water management- i.e. traditional, modern, centralized, de-centralized - all exhibit one major feature, i.e. the lack of integration of water management with management of other natural resources, especially land and forests. Since the forests on the privately owned lands have not been classified and accounted as forests in the government records they are treated as un-cultivable lands. Thus, these forests, which were and are the major conservators of rain water are being rapidly felled. Thus, there is an urgent need to re-examine the issue of water conservation and use, in the larger context of the changing agro-eco-system conditions, especially the major trends discussed in section I.

9. Conclusion

A summary table of the issues discussed above is presented in Table II at the end of the document.

The Deogad block is characterized by high rainfall, with the average rainfall being around 2400 mm. Another peculiar feature of the block is its topography in which all the watersheds drain into the Sea, rather than flow through a lengthy river, which could be easily dammed. The length of the rivers is very small (around 50 to 100 kilometers) and estuarine areas account for the tail end (ranging from 5 to 10 kms). All these features offer no scope for creating large surface reservoirs. However, as a result of the high level rainfall and a geographical area of approximately 77,800 hectares, the total precipitation of water amounts to about 18,000 TCM (Thousand Cubic Meters). Of this, if we assume fifteen percent[1] as the rate of infiltration / percolation, then around 15,000 TCM of water is available from runoff. Of this, the existing storage capacity is able to store only about 1660 TCM (13 %), whereas the area under irrigation remains at roughly five percent of the cultivable area.

This implies that all the stored water is still not being fully utilized. This is because of two factors. First, the annual crop water requirement for a typical cropping

[1] This is only an assumption; the actual rate of infiltration could be lower or higher depending upon the surface and sub-surface conditions. 15 % is considered here as a fair average.

pattern in Deogad has been calculated at 1.2 TCM per hectare [2]. Assuming this parameter, if 1660 TCM of water is available then 1383 hectares can be irrigated. But the actual irrigated area is only about 650 ha, of which half is from well irrigation. This discrepancy is because of the MI tank at Shirgaon, which has usable storage capacity of 1400 TCM, irrigates but only about 70 ha, out a planned command of 125 ha of land[3]. Large tracts of plain land are not available in command area and hence the command area is small. This implies that even if 'large' structures are created, the topography of the area does not offer possibilities for large-scale flow irrigation. Hence, the only alternative is to go for small structures. Also it was reported that the MI tank has recharged a number of wells in the command and therefore the farmers prefer to use well water rather than canal water by participating in the WUA. Secondly, another reason for low water utilization could be explained by the fact that since the new KT weirs have been built fairly recently (three to four years ago), their utilization has not reached full capacity. Further, the planned structures offer storage of about 800 TCM[4]. If this is accomplished as planned in the next few years then the 'modern' surface storage structures will be able to store about 19 % of the water yield available and the rest of course will be drained into the Arabian Sea.

However, even if this level of storage is achieved, the maximum irrigated area could be increased only up to 9 % of the cultivable area due to the constraints explained above and even this is possible only if all the stored water is effectively utilized. The MI tank at Shirgaon accounts for about sixty percent of the storage capacity being created

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[2] This is based on a design document of the Irrigation Design department, where the following cropping pattern has been assumed for a KT weir. 20 % paddy (water requirement = 1994 mm); 30 % Vegetables (water requirement = 845 mm); 30 % Groundnut (water requirement = 660 mm); 10 % Mango (water requirement = 1110); 10 % Coconut (water requirement = 2000 mm) for 10 ha command area. Total water requirement = 11.6 TCM

[3] Even if we assume a crop water requirement of 2 TCM/ha (say, for only coconut) then ideally 700 ha should have been brought under irrigation. However, a tank with 700 ha would not be classified as 'Minor'. Hence it appears that the crop water requirement for the crops in the command of the MI tank have been highly inflated to justify the need for a reservoir.

[4] Since for certain structures the storage capacity data was not available the storage capacity was calculated from the command area, using the ratio of 1 ha command = 1.2 TCM. However since the actual storage in the dams is more than water required for irrigation purposes, the actual total storage would be slightly higher than the above estimate.

for the entire block. But it services only a small fraction of the population. Hence, there is a big question mark about the justifiability of this venture.

Another important trend that was observed is that with the increasing government intervention, there is growing neglect and apathy towards maintenance of traditional structures. This has affected their performance and has therefore resulted in the loss of its due recognition in the overall community-based eco-management systems. The issue of concern here is not just the loss of physical structures but also the erosion of traditional knowledge and wisdom since the new generation is not getting an opportunity to participate and learn in the community managed systems. This loss seems to be irreparable and irreversible.

SECTION IV: REFLECTIONS AND ANALYSIS

1. Major Trends in NRM in the Block

The overarching aim of the exercise was to present a broad picture of natural resources situation and of the development strategy adopted in the Deogad block. The foregoing discussion about natural resource management in the block and the interventions in the water sector creates a mixed and complicated picture. However, three major trends could be discerned, from the study, namely: (a) the transformation from food to cash economy; (b) the growing unsustainability of mango production, both economic and ecological, especially for the small farmers; and, (c) the growing neglect and decline of traditional water management structures and practices and increasing mis-management of water resources. These points are discussed in further detail below.

A. Transformation from Food to Cash Economy

There were two distinct developments which have given major impetus for the transition from the subsistence economy to cash economy in the region: (a) the government policy to promote 'horticulture' on barren and waste lands and (b) the closure of textile mills in Mumbai resulting in the in-migration of the male workers into the region.

In 1990, the Government of Maharashtra (GoM) announced a new scheme as part of employment guarantee scheme (EGS) to assist small farmers. This new scheme made provisions for subsides to promote horticulture on barren and wastelands (or uncultivable lands), and thereby create employment for the landless as well as small and marginal farmers. Since the terminology of the land record system classifies all the forests on private lands as barren and uncultivable lands (since the time of the land-settlement many decades ago), these lands and their owners automatically become eligible for this scheme. The felling of forest trees was seen as a natural course of action to benefit from this scheme and turn the hill slopes into mango and cashew orchards, thus making them more productive.

Since the 1940's, a large number of male workers from Konkan had migrated to the city of Mumbai to work in the textile industries. However, following the closure of the textile mills in the early eighties after a prolonged textile strike, most of the textile mills

never revived. Hence, while some older workers stayed back in the city with their next generation, much of the productive workforce chose to return to their native villages in the Konkan region. However, since these youth did not form part of the traditional agricultural work-force, they began to look for new avenues of earning money, since they already had been part of, and had experienced the 'joys' of a cash economy. Mango plantation in general and the new government scheme of subsidies in particular offered a lucrative proposition and they naturally invested all their savings and bodily energies into it.

Alongside with the expansion of Mango and Cashew horticulture, the production of traditional food grains, i.e. the local coarse grains also fell drastically. The high yielding variety (HYV) of rice introduced in the mid-sixties led to the increased production of rice from the same area of land. This initially led to great satisfaction among the farmers and discouraged them from cropping the more labor intensive and less yielding coarse grains. It needs to be mentioned here that coarse grains were cultivated on hill slopes or hilltops and not on the paddy lands in the valley. Data on paddy yield shows that the yield has continued to rise, albeit because of fertilizer inputs.

During the past thirty-five years, fishing and allied activities have also increased. The advent of "persiasian" nets and deep sea fishing trawlers led to increased fish catch. Investments in the fishing business also increased. Mango growers and other external financiers made new investments in boats and nets. They advanced loans to fishermen on soft conditionalities but saw to it that they earned good profits by ensuring their rights on the catch and transporting it to more lucrative markets such as Mumbai and Kolapur. The overall increase in economic activity also led to some increase in other marginal activities such as quarrying of laterite stones, transport industry, and service sector such as schools and health care. All these factors gave further impetus to the cash economy.

In spite of these developments, the percentage of households living in the 'Below Poverty Line' (BPL) category has been estimated to be twenty-six percent of the total number of households. The district average is forty-seven percent. However, one of the serious limitations of this estimation is that the norms for BPL survey requires that households living in stone houses ('pucca') are classified as households above the poverty line. Since, even the poorer households in this region use laterite stone to build their houses, they are automatically classified at above poverty line. Hence the actual

number of households below the poverty line in the block could be much more. The Block Development Officer of Deogad also expressed a similar view.

B. Mango Production – The "Unsustainable" Mainstay of Deogad Economy

As discussed in section II, there has been significant change in the land use pattern in the block, which has occurred over the past thirty-five years. While, on the one hand, the land under cultivation has increased only marginally, the land under traditional food crops has given way to horticulture, especially of mango and cashew. This shift has produced distinctive economic and ecological impacts. While traditional food crops were grown without disturbing the surrounding forests in a significant manner, mango cultivation required clear felling of the entire patch of land. So while food cropping did entail cutting down some forest, it did not involve massive clear felling. This, therefore, helped in some way to still maintain a vegetative cover in the post monsoon period, especially of grasses and shrubs. However, in the case of mango plantations, the under-growth is completely cleared. This exposes the earth's surface to nature's elements, especially to the bright sunshine, high rainfall and high velocity winds (Deogad is a coastal area and records wind with high speeds). This in turn has accelerated soil erosion, especially in the initial period of four to five years when the plantation is young and the canopy cover is not closed. From the planter's point of view, however, it is necessary to clear the lands in between the trees. Otherwise wild fires (especially due to dry grasses) in the post monsoon period could completely destroy their plantations.

Also during the past thirty-five years, the density and quality of the forests have considerably eroded. There is no single reason for this. A number of factors such as, greater demand for fuel-wood and fodder, increased lumbering, greater penetration of all-weather roads, dispersion of habitats, and similar other factors have caused deforestation, apart from clearing forests for horticulture as discussed above.

The expansion of horticulture in the recent past has structurally altered the agrarian economy of the block. Earlier, the small farmer used to grow food and a number of other crops for his self-consumption. However, over the years, the diversity of the crops reduced. Crops such as turmeric, chillies, sesame, and sugarcane, grown thirty years ago are no longer grown. Earlier, the food grains grown by the farmers used to provide them food throughout the year, but now according to them, the rice they grow is sufficient only for six to eight months' consumption. Apparently, this is despite the

increase in the yield of rice. They now depend on their orchards to give them cash through sale of mango and cashew to fulfill their other needs including the shortage in food grains.

The variety of mango grown in the region is known as the Alphanso mango. This is a superior variety of extremely sweet and delicious mangos with a good pulp yield. Though this variety is a native species, it has undergone a lot of hybridization. There are known to be some thirty-eight varieties of Alphanso mangos. Now only three or four are available. Mango is an alternating crop, i.e. mango trees bear fruits only every alternative year. However, the lure for more money and also the growing dependence on cash earned through mango crop has forced the farmers to look for ways to overcome this 'deficiency' in their native variety. Hence, farmers are now resorting to growth hormones to arrest vegetative growth and ensure fruiting every year. This chemical input is in addition to the tons of pesticides that are sprayed on the plantations at the time of flowering to protect the flowers from pests and ensure a 'bumper' crop. All these external inputs costs the farmer a dear and they, therefore, look forward to better yields and higher prices to overcome their rising costs. However, the government does not regulate the sale of mangoes. The mango grown by the small farmers are collected by 'agents' who themselves are large plantation owners. These agents have a fleet of small trucks at their disposal that is used only during the mango season. During the rest of year it is kept idle and yet maintaining the fleet is economically viable, such is the quantum of income they earn by selling and exporting mangoes. These agents collect the mangoes from the small farmers and transport them to big cities such as Mumbai and Pune where these are sold to the traders. The traders and retailers meet at the designated 'Agricultural Produce Marketing Centers' where the produce is auctioned. The trader then informs the farmer the price for which his fruits were sold. The farmer has to accept, as a fait accompli whatever price the traders give. There are no cold storage or processing facilities to help the farmers. Attempts at establishing a co-operative pulp-making factory failed. Rather the larger growers-traders nexus saw to it that they failed.

Since the establishment of the district in 1982-83, all attempts at forming the local Agricultural Produce Marketing Committees (APMC) have been futile, mainly because of discreet opposition by the lobby of large mango orchard owners. As per law, the local APMC, once established will have monopoly over the trading of agricultural commodities produced in the block. The creation of an APMC at the block and district level would have considerably benefited the small farmers.

In this entire process of production and sale, the small farmer with a few trees on a few acres of plantation suffers. However, the small farmer with increasing aspirations continues to try to emulate the big 'bagaitadars' (orchard owners). But the rising input costs, failing crops, resistant pests, and exploitative middlemen all collaborate to puncture the aspirations of the small farmer, for whom living in the 'debt trap' has become a way of life.

The chemical inputs in mango cultivation in the form of fertilizers, pesticides, and growth hormones are rapidly increasing, which is severely affecting both the economy and the ecology. Thus, the main question is will the small farmers (who are in majority) be able to sustain mango cultivation in the future? This seems to be a issue of serious concern for small farmers, though very few of them are aware of this. It is also the issue for the overall economy of the block, which largely depend on these small farmers. In short, with increasing risks, both environmental and market-based, mango and cashew cultivation that today forms the mainstay of the economy of Deogad could be the harbinger for the future social and ecological crisis.

C. Decline of Traditional Water Management Systems: Need for a new Perspective

The discussions in Section III of the paper have highlighted that the traditional water management systems are deteriorating.. Not only are traditional systems declining, but there is also a growing trend of un-regulated exploitation of ground water. The changing cropping pattern is also (directly and indirectly) affecting the local people's motivation to conserve and adopt their traditional systems. Another factor causing this deterioration is the increasing government intervention in this sector. Due to lack of adequate and meaningful participation of local people in the water management systems designed and built by the government, there are many distortions and inefficiencies creeping into these new systems.

As discussed in the concluding paragraph of Section III, considering the total availability of water, the amount of water that is being harvested and stored is very small. But, the physical limitations on expanding direct harvesting and storage of surface water points out to the fact that alternative strategies for water conservation and use need to be adopted. One such strategy could be to increase the percolation to increase the ground water storage through better management of surface areas, especially hill

slopes. Since there are many limitations to direct use of water through flow/lift irrigation, other methods such as in-situ conservation and conservation through increasing vegetation (biomass) need to be considered. Adoption of these strategies calls for a different perspective towards NRM. This perspective has to be based on the principles of integrated and sustainable management of resources, which are clearly absent in the current approaches.

2. Towards a Sustainable Economy and Ecology

The accompanying Table I provide a brief and summarized picture of the natural resource situation in the block. The data from the table shows that there are surpluses in the overall resource balances in the block, especially in crucial resources such as food stocks, biomass, and land. Water too is available in plenty though only a small portion of it is being directly harvested and used. Our field observations also support this data, wherein it was observed that, on the whole, there is no extreme degree of resource scarcity. However, it was observed that the picture shown by the averages (especially at household level) is not the reality. Disparities in access and ownership to resources do exist, with the orchard farmers owning large mango-plantations at one end of the spectrum and the landless and marginal land holding shepherds, living on the hilltops at the other end of the spectrum. However, with the limited scope and resources of this study, we have not been able to dwell on these issues in detail. This is an area that requires detailed investigation and study.

One important data element that is needed to complete the picture being presented in the table is about the mango production in the block. However, in spite of many attempts it was not possible to get a fair estimate of the mango production in the block. If the local APMC had been created, it would have been possible to ascertain the volume of mango production. The acreage approach to calculate the production does not help, because mango trees of different ages bear different amount of fruits. The agriculture department does not have accurate records of the acreage under mango crop as discussed in Section II.

This surplus of natural resources, in fact, provides a ready foundation for adoption of the alternative development strategies based on integrated and sustainable NRM. These would involve adopting low external input sustainable agriculture and maximizing biomass output, especially non-food biomass that can be processed and

consumed locally and also exported. This suggestion about non-food biomass relates to the danger of perishability, which is the main problem with mango. Agro-forestry, diversified horticulture, and food processing are some of the activities for which there is abundant scope. These could form the basis for a new economy. As seen in the table below, timber production, (especially small timber) is about 5 lakh tons/year, whereas the fuel wood demand is only 50,000 tons/year. This important surplus biomass resource could be used sustainably for creating a new economy based on renewable material and renewable energy resources.

Table I

Natural Resource Situation at a Glance - Deogad Block		
Human Resources	**Amount**	**Units**
Total Population (1991)	1,19,552	Persons
Households (HH)	23,937	Households
Average Persons/HH	5	Persons
Land Resources (approximate figures, in nearest thousand)		
Total Land	78,000	Hectares
Non Agricultural land	1,000	Hectares
Cultivable land	13,000	Hectares
Irrigated Land	650	Hectares
Irrigated Land (% of cultivable)	5	%
Irrigated Land (proposed)	630	Hectares
Irrigated Land (% of cultivable)	4	%
Non Cultivable land	64,000	Hectares
Total Land Per HH	3.25	Hectares
Agricultural Land per HH	0.5	Hectares
Irrigated Land per HH	0.02	Hectares
Non Cultivable Land per HH	2.73	Hectares
Water Resources		
Average Rainfall	2400	Millimeters
Total Water Availability (water yield)	18,000	TMC
Infiltration / percolation (15 %)	2,700	TMC
Run off (85 %)	15,300	TMC
Surface storage (Present) (year 2000)	260+1400=1660	TMC
Surface Storage (% of water yield)	11	%
Surface storage (Proposed)	630	TMC
Surface Storage (% of water yield)	4	%
Biomass		
Supply (production per year)		
Food Grains (6500 ha)	1,50,000	Tons
Mango and Cashew (approximately 10,000 ha)	?	Tons
Wood (@ 10 T /ha/yr for approximately 50,000 ha)	5,00,000	Tons
Demand (per year)		
Food Grains (@ 2 T /HH)	50,000	Tons
Fuel Wood (@ 2 T / HH)	50,000	Tons
Fodder (@ 5 T / pair/year)	1,25,000	Tons

(Sources: District Statistical Abstract, ZP Sindhudurg, Census, 1991)

The total land available per household is 3.25 ha, whereas the agricultural land available is only 0.5 ha and irrigated land is 0.02 ha. The un-cultivable land available is 2.73 ha/HH. Hence, converting this wasteland into mango orchards has been but a

natural corollary of the limitations imposed by the peculiar geographical conditions on the one hand, and the opportunities offered by the lucrative external markets for mangoes on the other. However, over-reliance on mango to "cash" this opportunity could well prove to be its major weakness.

Based on the above discussion regarding major trends, three areas have been identified as areas for long-term sustained action. They are: (a) developing sustainable food and nutritional security through use of low external input, sustainable intensive cultivation techniques for the resource poor; (b) research and extension work for developing organic methods of mango cultivation and also ushering in institutional reforms to provide better market access to small mango farmers; and (c) rejuvenate traditional water management practices and develop community based water management systems.

The first area for intervention is based on the observation that local food security is declining and the transition to cash based economy is leading to food in-security. Though the possibility of food imports always exists, such mechanism affects the vulnerable sections. Hence, developing household food security based on local resources, especially land, water, and biomass has to undertaken.

Since, the mango and cashew crops continue to be the mainstay of the local economy, ways and means have to be found to decrease the cost of external input for cultivation of these crops. The cost and quantity of external inputs being used for these corps is rapidly increasing make them economically un-viable. Also the ecological impact of large-scale chemical pollution of water bodies due to excessive use of fertilizers and pesticides has to be considered. Hence, research work has to be undertaken urgently to investigate methods by which these orchards can be converted into 'organic' orchards. Along side this, efforts also need to be made to find ways and means of helping the small farmers to be able to sell their produce at better prices through proper marketing arrangements. Facilities for processing and cold storage also need to be considered.

The third area of intervention is in water management. Efforts need to be made to increase community participation in water management and evolve local community based institutions for water management. Also further detailed research and documentation work needs to be undertaken to study the traditional systems and its

dynamics, so that the eroding indigenous knowledge can be recovered and applied in a meaningful way.

Thus, a combination of strategies such as developing community based water management systems, adopting new eco-friendly and low-cost technologies and revival and adaptation of traditional technologies for water management; use of low-external input, sustainable and intensive cultivation for developing household food security; and innovating on way and means of growing mango and cashew without using chemical inputs are needed to address the present problems encountered in NRM in the block.

History shows that many civilizations, which have flourished but vanished only because at the height of their prosperity they sowed the seeds for their doom in their unsustainable and in-equitable social and ecological practices, especially in agricultural systems. While the present trend for monoculture cash-cropping and export-oriented agriculture appears lucrative and promises high levels of prosperity would they not lead to a highly inequitable society and degraded ecology? If, yes then today's prosperity seems to be big price to be pay for tomorrow's doom.

3. Learning's for Developing the Sustainable Livelihoods Perspective

The process of developing a well-articulated Sustainable Livelihoods Perspective (SLP), at the conceptual and theoretical levels, is underway for the past two decades among various academicians, development analysts, and also grassroots workers. While a complete discussion on the conceptual aspects of Sustainable Livelihoods (SL) is outside the scope of the present paper, the following paragraph tries to highlight some of the key findings from the above study which have implications for the SLP both, at the conceptual and practical levels.

A. Lack of data about Livelihoods at Village Level

The study shows that there is no data at the village level on livelihoods as a whole, i.e. what are all the resources the people use to gain their livelihoods at what are the important livelihood activities. The available data on resources is widely spread among different sources and forms. The main resources covered are human resources: population mainly demographic and occupation data. Apart from this data about land holding, land use (crops, trees/ groves/pastures, forest), water (water storage structures,

sources of irrigation and wells) is available. Data about another major livelihood resource, i.e. livestock is also available to some extent. As already discussed in section I there are many gaps and inconsistencies in this data. As regards the livelihood and poverty situation the only data available is about the number of families living below the poverty line (BPL). However, this data gives very little information about the livelihoods of these families and their socio-economic profile. Also the data throws no light on the causes of poverty, i.e. what are the resources they lack, mainly with respect to their existing livelihood activities.

Data on land holding only gives information about private lands. There is no data about common property resources (CPRs), who are the people access it for what, and how many resources are used/depleted. In CPRs the mainly forests and water bodies need to be monitored and data about them gathered. Also our inquiry with the various agencies dealing with NRM functions showed that none f the agencies had up-to-date data about status of natural resources – especially land, water-bodies: how degraded it is, what was its past productivity, current productivity etc.

So from the existing data in government records nothing can be known about the 'livelihoods' of the people as a whole. Form the existing system of record keeping we can get some information about agriculture and households living below the official BPL. The focus of all record keeping is on agriculture, mainly the crops grown and their yield.

B. Shift from Food Crops to Cash Crops affects Local Food Security

Though the study has not been able to locate direct evidence of food insecurity, food insecurity does prevail among the poorer sections. However, they have access to public distribution system and other sources such as barter, and hence the food situation in Deogad is not as bad as in other food scarce parts of the country. However, the study does show that the shift towards cash crops is severely affecting food crop production. Though the current trend of increasing production due to increasing productivity (mainly due to higher and higher levels of fertilizer inputs) is clearly visible, this is unsustainable. Farmers agree that food security situation is bad, though now there is lot a cash in the economy and also opportunities for wage labor, therefore they are in a position to purchase grains rather than cultivate. Therefore at the household availability of self-produced food-grains has decreased in proportion to the population and as compared to

earlier. This dependence on cash economy has made the people's livelihoods more vulnerable.

C. Impact of Migration on Livelihoods

In early sixties out-migration was seen as good livelihoods option, but when there came limits to urban-migration (due to problems in urban-industrial systems' ability to absorb such a large workforce) reverse (in-migration) began – coming back and engaging in horticulture was seen to be a good livelihoods option. The presence of kith and kin the villages and also some assets such as land and house helped this process. This implies that if suitable conditions (mainly investment through subsidies) are created in rural areas then the rural folk are willing to in-migrate. Also it shows that there is an increasing limitation to urban migration.

D. Critical Role of Water in Livelihood Improvement

Water is a scarce good but it is a critical input to improving livelihoods, especially though agriculture. The approach to water resource development is not rooted in the contextual realities – social and biophysical. The approach to water resource development is purely technocratic with little on no participation of the local people. This causes several distortions in the intervention ranging from technical lacunas to feeling of non-ownership among the beneficiaries. Therefore, economic, social, and environmental sustainability is affected. Exactly what impact this is having on the livelihoods of the people is still to be investigated, but at this stage on thing is clear: water resource development as is being presently approached is devoid of equity and livelihoods focus.

E. Access to Markets: Provides Livelihoods but also increases Vulnerability

The Devgad study shows that by providing access to outside markets to horticulture produce (mainly mangoes and cashew nuts) by increased transport and communication facilities the cash income of the local people has gone up. However, this has also made them more cash-dependent to fulfill their livelihood needs. Their livelihoods are now exposed to market fluctuations and they have become more vulnerable to external disturbances. For example, the recent earthquake in Gujarat affected Mumbai markets for purchase of mangoes (Kutchi's from Gujarat being one to

the main consumers of mangoes). The mango prices crashed and the farmers suffered losses.

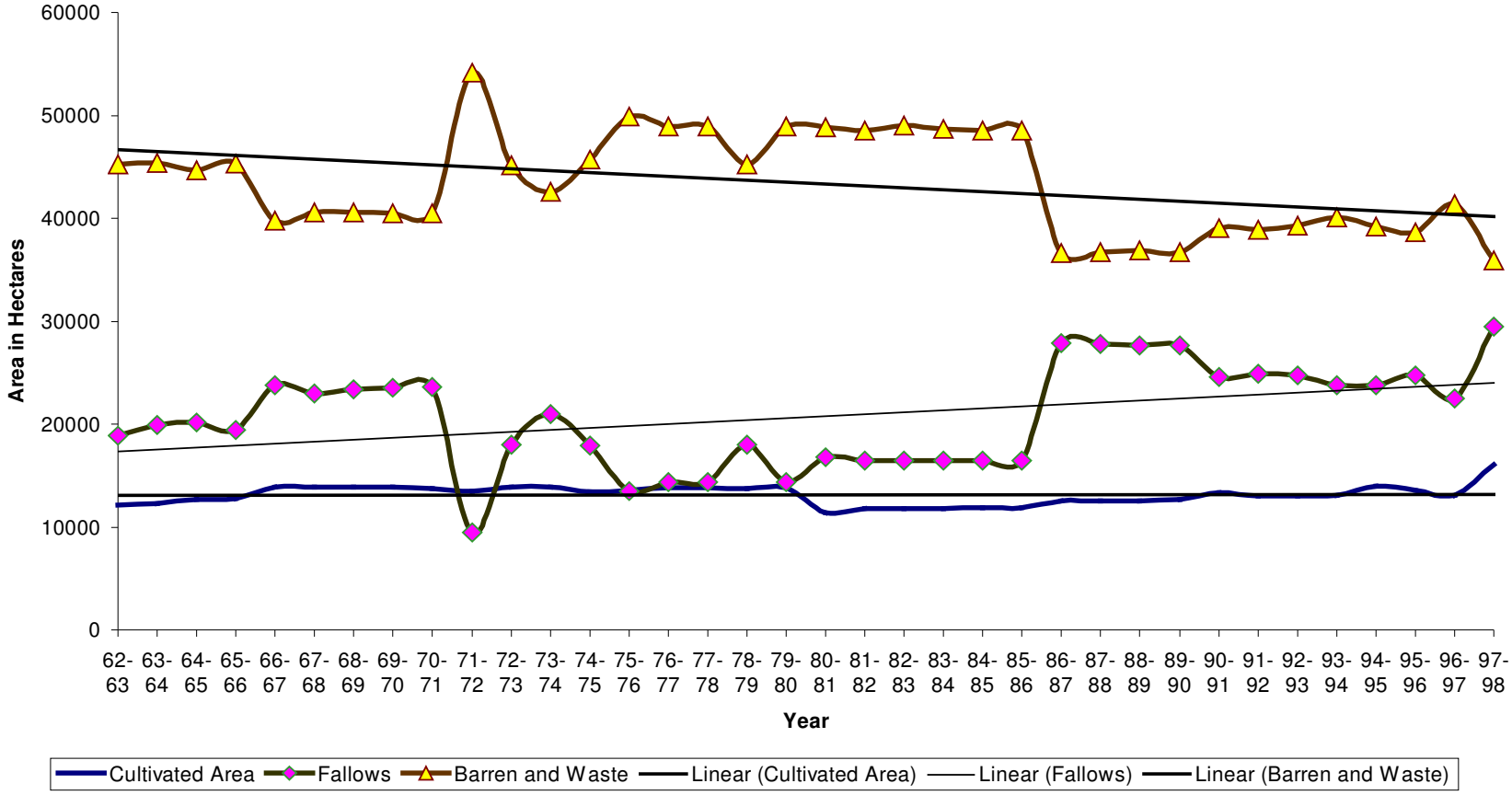
F. Neglect of development of local resources

The current policies of resource development, mainly in the water and agriculture (horticulture) sectors with their emphasis on using resources to produce exportable surplus has led to the neglect of the development of local resources. Biomass in various forms: timber, biomass as manure and as agricultural produce of a wide variety has been neglected. This is especially critical because the poor who do not have very little access to land and water depend mainly on these non-mainstream resources and also reduce their vulnerability by increasing diversity of the resources basket and accessing it through a wide range of institutional mechanism. But by adopting an approach to development, which does not consider these realities of the poor, both development of non-mainstream local resources and also the poor who depend on them, has been neglected.

One the major limitations of the study has been that it has not studied the institutional aspects of NRM, both in case of water and other resources. Prima facie it appears that caste is a major institution, which determines and controls people's access to livelihood resources. This therefore also determines their economic position. But, caste as an institution of stratification in rural India is well studied. Specifically how this institution operates in the context of Deogad and what are its implications for peoples' livelihoods needs to be further studied. This would then also give insights into the current status regarding the rights and access to resources, by different sections of the society, the knowledge of without which the understanding of the livelihoods situation would always be incomplete.

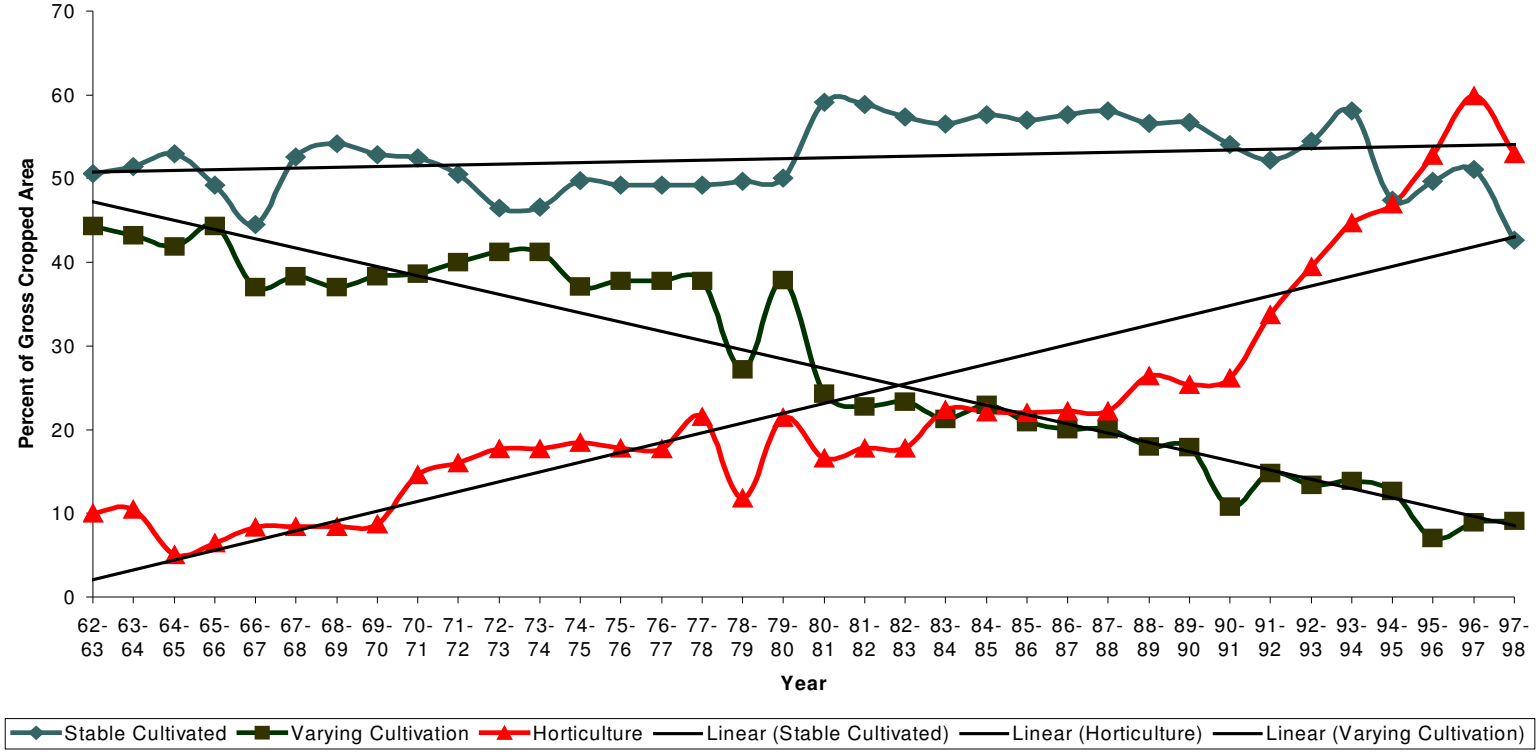
* * *

Land Utilization Pattern of Deogad Taluka

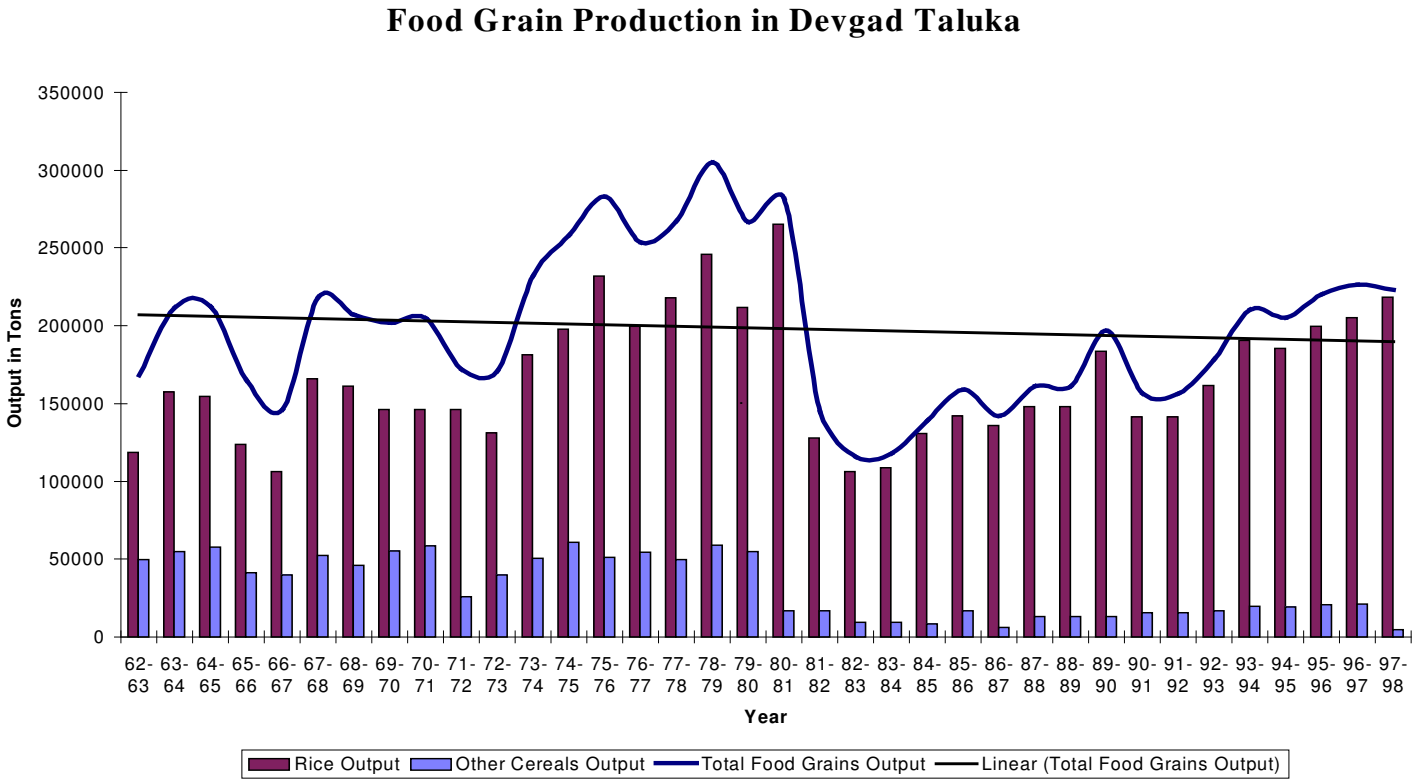


Graph I

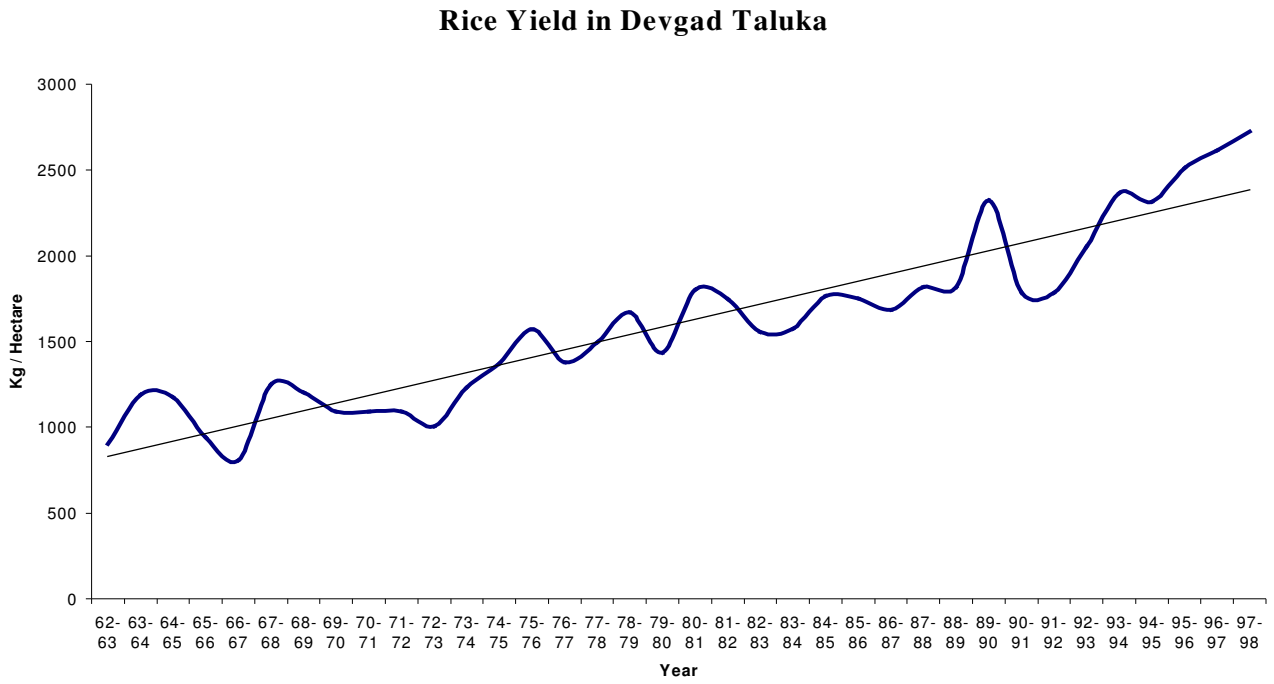
Cropping Pattern in Deogad Taluka



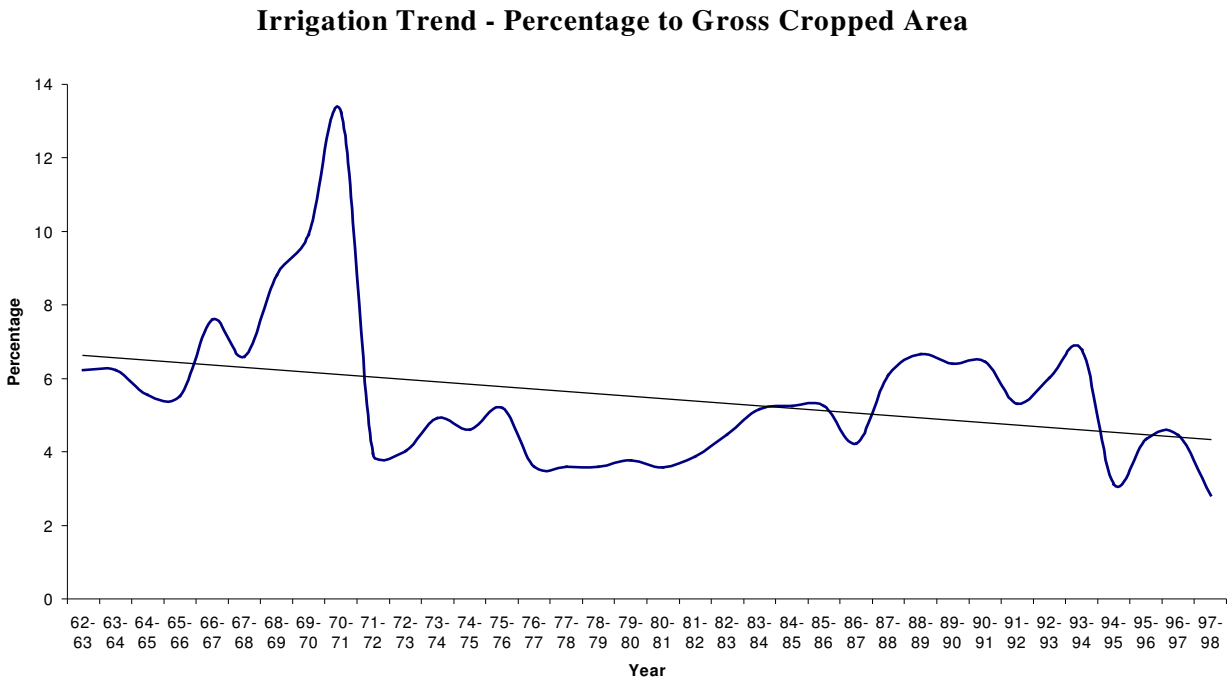
Graph II


Food Grain Production in Devgad Taluka
Output in Tons
350000
300000
250000
200000
150000
100000
50000
0
62-63 63-64 64-65 65-66 66-67 67-68 68-69 69-70 70-71 71-72 72-73 73-74 74-75 75-76 76-77 77-78 78-79 79-80 80-81 81-82 82-83 83-84 84-85 85-86 86-87 87-88 88-89 89-90 90-91 91-92 92-93 93-94 94-95 95-96 96-97 97-98
Year
Rice Output
Other Cereals Output
Total Food Grains Output
Linear (Total Food Grains Output)

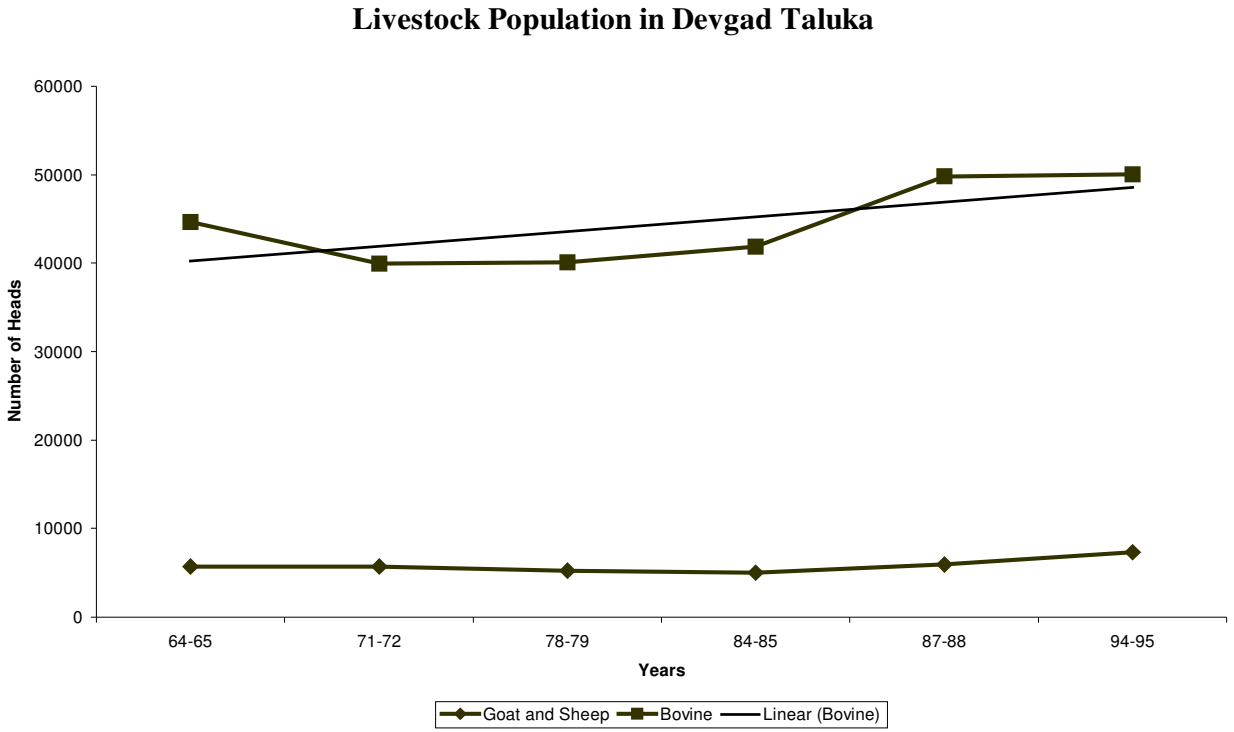
Graph III


Rice Yield in Devgad Taluka
Kg / Hectare
3000
2500
2000
1500
1000
500
0
62-63 63-64 64-65 65-66 66-67 67-68 68-69 69-70 70-71 71-72 72-73 73-74 74-75 75-76 76-77 77-78 78-79 79-80 80-81 81-82 82-83 83-84 84-85 85-86 86-87 87-88 88-89 89-90 90-91 91-92 92-93 93-94 94-95 95-96 96-97 97-98
Year

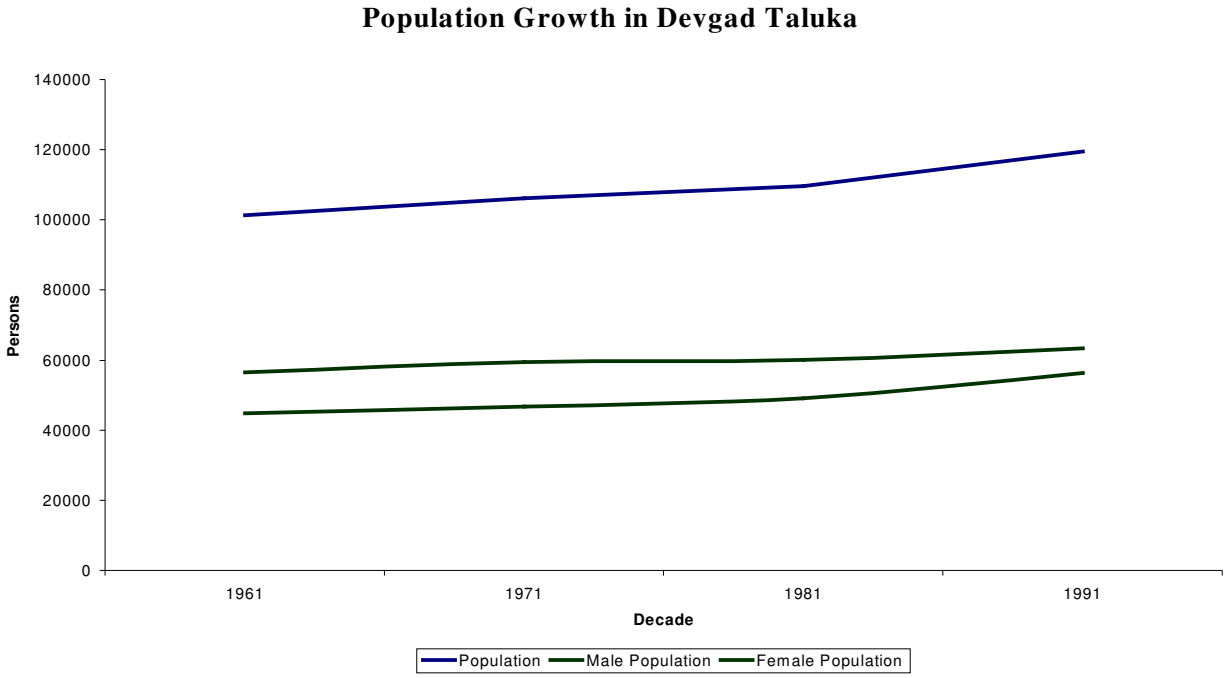
Graph IV


Irrigation Trend - Percentage to Gross Cropped Area
Percentage
14
12
10
8
6
4
2
0
62-63 63-64 64-65 65-66 66-67 67-68 68-69 69-70 70-71 71-72 72-73 73-74 74-75 75-76 76-77 77-78 78-79 79-80 80-81 81-82 82-83 83-84 84-85 85-86 86-87 87-88 88-89 89-90 90-91 91-92 92-93 93-94 94-95 95-96 96-97 97-98
Year

Graph V

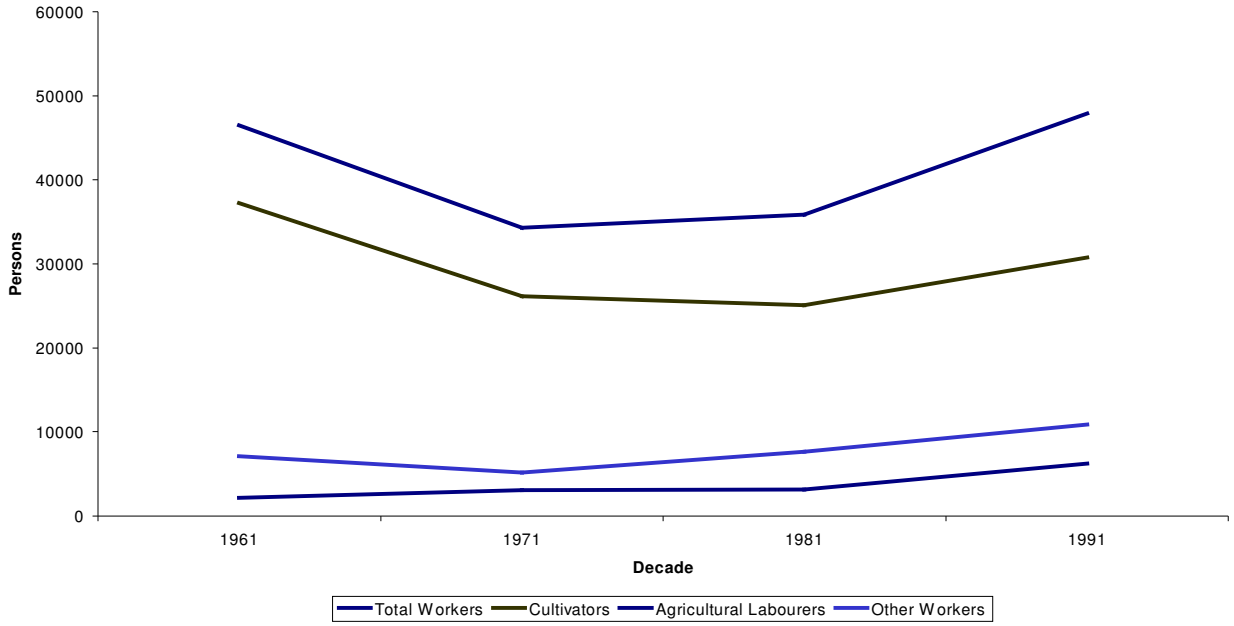

Livestock Population in Devgad Taluka
60000
50000
40000
30000
20000
10000
0
Number of Heads
64-65
71-72
78-79
84-85
87-88
94-95
Years
Goat and Sheep
Bovine
Linear (Bovine)

Graph VI


Population Growth in Devgad Taluka
140000
120000
100000
80000
60000
40000
20000
0
Persons
1961
1971
1981
1991
Decade
Population
Male Population
Female Population

Graph VII

Decadal Change in Occupation Pattern in Devgad taluka



Graph VIII

TABLE II: Comparison of Various Approaches to Water Management in Deogad Block

Variable		Traditional Methods					Modern Methods		
	Type of Structure	**Temporary Bandhara**	**Well**	**Natural Kond**	**Gaon Tale**	**Erosion Resistant side walls**	**K.T. Weir**	**Command Area Approach / MI tank**	**Watershed Development Approach**
1	**Technique Type**	Storage and Harvesting	Storage and Harvesting	Storage and Harvesting	Storage, Harvesting and Conservation	Conservation	Storage and Harvesting	Storage, Harvesting and Conservation	Harvesting and Conservation
2	**Sub types**	1.Tal-mati, 2. Stones	1.Open, 2.Bore well				1.Storage, 2. Diversion		
3	**Purpose**	Canal irrigation	Drinking water & lift irrigation	Drinking water & lift irrigation	*Recharging natural springs	Avoid erosion of stream bank	1. Lift irrigation, 2. Canal irrigation	Canal irrigation	Integrated development of soil, water & biomass.
4	**Implementing Agency**	Farmers group, GP	Pvt., GP, GSDA,	GP, Pvt.	Local informal group, ZP (revival)	ZP, Local group, Pvt.	IPI & M.I. Z.P	MI (State sector), CADA	Agriculture Department, State sector.
5	**Funding Agency**	ZP + Local	ZP, Pvt.	ZP, Pvt.	Local group, ZP	ZP, local contribution, Pvt.	State Government	CADA	State Government
6	**Maintenance Agency**	Farmers Group	Pvt., ZP.	GP, Beneficiaries	Local group, GP, ZP	Local group, GP, ZP	1st Year – MI.Z.P, Later – GP		Local group + NGO
7	**Method / Logic / Technology**	-> Obstruct the water flow by building a temporary bund when the stream flow is at its low so that water gets stored & can	-> Tap the ground water channel to store water in a chamber, -> Extract ground	-> Within the stream wherever there is a natural depression and presence of hard rock, water gets	-> With stream build a walled chamber in which the water can be stored. The stored water will then percolate and recharge the	-> Due to heavy rains and narrow valleys the streams tend to exert pressure on the bank leading to erosion. The stone walls try to hold the banks by	-> Obstruct the water flow by fitting mud & wooden planks in the gaps between concrete pillars. The pillars are permanent	-> An earthen dam which will collect water from a fairly large catchment area (115 ha). It forms a reservoir that can serve the	->Treatment of land starting from ridge to valley. E.g. Continuous contour trenching, gully plugging, loose boulder structures etc.

		be used till the next rain. Heavy rains wash the bandhara away. So it has to be build after every rainy season.	water by directly tapping the ground water reservoir.	accumulated. Water is retained throughout the year depending on the depth of the depression.	spring flowing into the stream. This way the stream is held perennial.	resisting the pressure.	whereas the plank walls are refitted again for the next dry season. The planks are fitted when stream flow is at its low.	command area (70 ha) down stream by canals/pipes.	
8	**Inputs & Materials**	-> All local material– mud, wood, stones.	-> External machinery, Local – stones for side walls	-> Pipes & Pumps for lifting (not required in gravity supply)	-> All local– Stones only.	-> All local – stones, mud	-> External – cement, rock. Internal – mud, wood (planks)	-> Local + external –mud, stones.	Local plus some external sources.
9	**Local Participation**	-> Almost complete	-> In case of common well	-> Limited to maintenance	-> Complete	-> Limited to maintenance	-> Limited to maintenance	-> Limited to water use	Making available land & labor
10	**Geographic location**	-> Flowing stream	-> Wherever location is suitable	-> Stream bed	-> Stream bed	-> Stream banks	-> Flowing stream	-> Broad valleys & plains where large water shed areas are available.	All the lands.
11	**Exact Site Selection Criteria**	-> Traditional knowledge about the capacity of the substrate to hold water in the streambed –availability of impervious strata -> Command	-> Availability of impervious strata -> Vicinity to use point	Natural Phenomenon -Natural depression, impervious substrate	-> Traditional knowledge -> On stream sides	-> Near the built up weirs or any other water structures -> Near agriculture fields.	-> Location of Traditional Bandhara/ availability of impervious strata -> Demand raised by people -> Command area availability	-> Availability of large catchment area.	-> Any watershed area.

		area availability - >On *kond*							
12	**Problems**	-> Non-availability of wood logs & clay mud -> Recurring efforts & cost	-> Availability of impervious strata	-> Siltation of the *kond* -> Unhygienic use	-> Siltation -> Non-maintenance/ negligence	->Lack of peoples initiative/ contribution	-> Non-availability of impervious strata -> No maintenance -> Non-use of storage water -> Siltation	-> Lack of the required terrain in Deogad Taluka for such approach.	-> Geographical limitations. -> Limitations of standard norms -> Lack of local participation
13	**Maintenance & its cost**	-> Complete re-building every year	-> Cleaning	-> Repair and replacement of equipment	-> Repair of stone walls	-> Repair of stone walls	-> Removing & fitting of planks + mud		

G.P. – Gram Panchayat – Village, PS –Panchayat Samiti, Deogad Taluka, ZP – Zilla Parishad, District Sindhudurg, M.I.Z.P – Minor Irrigation Zilla Parishad, Sindhudurg, , IPI – Irrigation Project Investigation, Irrigation Department, Kankavli, GSDA – Ground Water Survey and Development Agency, Sindhudurg, CADA – Command Area Development Authority.