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WATERSHED DEVELOPMENT APPROACH IN FRAGILE RESOURCE REGION : AN ANALYTICAL STUDY OF MAHARASHTRA

(Evaluation of National Watershed Development Programme : Maharashtra)

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FOREWORD

The failure of seed-fertilizer technology in penetrating the dry farming tracts of the country has led to a rethinking in our developmental strategies. The predominance of rainfed agriculture in the country coupled with the nonavailability of suitable technologies has resulted in aggravation of regional inequalities and slowing down of agricultural growth. Therefore, the rainfed farming technology seemed to be the plausible solution for the problems of these areas.

Keeping the problems of rainfed agriculture in view, the Central Government initiated the programme of National Watershed Development for Rainfed Agriculture (NWDPRA) in 1986 with elaborate guidelines. The objectives of the NWDPRA included conservation and upgradation of soil, upgradation of technology for crop production and, stabilization and augmentation of fruit, fodder and fuel economy. This was later expanded to include eco-system balance with the standard of living of the population in the guidelines of 1990. Though the initial design of the programme included only the rainfed arid tracts, this restriction was lifted later to include the high rainfall zones also.

The present study was taken up at the instance of the Ministry of Agriculture, Government of India, with an objective to evaluate the National Watershed Development Programme for Rainfed Agriculture (NWDPRA) in Maharashtra State. Maharashtra has a large share of the chronically drought-prone

areas of the country. This coupled with low level of irrigation gets reflected in lower yields and poor rates of growth of agricultural sector. In the presence of large patches of highly degraded lands and lower irrigation potential, the only plausible alternative is to bring the rainfed tracts under watershed development. In fact, the agro-climatic zonal planning exercise of planning commission also suggested the same strategy for the State.

The analysis of the present study was carried out at two broad levels. At the first level the design and implementation of NWDPRA are analysed. This analysis suggested location specific aspects dominate the impact parameters. Hence, care should be exerted to incorporate these specificities while preparing the implementation plan. It was found that certain districts and regions are showing consistently lower achievements whereas, others showed better achievements at lower cost. The administration of the programme is done through an elaborate structure. It would be beneficial if this structure is reformulated by using the present Karnataka pattern. At the second level, the impact of the NWDPRA on the household economy was analysed, with respect to land use pattern, cropping pattern, yield levels, income levels, living standards, inequalities, etc., of the watershed beneficiaries vis-a-vis non-beneficiaries. This micro analysis is carried out for three watersheds belonging to three different

agro-climatic regions of the State. The analysis suggested that not only the agro-climatic situations but also the location specific aspects influence the impact parameters. The study brought out clearly that watershed technology would be the best alternative among the present dry farming technologies. It is not only land augmenting but also technologically sound, and ecologically desirable.

D.C. Wadhwa
Director

PREFACE

Rainfed agriculture in the country has always received less than its due share in terms of policy attention. Sixth five year plan and the following policy statements have taken note of the discrepancies and suggested an integrated watershed development approach. The National Watershed Development Programme for Rainfed Agriculture was designed and implemented in various States, keeping in view the needs of rainfed farming. Maharashtra, being one of the pioneering States in soil-water conservation technology, forms an interesting area for the study. The project endeavours beyond the borders of an evaluation study and tries to incorporate a few new aspects.

Our work on the project began in late 1989 and continued through the last two years. It was only the concerted efforts that could lead to some of the indepth findings included here. The work could be accomplished only due to the support we received from colleagues and friends. Our sincere thanks are due to the Director of the Institute for encouragement and to the staff members for their support in various activities. The farmers from the sample watersheds had given best of their knowledge. We thank them for bearing with us and the elaborate interview schedule. We are grateful to Dr. K. Badri Narayanan for long discussions and many useful comments.

We have received help from the Directorate of Agriculture, Government of Maharashtra, Pune. Shri Nanasaheb Patil, (Director of Agriculture) and Shri J.Y. Patil (Additional

Director of Agriculture) were extremely helpful in extending the support for secondary data collection and long drawn discussions. Our thanks are due to them and also to their colleagues Sarvashri Datar, Sadavarte, Jadhav and Deshpande.

At the institute Sarvashri V.B. Lokre, N.T. Aware, S.R. Nikumbh, V.G. Kasabe, S.B. Kate and Mrs. Chandrachud helped us on various occasions for different things. Their share in the work exceeds normal expectations of their duties. But for their support the project would not have taken proper shape. Our grateful thanks are due to them. Smt. Vidya Kher in her usual unassuming style helped at various processing levels despite her pressing load. We thank her for the support. Any such study needs support from library staff. We gratefully acknowledge the support received from them. The excellent typing was done by our typists that helped us in bringing out the study in this neat form. It is a pleasure to thank them.

However, none of the above are in any way responsible for the errors of commission or omissions if any.

R.S. Deshpande

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ABBREVIATIONS

1. AICRPDA	-	All India Crop Research Project for Dryland Agriculture
2. CAZRI	-	Central Arid Zone Research Institute
3. COWDEP	-	Comprehensive Watershed Development Programme
4. CWSCRI	-	Central Water and Soil Conservation Research Institute
5. DPAP	-	Drought Prone Area Programme
6. ha	-	Hectare
7. IADP	-	Intensive Agricultural Development Programme
8. ICRISAT	-	International Crop Research Institute for Semi Arid Tropics
9. IDADP	-	Integrated Dryland Agricultural Development Project
10. NWDPRA	-	National Watershed Development Programme for Rainfed Agriculture
11. ORP	-	Operation Research Project
12. qtls	-	Quintals
13. SAU	-	State Agricultural Universities
14. UAS	-	University of Agricultural Sciences, Bangalore

CHAPTER I

INTRODUCTION

1.1 Introduction

Analysis of agricultural development in India suggests that the policy planning has reached at complex cross roads. New technological infusion has brought to the fore quite a few debatable issues. Often discussed issues among these address themselves to the differential impact of the strategy and resultant disparities. Even in the absence of any deliberate bias, the technology did not cater to the needs of have-nots be it region, class, crop or individuals. Consequently, the emerging differentials at all levels attracted the attention of academicians and planners. Rainfed areas, crops and populace of these regions suffered both in terms of resource shares and thence developmental impetus. This had a telling effect on the overall growth scenario and the growth rates of agricultural sector seemed decelerated. Rainfed areas were left out of the ambit of seed-water-fertilizer technology of mid sixties not mainly due to the severe resource constraints and the crop systems but more because of the content of the technology. This was compounded by the major chunk of public resources being allocated to better endowed regions and technology. Naturally, it was followed by the research inputs catering only to the needs of superior crops, regions and groups (Jodha 1979, 1991).

Rainfed areas in the country account for about 70 per cent of the cropped area and contribute more than half of the

country's foodgrain production. These areas share 60-80 per cent of the output of coarse cereals, major pulses, oilseeds and fibre crops (Mitra and Mukherji, 1980). Sheer weight of their share in the crop economy alone can supress or enhance the growth performance at country level. This bit of information is neither new nor of recent origin. Plan documents have continuously harped on this theoretical point with only token reflections in terms of resource allocations. It was the seventh plan document which gave considerable importance to rainfed farming (Planning Commission 1986). This lead was followed through in the approach paper to Eighth Plan. It is expected that these areas if brought to the mainstream of development, the growth sustenance would not be a distant dream.

It is often argued that the rainfed agriculture is handicapped on the natural resource front. But, one can diagonally argue that the cropping systems and, cultivation practices in these regions were not suitably tailored to the natural constraints. Historically, farming began in the river basins and slowly shifted to the other regions due to population pressure. Hence, the practices followed in the assured rainfall regions were the guidelines for the less endowed regions.[1] Naturally, these were not fully compatible to the heterogenous eco-systems of the rainfed areas and hence did not produce the

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1 This is somewhat similar to the experiences of less developed countries which imitate macro-policy measures of the developed world.

expected results. No doubt, over centuries of experience, these have been largely tuned to the natural eco-system but then in such efforts time was lost and large patches of land, were left degraded with uneconomic returns. Predominance of subsistence agriculture consequently brought pressure on land, forest and pastures. This resulted in the degradation of vast patches of land more so in the rainfed areas of the country. If the existing water resources are used judiciously it would be possible to sustain the productivity levels across large areas in the country. Keeping water and soil as basic resources it was necessary to categorise the eco-systems and develop proper culturable practices. Such programming would not necessarily involve sea-changes but only the internalisation of the vast experience.

1.2 Concept of A Watershed

Keeping this in view agricultural planning on the basis of watersheds is being advocated. As a definition watershed is an area enclosed in a catchment boundary of a river basin. But, it is an eco-system or bio-geo-physical unit in which the interdependence of renewable and non-renewable environment is closeted. In other words, it is a "resource region" where the eco-system is closely interconnected around a basic resource - here water. The watershed or river basin is therefore an ideal management unit (Laconte and Haims, 1982). As aptly described by Barrow (1987):

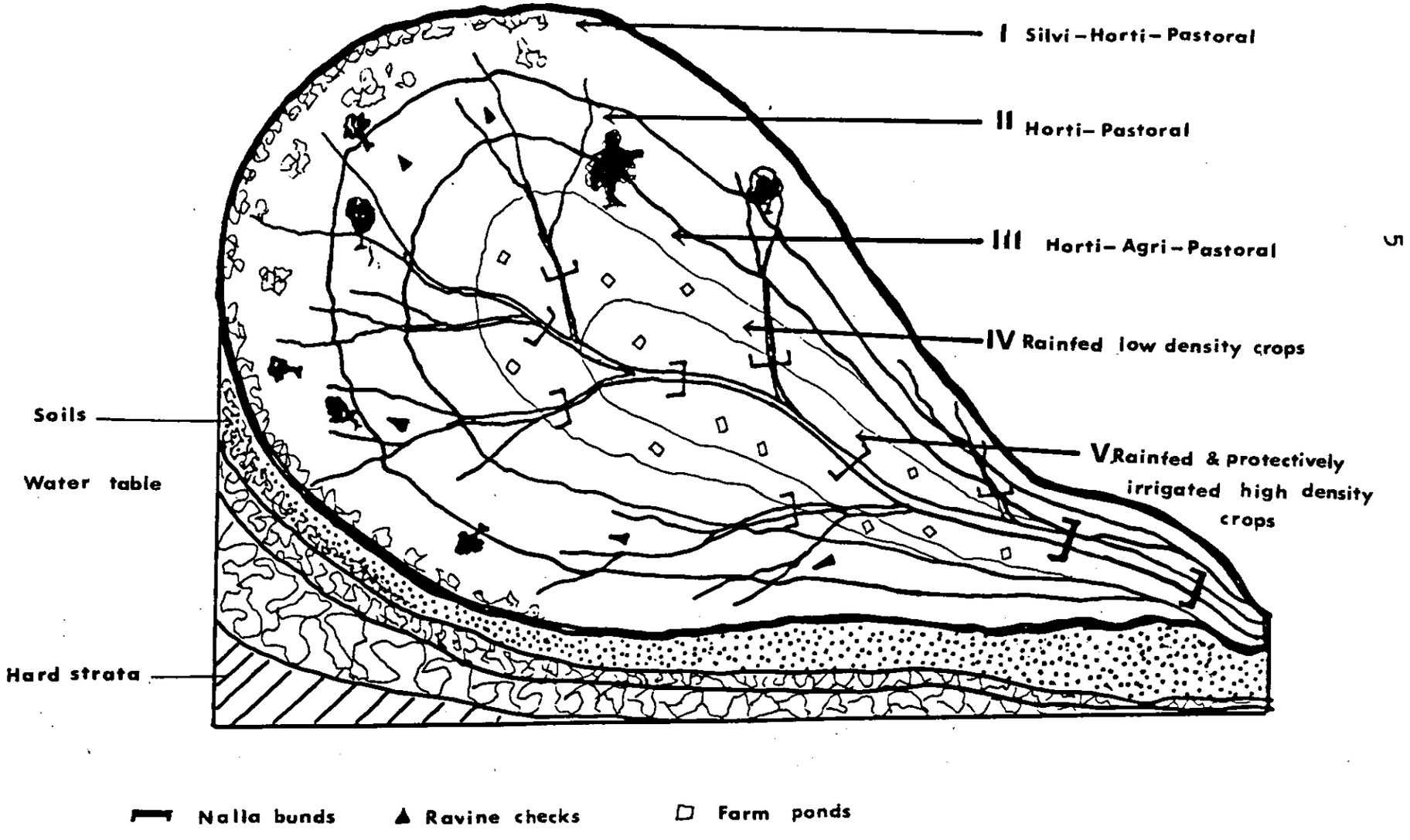
> 'It is not ephimeral in the way administrative districts might be, and within watershed physical and biological resources are linked by a complex of processes, changes in any of them can cause serious effects on the others'.

Hence, management of resources on the basis of watershed is both ecologically sound and operationally viable with minimum social cost.

We have shown in Figure 1.1 a diagrammatic representation of a normative watershed. Usually we find watersheds of varying shapes and sizes. But, a leaf or basin shaped watersheds are often seen in fields. According to the spread of area, watersheds are termed as sub-watershed, milli or macro, mini and micro watershed (Bali, 1978). But, fundamentally every watershed (from a few hectares to a few thousand hectares) is a part of a bigger watershed and has several smaller watersheds as its components. This makes the size definitions of watershed redundant. Figure 1.1 shows an ideal watershed around a river system. The ridge lines are marked in bold face to indicate boundaries. The other inside contour lines distribute the land mass into five distinct zones according to topography. At times researchers have also adopted a three level classification namely - upper, middle and lower reaches of the water flow. Our categorisation helps in distinctly identifying the agro-eco-systems under five categories.

i) The first ridge portion is suitable for tall forest and silvi-pastoral systems. A careful planning of waterflow begins in this region. In this region with good soil cover,

Figure 1·1 : Design & Planning of a Watershed System.



tall forest species can be planted and other rocky regions would be suitable for shrubs and hardy tree species like Eucalyptus hybrid, Dalbergia sissoo, Acacia Catechu, Holarrhena antidysentrica, Leucaena leucocephala. The contour lines in this region can be planted with agave and local hill grasses.

ii) The next portion would be below the first region and on the steep slope. This would have better soil cover as compared to the ridge level region. Overall the soil depth will be varying and the fertility level lower in this area. The silvi-pastoral system continuum can be supported by dry-land horticultural crops and hence the cropping system here can be described as silvi-horti-pastoral system. The vegetative bunds in this region can be a combination of agave and strong root grasses like khus or dongri. The horticultural crops usually taken in such regions are Anacardium occidental, Achras zapota, Punka granitum, Annona squamosa, Zyziphus sp., and others of similar types.

iii) The third region is a horti-pastoral region with some high value horticultural crops and good fodder yielding varieties of grasses. This region will have good soil cover and the soil is higher in fertility level as compared to the other two regions. The soil depth will be varying according to slope and span of the region. The horticultural crops suitable for this region are Mosamti, Orange, Achras zapota, Anacardium occidental, Mango and other similar fruit crops. Fodder crops like H. stylo, A. tortilis, A. lebbek, P. cineraria and other

grass varieties can be successfully taken in two tier system.

iv) The fourth region can be characterised as the rainfed region with recedual moisture for the second crop. Kharif dry land crops are best suited for this area, which will have soils of medium depth and better fertility. Vegetative key line bunds, contour ploughing and deep furrowing can give better results here. The crop system should be self sustaining with negative net fertility draft of the soils. In assured rainfall zone this area can also be brought under rabi crops with protective irrigation. The cropping system will follow the regional agro-climatic dicta.

v) The basin of the watershed or the lower reaches are characterised by most furtile and well drained soils. Water table in the region is quite satisfactory (provided the treatment in the upper reaches are effective). This area is suitable for two season cropping and the crop systems would depend on the broader agro-climatic parameters. Based on the farm ponds or groundwater wells this area can also have certain irrigated crops.

As mentioned earlier, the above classification is a generalisation for the rainfed areas, the crop and tree systems would be dictated by the habitat. Watersheds being natural hydrological regions their treatment falls in the domain of biological and soil sciences. But, the components of these treatments and interaction of people in the process brings it closer

to social sciences. The private holdings would be spread over the five regions indicated above. Hence, the treatments would involve both public and private lands, which needs a group action triggered by public resources and a voluntary participation without afflicting higher inequalities. This would call for help from theories of social group dynamics and economics of different treatments across the groups of farmers. For a period of more than four decades we have seen the tardy development of dry farming practices. Thus far it is difficult to say that we have achieved considerable leap forward in dry farming technology.

1.3 Dry Farming in India

The development of dry farming technology in the country began in early thirties with the establishment of dry farming research stations at few places[2] (Kanitkar and Sirur, 1960). Early research on dry farming was mainly confined to soil and moisture conservation through contour bunding. Though the programme was well conceived, the work was terminated in 1943 during the World War II. The dry farming research station of Solapur however, continued its work. Soil conservation through bunding was the only activity undertaken in this programme and became synonymous to dry farming practices (GOI, 1964). This programme was consierred effective in certain regions and by 1973-74, about 15 million hectares were covered under soil

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2 Agricultural Research Stations were established at five locations (1) Solapur (1933), (2) Bijapur (1933), (3) Hagari (1934), (4) Raichur (1934) and (5) Rohtak (1935).

conservation. But, in the absence of complementary dry farming practices, fuller potential of the programme could not be exploited. The results of crop cutting experiments in Maharashtra, Karnataka and Tamilnadu showed 11 to 25 per cent increase in yields in the bunded fields (Jodha, 1979). But then out of the Bombay dry farming practices only contour bunding assumed prominence. Jodha points out three reasons for the staggered viability and wide nonacceptability of the programme namely (i) Over-emphasis on engineering component, (ii) Lack of strong biological component, and (iii) Complete neglect of supporting institutions (Jodha, 1979, p. 494). He further elaborated on these three important deficiencies of the development of dry farming technology till 1970. TheIntensive Area Development Approach (IADP) and Drought Prone Area Programme (DPAP) envisaged to enhance the employment opportunities rather than boosting the technology in the selected blocks of the country. Fifty-four districts over 13 states were taken up under these programmes which emphasized civil works of a permanent nature so as to contribute to the mitigation of after drought miseries. It was observed that there were no technically sound master plans drawn and hence the targets could not be reached (Sevak, 1975). Moreover, the designs of IADP and DPAP were neither conducive for technology spread nor had any integrated approach.

With the fading of area development programmes and the advent of anti-poverty wave it was felt necessary to bring the entire semi-arid and arid zones into the mainstream of development.

The first hurdle was the development and dissemination of the locale specific technology. In order to overcome this, a comprehensive approach through All India Co-ordinated Research Project for Dry Land Agriculture (AICRPDA) was introduced with two-fold objectives : (i) research and development of new dry farming technologies; (ii) testing of this development through pilot projects. This, along with Integrated Dry-land Agricultural Development Project (IDADP) was launched in 24 locations all over the country. The emphasis was on the development of location specific technologies and testing them under field conditions (AICRPDA, 1982). Simultaneously, the work at Centra Arid Zone Research Institute (CAZRI) on development of suitable technologies for arid zones was helpful in many respects. The technology development was involved mainly agronomic practices, crop variety research, fodder and forest trees, horticultural crops, soil and water conservation techniques. But,in the absence of proper institutional support, the technology could not be spread to large part of the country. However, the efforts were useful to sustain the pace of development of the technology.

Contributions of ICRISAT (International Crop Research Institute for Semi-Arid Tropics) have been pioneering in the technological development of rainfed agriculture. Though, the work was mainly confined to research and development, the dissimination of the results began in the later phase. ICRISAT not only proposed and developed the technology for drought

tolerant varieties but also gave a holistic package for semi-arid tropics including cultivation practices, treatment of pests and diseases, economics of rainfed farming, risk management and such other issues. (See Ryan and Walker, 1990). The adoption of these technological advances have been showing exemplary results.

A significant public policy inclination towards rainfed agriculture can be noted from the sixth plan beginning. Earlier plan documents do mention the necessity of a systematic approach to tackle the problem of rainfed agriculture but it could not concentrate on a strategy. The sixth plan adopts a watershed development approach to check the spread and deterioration by erosion and to encourage natural vegetative cover in non-culturable area. Water harvesting and development of small watersheds of about 50 to 100 hectares, were suggested. (GOI, 1981). The policy was continued through seventh plan and a new centrally sponsored scheme of National Watershed Development Project for Rainfed Agriculture (NWDPRA) was taken up with three-fold objectives : (i) to harvest rain water, (ii) to conserve soil moisture, (iii) to extend cropping systems and farming practices for production increase and risk mitigation (GOI, 1985, p. 3).

Above review suggests that the technological development in rainfed agriculture broadly went through four phases of development, viz.,

1. Soil-conservation and Bombay dry farming practices,
2. Risk mitigation technologies - including crop varieties, cropping system, pest and disease management, risk sharing and diversification,
3. Resource centred technologies - soil and water conservation, water balance approach in crop planning,
4. Combined or integrated cropping systems - silviculture, dry land horticulture, pasture development with animal husbandry.

However, these phases could not transcend the institutional and economic barriers due to heterogeneity and precise integrated projectisation. Hence, the existing incompatibility between natural resource centred planning and customarily decided production planning persisted. Moreover, an integrated technological effort was a natural culmination of all these phases and hence it was not surprising that seventh plan took a serious note of it.

1.4 An Alternative Approach

The contours of the dry farming technology were mostly governed in portions and integrated approach emerged as an inevitable need. In the seventh plan document high priority was accorded to dry land/rainfed farming with a two-fold objective of raising productivity and minimising risk. The plan launched a new centrally sponsored scheme called the National Watershed Development Programme for Rainfed Agriculture (NWDPRA) to supplement the state efforts by merging

the ongoing programmes. The ongoing programmes at the time of starting of NWDPRA included the State level watershed development works, Operation Research Project (ORP) of ICAR, World Bank sponsored projects at Manoli (Maharashtra), Kabbalnala (Karnataka), Maheswaram (Andhra Pradesh) and Purua Nala (Madhya Pradesh) and various initiatives taken by different voluntary organisations at various locations (Deshpande and Reddy, 1991). Hence, the initial experience needed for launching an ambitious NWDPRA was already existing.

The NWDPRA was administratively approved by the Government of India, vide Ministry of Agriculture, Department of Agriculture and Cooperation's letter No. 6-13/85-CAV dated 3rd July 1986. Initially, the programme was sanctioned for four years with a total outlay of Rs. 239 crores of which the Central Government would be meeting Rs. 120 crores. The programme was followed through and extended upto 1994-95 with the revised guidelines. The working group on dry land farming constituted by the Planning Commission and the Approach Paper to the Eighth Five Year Plan reiterated the need to strengthen and extend the programme further. The revised guidelines reflect the cumulative experiences acquired from the countrywide experiments. We attempt a comparison of the changes in the programme outline from its beginning and an analysis of design in the next chapter. Here we shall describe only a consolidated picture of the programme.

The NWDPRA has its primary objective of stabilisation of agricultural production in rainfed areas by significantly stepping up investment in the dry land agriculture. The programme was designed to concentrate on : (i) taking watershed as a basis, to conserve and upgrade crop lands and non-arable lands as a vital natural resource; (ii) to develop and demonstrate location specific technologies for the proper soil and moisture conservation measures, crop production and stabilisation; (iii) to augment the fodder, fruit and fuel resources of the village communities by use of appropriate alternative land use (GOI, Guidelines, 1986). Subsequently, in the light of the experience gathered during the implementation for four years, the programme objectives were made more transparent and clear. The guidelines circulated to the State Government in 1990 indicated five objectives, viz., (i) conservation, upgradation and utilisation of land, water, plant, animal and human resources in a harmonious and integrated manner; (ii) generation of employment during and after the project; (iii) improvement and restoration of ecological balance through scientific management of land and rainwater; (iv) enhanced availability of water for irrigation and drinking purposes for human and livestock population; (v) reduction of inequalities between irrigated and rainfed areas in order to contribute towards better life in rural areas through larger cash flows (GOI, 1990).

The changed emphasis and revised focus can be clearly noted from the above guidelines, which stemmed out of the experience gathered during four years of implementation. The basic soil-conservation centered approach changed to an integrated economic programme. Sustenance of growth in productivity, reduction of overt fluctuations, correcting and restoring the balance of agro-eco-system and ultimately improving the quality of life in a compact resource region, became the focus of the programme.

1.5 Review of Some Relevant Studies

An integrated approach to development of a resource region has to be studied in a holistic manner. It is always difficult in these cases to exactly quantify the incremental benefits and ascribe these to a particular treatment but it is still possible to indicate the direction of change in economic parameters. Any such impact analysis is always complicated by the multiplicity of the layers of impact and difficulties in decomposition of these incremental parameters. Hence, among the studies available on the impact of watershed development we can broadly find three distinct groups viz.,

i) Studies concentrating on impact assessment of individual components of watershed technology,

ii) Studies attempting quantification of overall changes, and

iii) The studies basically pointing the programme constraints.

The integrated and interwoven approach of the watershed treatment technology makes these three groups interdependent. We have tabulated the type of impact analysis parameters available across studies (see Appendix 1.1).

Watershed development programme is administered by soil conservation departments in various States. This naturally led to higher emphasis on soil conservation works. Hence, many studies on soil conservation analysed the impact of contour and graded bunding on productivity and income. Ram Mohan Rao, et al., (1967); Lal Gupta, et al., (1970) and Ram Mohan Rao, et al., (1987) have indicated substantial benefits of contour and graded bundings at different locations. The yield increase in dry land crops goes upto 25 per cent and the benefits vary according to agro-climatic situations. Water harvesting structures along with the water conservation increases the net incremental benefits due to the availability of protective irrigation at the time of moisture stress. Farm ponds have shown substantial improvement in net incomes in the studies conducted at various locations by Tejwani and Babu (1982) and Itnal and Narayan (1987). The Benefit-cost ratio worked out at 4:3 and incremental income ranged between Rs. 1200 and Rs.2000. It may be relevant to note here that the incremental benefits out of farm ponds would be inversely related to normal precipitation of the region. Deep Joshi and David Seckler (1981) noted additional net income through the total package of rain water harvesting. Only a few of the studies have

analysed the incremental benefits due to specific dry farming practices falling under the overall watershed approach. A few studies also indicate positive changes in the productivity and net income due to dry farming practices like broad beds and furrows, deep ploughing, mulching, mixed cropping, rational cropping sequences, etc. However, impact assessment of a component specially when it is an integral part of a system is riddled with difficulties. The gains achieved are not sustainable in the long run. Moreover, it is erroneous to ascribe such gains to individual components.

Impact assessment of watershed technology can best be accomplished by incorporating all the components. Moreover, such studies are of recent origin and hence the results are currently debatable. The study of Sukhamajri watershed by Deep Joshi and David Seckler (1981) and Kanchan Chopra et al. (1989) showed exemplary results of the integrated programme. The incremental benefit ranged between Rs. 1800 and Rs. 2000 per hectare. It may be noted that this project was fully supported by the scientists of CSWCRTI. In a similar experiment supported by ICRISAT the watershed projects in Hyderabad, Solapur and Akola districts, Sarin and Ryan (1983) noted stabilisation of cash flow and substantial increase in the productivity and incremental income. They noted changes in the availability of additional employment. Walker et al. (1989) also reviewed the overall impact of the application of watershed based technologies at different locations in

Maharashtra, Madhya Pradesh and Karnataka. Their results indicated incremental net income ranging between 49 and 203 per cent of the base level. The benefit-cost ratio worked out in the range of 1.08 to 3.81 across the locations. Ghodke (1989) also confirmed similar results in SAT area apart from noting high incremental productivity.

In an analysis of State level Comprehensive Watershed Development Programme (COWDEP) of Maharashtra, Deshpande and Reddy (1990) noted significant changes in the household economy. The study covered entire programme at State level and in 30 blocks of the State. The block level analysis indicated concentration on certain specific components and overall good results of the in situ moisture conservation technology. The average size of watershed is between 200-300 ha. across the blocks and about 50 per cent of the beneficiaries were small and marginal farmers. It was noted that the employment generated in each of the watersheds ranged between two and thirty thousand mandays depending on the agro-climatic zones. The beneficiary level analysis indicated quite encouraging results. The crop pattern, cropping intensity, proportion of wasteland and yield per hectare changed substantially. Moisture availability has increased in the watershed regions. One of the important contribution made by the study relates to the role of peoples' participations in the watershed management. In a comparative analysis of the cases of active beneficiary participation as against the passive participation, it was

noted that the participatory process acts as a powerful catalyst for the programme, a result supported by Chandrakant et al. (1989), Katar Singh (1991) and Chopra et al. (1989).

In a State level study of the watershed development programme of Maharashtra (Government of Maharashtra, 1989), 138 watersheds, 1240 beneficiaries and 97 non-beneficiaries were analysed. The findings highlight changes in cropping pattern, increased double cropping, reduction in soil erosion, improvement in soil texture and increased moisture availability. There are a few shortcomings highlighted in the evaluation. But, it is silent about the level of participation of the beneficiaries.

The prominent constraints brought out by the analysts of the watershed development approach include method of planning, administration and the level of participation. An integrated inter-disciplinary approach for planning and administration is advocated by many studies (Deshpande and Reddy (1991), GOI (1991), Sarin and Ryan (1983), and Walker et al. (1989)). The hiatus between peoples' perceptions and official claims clearly emerge out of the studies of GOM (1989), Chandrakant et al. (1989) and Katar Singh (1991). The componentwise suitability, their acceptance at beneficiary level, the location specificity of the components had featured in almost every study that we came across. The problems of impact on income distribution, employment generation and the financial viability analysis are dealt by Dangat (1986), Jaiswal and Purandare

(1982), Tirath Gupta (1982) and Deshpande and Reddy (1991). The process of participation at grass-root level induces the interaction of economic forces in a watershed in the best possible manner. This view has gained momentum through the studies conducted by Chopra et al. (1989), Deshpande and Reddy (1991), Katar Singh (1991), and ICRISAT (1986).

Given the above scenario of the existing body of literature it was noted that still large gaps are existing in the study of economics of watershed management. The studies have either remained silent or touched the following issues only peripherally.

i) Methodology of impact analysis for the watershed treatment technology differs across different agro-climatic zones.

ii) Interdisciplinary teamwork approach for project planning, monitoring, evaluation and the problems associated with such administrative framework remained unexplored.

iii) The planning process formulation for watershed treatment and a simulated design for implementation and monitoring has not been illustrated.

iv) Economic analysis of watershed treatments, their location specificity, impact on distribution, viability and sustenance in long run and the role of people's participation in the process have not been studied for different locations.

We propose to attempt an analysis of the national watershed development programme of Maharashtra keeping in view the above issues. It would however be better to indicate an overwhelming limitation of such study. Any impact analysis of a watershed programme is guided more by the local level parameters hence the study would take shape under these contours.

1.6 Objectives and Methodology

Our review above suggested a few areas which are yet blurr and need an indepth study. We started our work on the study of National Watershed Development Programme by the end of 1989. This was the year in which some of the watersheds had shown substantial progress in the treatment but simultaneously attempts were being made at different levels to highlight the lacunae of the programme. Hence, there were quite a few studies which appeared during 1989-91.[3] Keeping in view the literature and original focus of the study we intend to set forth a four-fold objective for our analysis. These are :

i) to discuss and discern the methodological problems in the impact analysis of an area based programme like watershed development.

ii) to analyse the administrative set up and overall design of the programme with the help of the analysis of the data on components at the State and district level.

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3 The Annual Conference of the Indian Society of Agricultural Economics will be discussing the Economics of Watershed Planning in their session to be held in December 1991.

iii) to ascertain the impact of the programme on land utilisation pattern, emerging cropping systems, water availability, production, productivity, employment and adoption of new technology.

iv) to bring out the constraints operating on the programme and suggest ways and means to overcome these.

For the purpose of our study we have chosen three different districts falling in three distinct agro-climatic zones of the State. There are nine agro-climatic zones of the State of which the National Watershed Development Programme for Rainfed Areas (NWDPRA) was to cover only those areas having normal rainfall below 1125 mms and irrigation below 30 per cent (GOI, Guidelines, 1986). Hence, area from about 19 districts and the watersheds identified in these regions fall under the programme (see Appendix 1.2). These districts fall broadly under three agro-climatic zones, viz., Scarcity zone, Assured Rainfall zone and Moderate Rainfall zone.[4] (see Appendix 1.3). We selected Solapur, Aurangabad and Akola districts falling in the three regions respectively. These districts are typical representatives of the above agro-climatic regions. Out of these three districts one watershed each was selected with the maximum targeted area and componentwise wide coverage. The watershed boundaries transcend the village

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4 The nomenclature of the agro-climatic zones has some problem. on the Assured Rainfall zone receives lower rainfall than Moderate Rainfall zone and also has larger coefficient of variation in annual rainfall.

boundaries and hence we had to obtain the list of the farmers falling in each watershed. These beneficiaries were arranged in ascending order of the size of operational holding and fifteen beneficiaries were selected from each of the groups of marginal & small (below 2 ha.), medium (2 to 4 ha.) and big (above 4 ha.) cultivators. A control group of non-beneficiaries was selected from nearby villages not falling in the watershed area but having similar agro-ecological situation. After listing the non-beneficiaries we selected five non-beneficiaries in each of the strata based on size of operational holding as above.

Impact analysis of an area based programme like watershed treatment technology is riddled with intrinsic difficulties. An area based programme has a long term impact with concentric impact signals. In other words, we have the directly and indirectly generated economic activities along with spill over effects. Moreover, these activities interact with the socio-economic developmental parameters in the region and to that extent each societal group reactions differ across the development. These theoretical explanations amply indicate the difficulties in decomposing the net effect due to an area based programme.

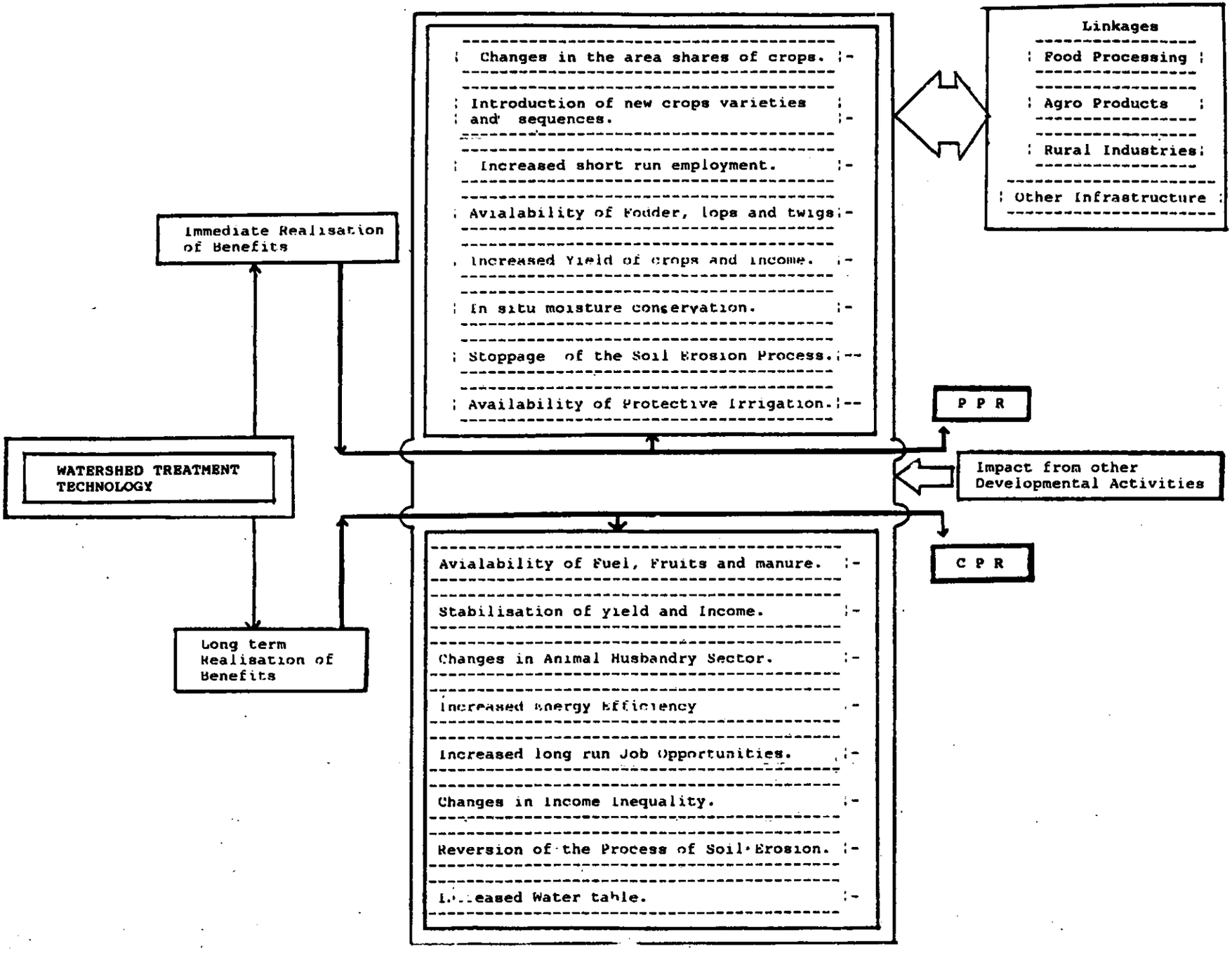
Literature on project analysis suggests the impact assessment by two methods, viz., comparing the pre and post project situations or locating the difference between the project and non-project areas (Gittinger, 1982). It is more

or less established that the project vis-a-vis non-project comparison is a better alternative provided we find a representative control situation. But, such controls are not easy to come across and especially so in a watershed impact analysis.

We have presented in Fig. 1.2 a representation of the impact of watershed treatment programme in the presence of other developmental activities. It can be seen that the overall impact is realised within first three years of the treatment but then these are stabilized only in the process which lasts for more than a decade. Apart from these, some of the parameters are not amenable to measurement whereas, most of the parameters are continuously under the influence of other ongoing developmental programmes. The decomposition of these effects into the watershed related and non-related activities is a methodological challenge in itself. To a large extent we can minimize this problem by taking project vis-a-vis non-project region with similar programmes. But even then, it is clear that the societal responses to developmental programmes would differ across regions.

Apart from the above difficulties, it is always difficult to get a matching control in the case of a watershed area. Two watersheds can differ in slope, level of initial development, interaction of people with environment, level of soil degradation, type of acquifer and water table. Hence, the matching control will always put the economic analysis into difficulties. We tried to overcome these problems but we can

Fig.1.2: Impact of Watershed Treatment Programme



not claim to have obtained a matching control.

The study is spread over two major parts. The first part analyses the macro parameters of the National Watershed Development Programme starting with an analysis of the design, administration and implementation in the State across districts in the next chapter. This is followed by the micro level analysis of the programme for the three agro-climatic zones spread over three chapters. The conclusions and policy implications are dealt in the last chapter.

Appendix 1.1 : Impact of Watershed (WS) Based Technology : A Review of Studies

Author/Year	Study Region	Activity	Crop	Impact on		
				Yield Change	Net Income	B/C Ratio
1. Ram Mohan Rao et al.* (1967)	Maharashtra	Contour bunding	Rabi Jowar	+25%	-	-
			Bajra	+25%	-	-
	Tamil Nadu		Rabi Jowar	+36%	-	-
			Bajra	+25%	-	-
2. Lal Gupta et al.(1970)*	Varanasi(UP)	Soil conservation	All Crops	+112%	+213%	4.58
3. Deep Joshi S. &David Seckler (1981)	Chandigarh	Rain water harvesting	All Crops	-	Rs.1812/ ha.	-
4. Sarin R.and Ryan J.G. (1983)	Andhra Pradesh	Integrated WS activities	All Crops	-	+4 to +300%	-
			Sorghum	-	+517%	-
			Castor	-	+600%	-
	Maharashtra (Solapur)	-do-	Sorghum	+300%	-	-
5. Walker et al. (1981)	Andhra Pradesh	Integrated WS based technology	All Crops			
	Mahboobnagar			+203%	-	1.37
	Medak			+130%	-	3.81
	Medak			+ 52%	-	3.02
	Akola (Maharashtra)			+ 28%	-	1.08

contd.

Appendix 1.1 : contd.

Author/Year	Study Region	Activity	Crop	Impact on		
				Yield Change	Net Income	B/C Ratio
	Gulbarga (Karnataka)			+ 52%	-	1.03
6. Ghodke, R.D. (1981)	Andhra Pradesh (Tadanpally)	Integrated WS based technology	All Crops	-	71%	-
			Local Sorghum	-	-45%	-
			Pulses	-	+1000%	-
			Pigeon pea	-	+960%	-
			Fodder	-	+230%	-
7. Tirath Gupta and Deepinder Mohan(1982)	Rajasthan		Tree Plantation	-	Rs.1640/ha.	-
8. Tejwani and Babu(1982)	Karnataka (Bellary)	Farm Pond	Jowar	-	-	0.75
9. Reddy YVR and G.R. Kanwar (1985)	Andhra Pradesh	Agro Forestry	-	-	-	1.45
		Silvi-Agri.	-	-	-	1.30
		Silvi-Pastoral	-	-	-	2.25
10. Agnihotri Y. et al. (1985)	Shivalik Hills	Vegetative cover	All Crops	64.6 qntls.per ha.to 85 qntls.per ha.	-	-
11. Government of Punjab (1986) *	Punjab	Soil Conservation	All Crops	-	Gross Incremental Income 83.7%	-
			Maize	-13%		
			Paddy	-30%		

Appendix 1.1 : contd.

Author/Year	Study Region	Activity	Crop	Impact on		
				Yield Change	Net Income	B/C Ratio
			Wheat	+16%		
			Potato	+ 4%		
12. Itnal, C.J. and Narayan, H.C. (1987) *	Bijapur	Farm Pond	Jowar	-	Incremental Rs.1300/ha.	0.95
			Sunflower	-	Rs.1800/ha.	1.11
13. Pant(1989) *	Madhya Pradesh	Integrated WS Technology	Sorghum	+127%	-	-
			Wheat	+111%	-	-
14. Deshpande and Reddy (1990)	Maharashtra	-do-	Paddy	+ 18%	-	-
			Ragi	+ 34%	-	-
			Pulses	+ 7%	-	-
			Bajra	+ 46%	-	-
			Wheat	+ 11%	-	-
			Jowar	- 2%	-	-
			Sunflower	+ 64%	-	-
15. G.V. Krishna Rao(1990)	Andhra Pradesh	-do-	Paddy(Kh.)	+ 54%	Gross Income	-
			Paddy(Rabi)	+135%	+13%	
			Sorghum	+ 17%	-	-
			Pigeon Pea	+ 7%	-	-
			Castor	+ 61%	-	-
16. Katar Singh(1991)	Karnataka	-do-	All Crops	-	Rs.1970/ha.	1.84 to 7.30

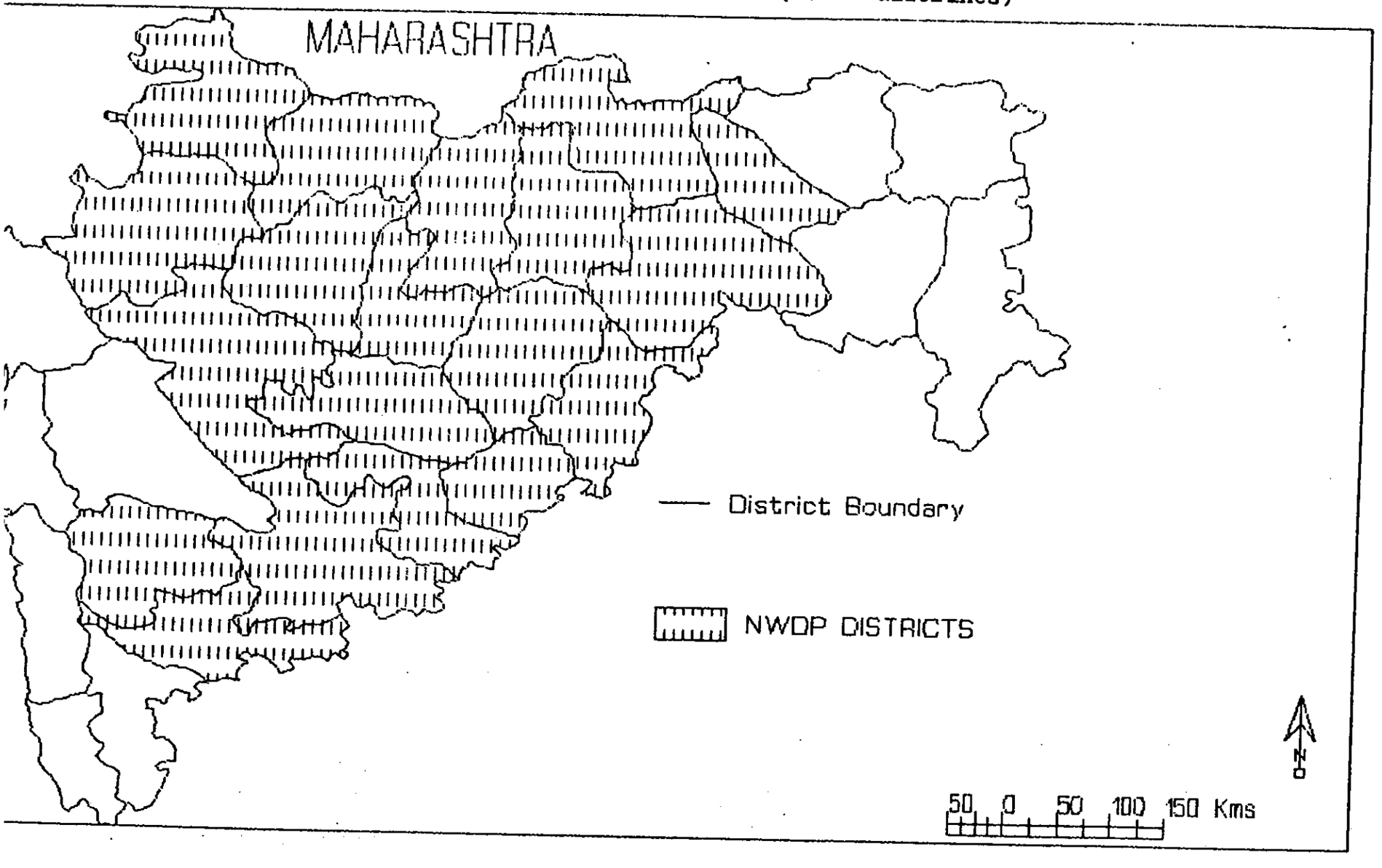
contd.

Appendix 1.1 : contd.

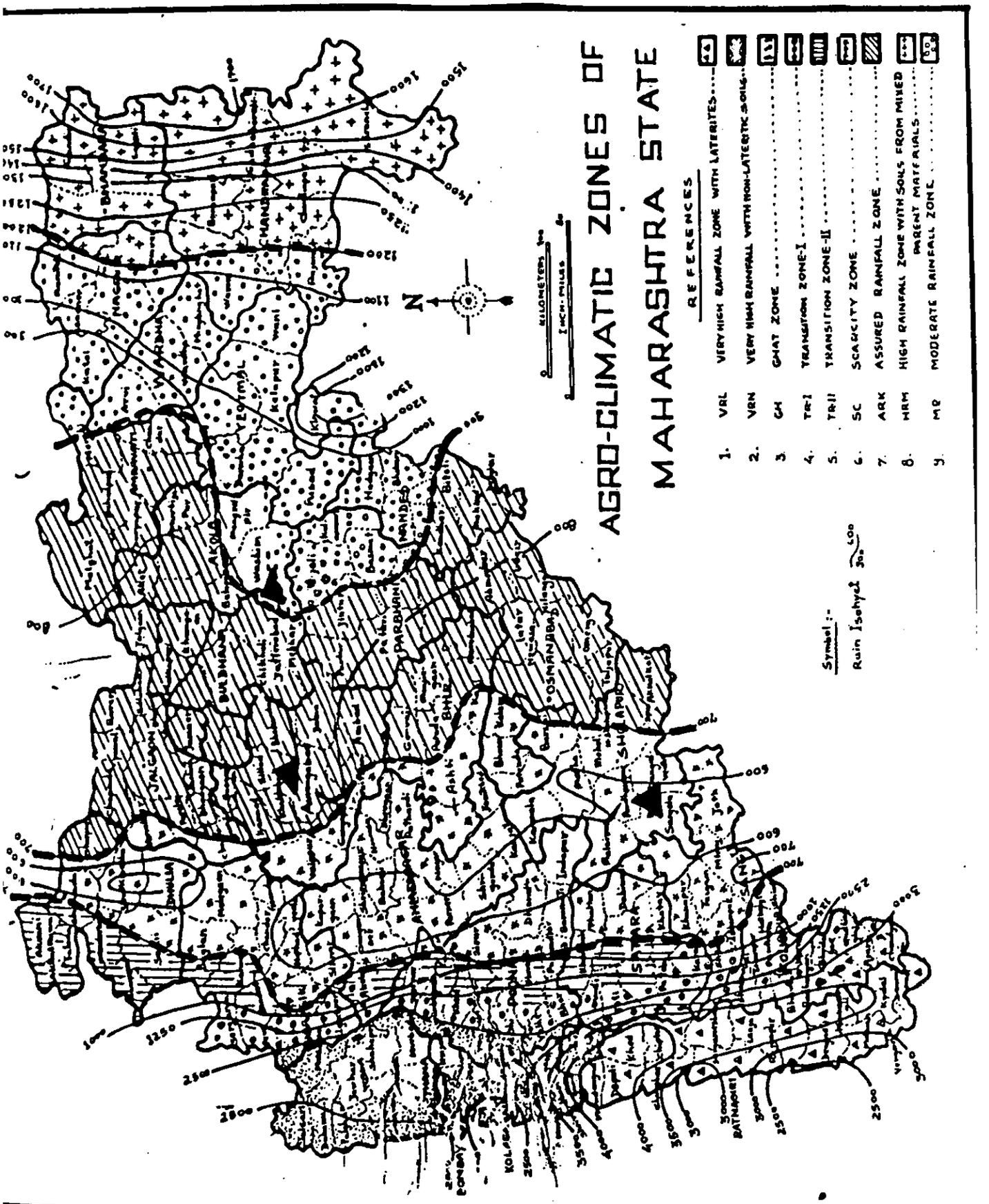
Author/Year	Study Region	Activity	Crop	Impact on		
				Yield Change	Net Income	B/C Ratio
17. Karan Singh et al. (1991)	Punjab	Integrated WS Technology	Forestry	-	-	2.74
			Animal Husbandry	-	-	1.14
			Soil conservation	-	(Gross Margins Rs.825-Rs.2780)	0.90
			Horticulture	-		7.05
			All components	-		0.99

* Studies quoted by Laxmikanthamma 'Economics of Watershed Development : A Review,' an unpublished paper, Institute for Social and Economic Change, Bangalore.

Appendix 1.2 : Programme Area of NWDPRA (1986 Guidelines)



Appendix 1.3 : Agro-Climatic Zones of Maharashtra.



Appendix 1.4 : List of the Districts Identified for NWDPRA by the Agro-Climatic Zones in the State of Maharashtra

Sr. No.	Name of the District	Agro-climatic Zone	Total Area under NWDPRA
1.	Ahmednagar	Scarcity Zone	14278
2.	Solapur	Scarcity Zone	18682
3.	Satara(Partly)	Scarcity Zone	10494
4.	Sangli(Partly)	Scarcity Zone	14147
5.	Nasik(Partly)	Scarcity Zone	14306
6.	Dhule(Partly)	Scarcity Zone	12524
7.	Jalgaon	Assured Rainfall Zone	14866
8.	Aurangabad	Assured Rainfall Zone	14835
9.	Jalna	Assured Rainfall Zone	16257
10.	Osmanabad	Assured Rainfall Zone	14987
11.	Latur	Assured Rainfall Zone	20486
12.	Amravati	Assured Rainfall Zone	15219
13.	Buldhana	Assured Rainfall Zone	16758
14.	Akola	(Part under Moderate Rainfall Zone)	15192
15.	Beed	(Part under Scarcity Zone)	16097
16.	Parbhani	(Part under Assured Rainfall Zone)	16336
17.	Nanded	Moderate Rainfall Zone	14730
18.	Yeotmal	Moderate Rainfall Zone	15124
19.	Wardha	Moderate Rainfall Zone	19742

Source : Directorate of Agriculture, Government of Maharashtra, Pune.

CHAPTER II

DESIGN AND IMPLEMENTATION OF NADPRA IN MAHARASHTRA

2.1 Introduction

Major portion of the semi-arid deccan plateau falls in the State of Maharashtra. Of the 200 lakh hectares of gross cropped area, about 45 per cent falls in the drought-prone area The present growth rates in food production have a definite edge over those prevailing during seventies (Deshpande and Reddy, 1990), but the sustainability of this trend is doubtful. By the end of Eighth plan the State needs to achieve a production level crossing 160 lakh tonnes in foodgrains. With the varied agro-climatic conditions and history of technology adoption, this looks to be a formidable task. Hence, concerted efforts need to be directed towards the rainfed half of the State. The present level of the natural resources and their degradation is also quite alarming in certain pockets of the State. Given the limited irrigation potential both under surface and groundwater sources, the State needs to concentrate on an integrated policy for rainfed farming.

Agro-climatically, the State of Maharashtra presents a varied picture starting with the heavy rainfall belt of western coast to the rice monoculture heavy rainfall region in the east (see Appendix 1.3). These two situations envelop in them

the rainshadow region beginning with the narrow strip of transition zone to the moderate rainfall zone in the eastern Maharashtra. The three agro-climatic zones falling in this region are (i) Scarcity Zone, (ii) Assured rainfall Zone and (iii) Moderate rainfall Zone. The level of average annual rainfall ranges from 500 mm. to 1200 mm. All the three situations constitute the rainfed tract characterised by semi-arid characteristics with low and varying precipitation, low density dry land crops, higher level of production instability and hence drought proneness. Incidentally, some portions of this area comes under surface irrigation and hence dominated by commercial cropping system. But the unirrigated portion causes a continuous drag on the growth performance of agricultural sector of the State (Deshpande, 1988).

Efforts to bring this dry farming tract in the mainstream of development began right under the Stewardship of Harold Mann in the erstwhile Bombay Presidency. The Bombay dry farming practices developed in this region earned an acclaim in the country but could not influence the sectoral growth due to marginal yield gaps. The essentials of watershed technology were also basic components of these dry farming practices. It is mainly due to the lack of an integrated approach that the technology was either not adopted or did not prove attractive.

2.2 Design of the Programme and Objectives

Maharashtra was among the first few states to have

designed and implemented a Comprehensive Watershed Development Programme (COWDEP) covering about 27198 watersheds beginning in 1982. Of these about 12800 were targeted to be completed by 1987. We have earlier analysed the impact of the COWDEP programme in the State (Deshpande and Reddy, 1990). The analysis suggested positive impact with encouraging trends. During the year 1986, the Central Government initiated the National Watershed Development Programme for Rainfed Agriculture (NWDPRA) approved in the 7th plan document through its' Order No. 6-13/85-CAV dated 3rd July 1986, for the years 1986-87 to 1989-90 at a total cost of Rs. 239 crores. The earlier on-going programmes namely - Pilot project for water conservation/harvesting technology for dry land farming, popularisation of seed-cum-fertilizer drill etc., were either merged or discontinued. The State and Central Governments were to share the expenditure of the scheme on equal basis (see Appendix 2.1). In fact most of the State Governments superimposed the NWDPRA on the ongoing programmes, creating in the process three types of difficulties. Firstly, it was not possible to prepare a baseline plan for the watersheds undertaken for development and in fact the State Governments were compelled to append a hurriedly prepared component plan to the existing work. Secondly, the segregation of the impact of NWDPRA for monitoring and evaluation at national scale became a difficult task. Thirdly, under the count of flexibility no clear guidelines were issued (in fact the

letter of 3rd July 1986 and the subsequent correspondence has some sort of guidelines which cannot be called specific). This was however, corrected by issuing fresh guidelines in November 1990. But by then crucial three years of the programme were already completed.

The objectives of the MWDPRA set in the 1986 guidelines were :

> "1. Taking the watershed as a basis to conserve and upgrade croplands and waste lands as a vital natural resource;
>
> 2. to develop and demonstrate location specific technologies for proper soil and moisture conservation measures and crop production stabilisation measures required under different agro-climatic conditions;
>
> 3. to augment the fodder, fruit and fuel resources of the village communities by use of appropriate alternate land use system.' (GOI, 1986).

These objectives converge on two basic themes namely - balance of eco-system and growth. But then the guidelines circulated in November, 1990, prepared at Division of Rainfed Farming Systems and Watershed Management, Ministry of Agriculture, Government of India (GOI, 1990), makes it very clear that the watershed development approach is an integrated area development approach including the human population and environment. The document gists the five-fold objectives as -

> 'Thus, the ultimate objective of this project is to develop the natural resource base, sustain its productivity, improve the standard of living of millions of poor farmers and landless labourers and endeavour for restoration of ecological balance' (GOI, 1990, p.9).

The task set forth by the objectives though was not a formidable one but difficult to achieve in a short run and more difficult to sustain in long run without the support of the participatory process.

The initial design of the programme included only the rainfed tracts of the State. In fact, the 1986 guidelines indicate that only the watersheds falling within the isohytes of 500 to 1150 mms, with less than 30 per cent of irrigated area be chosen for developmental works under NWDPRA. The philosophy behind this restriction was perhaps to direct the concentration towards the lagging regions and avoids the additional public investment going in better endowed regions. This would not only reduce the drag caused by the lagging regions on overall growth performance but also help in bringing down the regional inequalities. Further, the 1986 guidelines also gave a few important considerations for selection of watersheds viz.,

1. Average size of watershed be less than 1000 ha.
2. The unit cost of development not to exceed Rs.2000/ha. and the staff cost to limit at 25 per cent of this.
3. Only those watersheds be selected where more than 50 per cent of the farmers are marginal and small holders and they own not less than 25 per cent of land.
4. The major portion of watershed should be arable lands.
5. Avoid the blocks with major irrigation projects.
6. Watersheds should be close to Agricultural Universiti

7. Priority be given to areas where farm tested technology is developed, necessary infrastructure is available, already earlier schemes are existing, local farmer's show willingness and cooperation, where soil survey and soil conservation programmes are undertaken and where cost-benefit ratio indicate definite increase in yield or a significant reduction in yield fluctuations. (GOI, 1986,pp. 3-4).

It can be easily seen that the criteria at serial number 1, 3, 4 and portions of 7 are operationally difficult things. The choice of watersheds, where soil survey and soil conservation programmes are already existing, earlier ongoing schemes are there and where cost-benefit ratio indicate definite increase in yield or a significant reduction in yield fluctuation, makes the task of any evaluation of the NWDPRA more difficult. Possibly, keeping in view these difficulties the guidelines of 1990 modified and avoided most of the above selection criteria (GOI, 1990; pp. 20-21). The new guidelines widened the scope of the programme by not restricting it to rainfed areas alone. This has brought in the other heavy rainfall regions under the scope of NWDP reducing the concentration of resources on the lagging regions. The phylosophy behind this "cover all region" approach stems out of the planning for large basin watersheds and to some extent advisable provided the projectisation includes large basin watershed planning as a major aspect, which in itself is a huge task.

2.3 Approach and Components

The approach essentially involved dovetailing of the

programme with the ongoing programmes of soil and water conservation. Initially, it was planned to include the ecologically fragile zones (with the assumption that lower precipitation with meagre irrigation would indicate the agricultural vulnerability) but as the programme progressed the idea was substituted to cover all the regions. The increase in this coverage was not necessarily accompanied by the change in funding pattern. Broadly, the programme intended to cover five aspects. Firstly, the soil and water conservation forms the primary component for evolving efficient cropping systems. Second is the management of input support system for the supply of seeds, slipes and other inputs. Training courses for field staff and farmers to evolve a scientific management of the watershed forms the third aspect. This was also expected to be supported by preparation of scientific field manuals, publicity material, audio-visual aids for training. A proper land survey with scientific inputs for undertaking treatment based on land capability classification forms the fourth aspect of planning. Lastly, conducting and directing adaptive trials on the farms of marginal and small farmers, forms an essential part of the technology (GOI, 1986). The targets were given to the States along with the proposed allocation under the programme (Appendix 2.2). These aspects were translated into field components and possibly in the process the weights for the components were not taken care properly. Appendix 2.1 gives the pattern of assistance for different components of the programme.

The guidelines circulated in 1986 were silent on many aspects and at times the approach was not very clear. This has led to a lopsided implementation in many States. The neglected aspects mainly included - training of farmer's and staff; sustainable farming system approach; village/community participation; differentiation of work plan across agro-climatic conditions; development of farm tested watershed technology; planning for the holistic eco-system; concurrent monitoring and evaluation. These shortcomings were visualised in the process of implementation and the 1990 guidelines carried a holistic integrated approach in the place of the earlier approach (GOI, 1990, pp. 10-27).

The guidelines of 1990 insisted an integrated survey to be carried out in each of the watersheds before undertaking the treatments with a twin objective -

i) to collect facts and figures regarding production systems and environment for project formulation, and

ii) to establish Bench Mark for evaluation of impact made by the project on selected watershed parameters.

It was intended that these surveys should include (i) Resource inventory; (ii) Hydro-geological survey, (iii) Vegetative resources and vegetation survey; (iv) Production systems - including crop and cropping system, dry land horticulture, livestock and grazing, village industries; (v) Human resource availability; (vi) Infrastructural facilities. This was

intended to generate data so as to yield a systematic watershed plan. The major thrust of such a plan would be to generate a sustainable farming system with the help of an integrated development of watershed by incorporating village or community farming system, participation, training and institutional support. Monitoring and evaluation of the programme in such case becomes easy.

2.4 Maharashtra Experience

In Maharashtra, the NWDPRA was taken up since July 1986 adhering to the guidelines provided by the Central Government. As indicated earlier, the State Government had a comprehensive ongoing programme under COWDEP. Given the short time for planning and a clear clue that "... the approach under the scheme is to give maximum flexibility to the State Governments..." (GOI, 1986, p. 4) and 'Preference should be given to those areas where already soil survey and soil conservation programmes have been undertaken ...'; the Government of Maharashtra chose 20 watersheds out of each district which were undertaken for development earlier under COWDEP. Nineteen districts were chosen falling in the isohytes of 500 to 1125 mm of normal annual rainfall. Overall, 380 watersheds were taken for development under NWDPRA (See Appendix 2.3). The choice of the watersheds falling within the district was assigned to District Soil Conservation Officer (DSCO) and Principal Agricultural Officer (PAO) to work with a committee

at district level. Detailed plan of the treatments which will include structures as well as cultivation practices was asked to be worked out. The plan thus evolved was supposed to be discussed fully with the farmers. We however, did not come across any such detailed plan or any evidence of farmer's meetings in the selected regions.

Administratively, the Government of Maharashtra chose to handle the programme through its well knit organisation implementing CO:DEP. The administrative framework is shown in Appendix 2.4. It can be seen that the administrative structure is quite elaborate and the project level (watershed level) teams do not find any independent place in the structure. However, at village level, an agricultural officer and VLW man the programme. The guidelines of 1986 also included that 'The staff cost should be limited to 25 per cent of the expenditure on works'. This might have created a bottleneck to organise any expert team at watershed level. An analysis of the administrative structure suggests four aspects. Firstly, the functionaries have multifold responsibilities with a number of ongoing programmes, hence it is difficult for them to pay entire attention to this programme alone. Secondly, the design of the programme, mentions about an integrated approach but at implementation level NWDPRA is treated as an 'add on' programme. It would have been better had all the ongoing

developmental programmes in the watershed region were pooled together under one umbrella. Thirdly, the people manning the administrative set up should have a multidisciplinary background but the approach of administration is under a unidisciplinary set up. Lastly, the participation of the relevar departments from other disciplines (e.g. hydrology, meteorolog horticulture, economics, statistics and forestry) is minimal at the level of watershed. Hence, the horizontal linkages are quite weak. These difficulties however, do not in any way come in the way of programme implementation. But, an administrative set up with multidisciplinary team at watershed-level and woven together to form a State level machinery might help in effective implementation of the programme. The guidelines for the programme of 1990 include such an approach. It states that "This will be accomplished by a multi-disciplinary (emphasis ours) watershed development team (WDT) for each mini-micro watershed in consultation with the farmers..." (GOI, 1990, p. 29). In other words, a Karnataka model of administrative set up, implementation and monitoring would be more suitable (see Appendix 2.5).

The present study is intended to review the progress of the NWDPRA during the period 1985-87 to 1989-90. As indicated earlier, this programme was superimposed on the ongoing programme of COWDEP and hence, seggragating the impact of NWDPRA becomes difficult. Under this programme 380 watersheds were taken for the purpose of development with total area of

294603 hectares, averaging 775 hectares per watershed. Out of this area, about 97 per cent forms the arable land and only about 3 per cent is non-arable. The lower proportion of non-arable land is more by design than a random phenomenon, since under the 1986 guidelines it was proposed that the choice of watersheds should be such that it has a major portion under arable area.

Table 2.1 gives the overall picture of watershed programme (COWDEP) in Maharashtra and divisionwise proportion of

Table 2.1 : Divisionwise Completed Watersheds under COWDEP by Level of Completion

Division	Proportion of watersheds which are		
	100% completed	75% completed	50% completed
Thane	6.37	5.32	10.47
Pune	6.53	16.90	29.96
Nashik	25.45	29.98	30.96
Kolhapur	9.00	12.52	16.33
Aurangabad	21.09	18.64	37.29
Latur	35.49	15.13	35.63
Nagpur	41.20	26.89	32.39
Amravati	40.61	29.75	33.08

Note : Last two rows have some problem in totals.

Source : Centre for Development Studies, A Review of Watershed Development Programme in Maharashtra, Pune, 1991.

completed watershed under different categories by levels of completion. The development of watershed is a continuous process and its dynamic nature does not allow to call any watershed as completed in treatment. Initially this means only that the targeted work is achieved but maintenance of structures, infusion of new techniques can always be included later on. The table thus can be taken only as indicative and not confirmetry. The table shows wide variations across divisions. Nagpur and Amaravati zones are leading whereas, Thane, Pune and Kolhapur regions are lagging behind. No specific reason can be ascribed to these variations. On an aggregate the State has made commendable progress despite difficulties in the design and implementation.

As between the components, major achievements are under soil conservation and land management sector. It can be seen from the Table 2.2 that Rs. 1645.7 lakhs were spent during the period of approximately three years, of which the share of Government of Maharashtra was Rs. 822.83 lakhs. This works out to an expenditure of Rs. 4.33 lakhs per watershed and an investment of Rs. 1.44 lakh per year/per watershed. The overall expenditure per hectare for the treatment of the project area (Rs. 1645.7 lakhs for 294603 hectares) works out to Rs. 558.6 for the three years.[1] The estimated cost of development for a watershed was taken at Rs. 2500 per hectare according to 1986 guidelines and enhanced to Rs. 3500 per hectare

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1 In NWDPRA the work on all 380 watersheds started almost in the same year and the intended coverage was 294603 hectares.

in the 1990 proposal (GOI, 1986, p. 2 and GOI, 1990, p. 35). Expenditure incurred during the three years and targeted cost of development of watershed indicate either a largely unaccomplished work or the average normative cost is inflated or a sizeable amount of investment remains to be incurred during the next phase.

As among the components good progress seem to have been achieved under keyline formation; contour cultivation; land development which includes afforestation, plantations, levelling etc., and runoff management measures. Contour and graded bunding, farm ponds, reclamation of ill drained soils and diversion drains are relatively lagging components (see Table 2.3). The target for farm ponds itself seems to be very small.[2] The illustration of the components is not very clear at project level and possibly this causes some intermixing of achievements (e.g., bunding and keyline formation or diversion drains). But, this picture has wide variations across districts.

We have presented in Appendix 2.6 the districtwise cumulative achievements under different components. It can be seen that during the period under review, eleven out of the nineteen districts had the aggregate expenditure less than Rs. 2 lakhs per watershed. In Akola district it was only 0.426 lakh, but the achievements are not unimpressive (see Figures 2.1 and 2.2 for spread of expenditure across districts).

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2 The total potential of farm ponds is 32 which even does not come as one farm pond per watershed.

Table 2.2 : Componentwise Expenditure Incurred on NWDPRA

(Rs. in lakhs)

Components	Expenditure incurred during 1987-88			1988-89			1989-90(upto Feb.90)			Grand Total GOM (GOM share)
	GOI share	GOM share	Total	GOI share	GOM share	Total	GOI share	GOM share	Total	
1	2	3	4	5	6	7	8	9	10	11
Land and Moisture Management for Coppping Systems Introduction :										
1. Soil Conservation	169.52	169.51	339.03	134.57	134.58	269.15	94.71	94.72	189.43	398.80
2. Crop Demonstrations	74.88	74.89	149.77	114.97	114.97	229.94	93.11	93.12	186.23	282.96
3. Establishment Charges	-	-	-	62.55	62.55	125.10	17.75	17.75	35.50	80.30
Contingency Seed Stocking	42.38	42.38	84.76	-	-	-	-	-	-	42.38
Supply of Seedlings and grass seeds	-	-	-	-	-	-	-	-	-	-
Training	-	-	-	0.65	0.65	1.30	-	-	-	0.65
Adaptive trials on small and marginal farmers	-	-	-	-	-	-	-	-	-	-
Improved tools and equipments	-	-	-	-	-	-	-	-	-	-
Preparation of field manuals publicity materials audio visual aids for training etc.	17.74	17.75	35.49	-	-	-	-	-	-	17.74

Table 2.3 : Componentwise Progress of NWDPRA in Maharashtra 1987-88 to February 1990

Components	Units	Total potential	Per cent of cumulative achievements
Contour Bunding/Graded Bunding and Terracing	Ha.	52030	39.4
Runoff Management Measures	Nos.	1798	50.0
Land Development (Plantation, afforestation)	Ha.	7553	54.0
Reclamation of Ill drained soils	Ha.	1617	20.0
Diversion drains	RMt	692851	17.9
Key line formation and contour cultivation	Ha.	102776	55.5
Farm Ponds	Nos.	32	37.5

Notes : (1) Total potential indicates targets identified under NWDPRA

(2) Cumulative achievements are totals upto February 1990.

Source : National Watershed Development Programme for Rainfe Agriculture, 1990-91, Department of Agriculture, Government of Maharashtra, Pune, 1990.

Fig. 2.1 : Expenditure Per Watershed on NWDPRA (1987-88 to 1989-90)

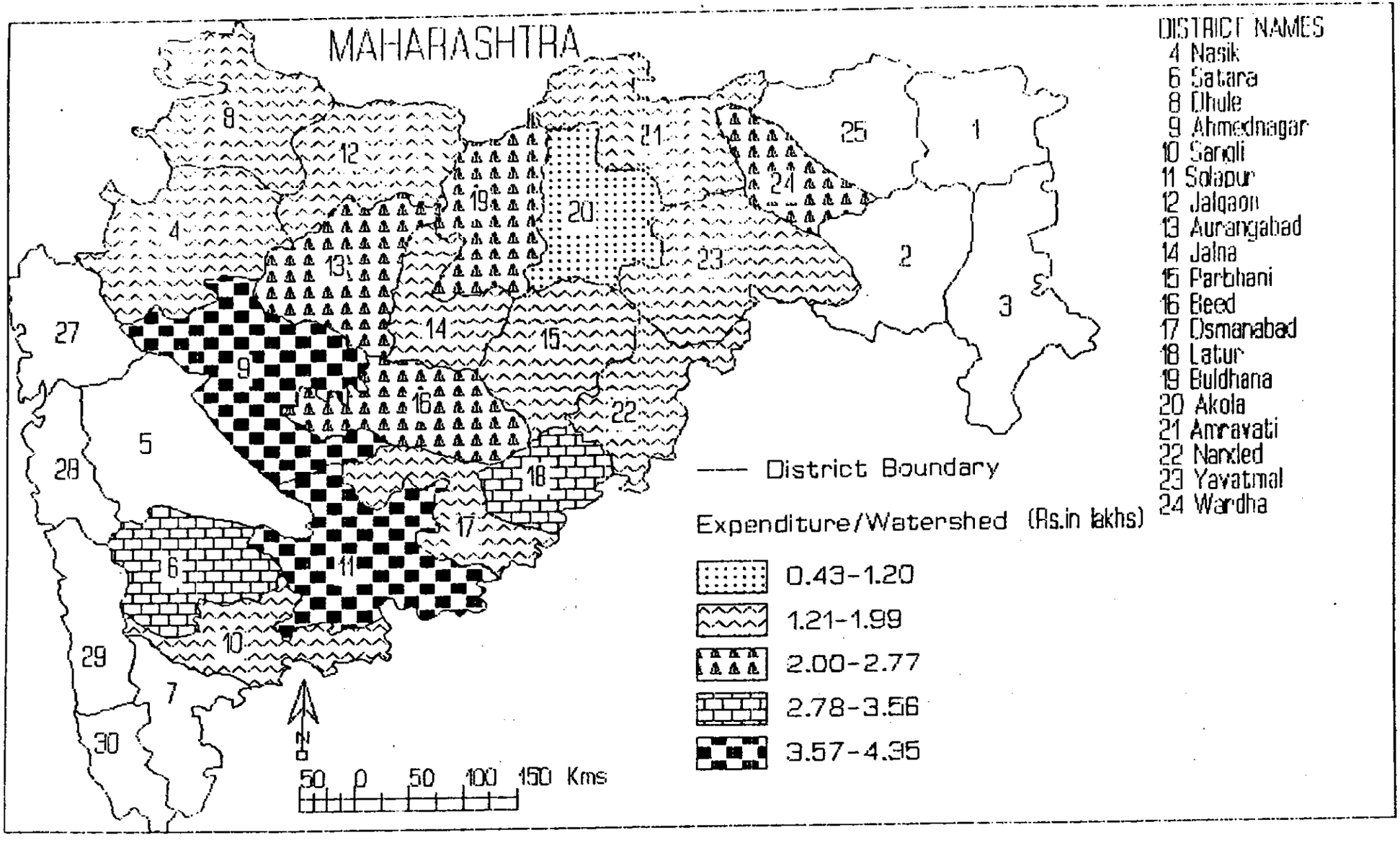
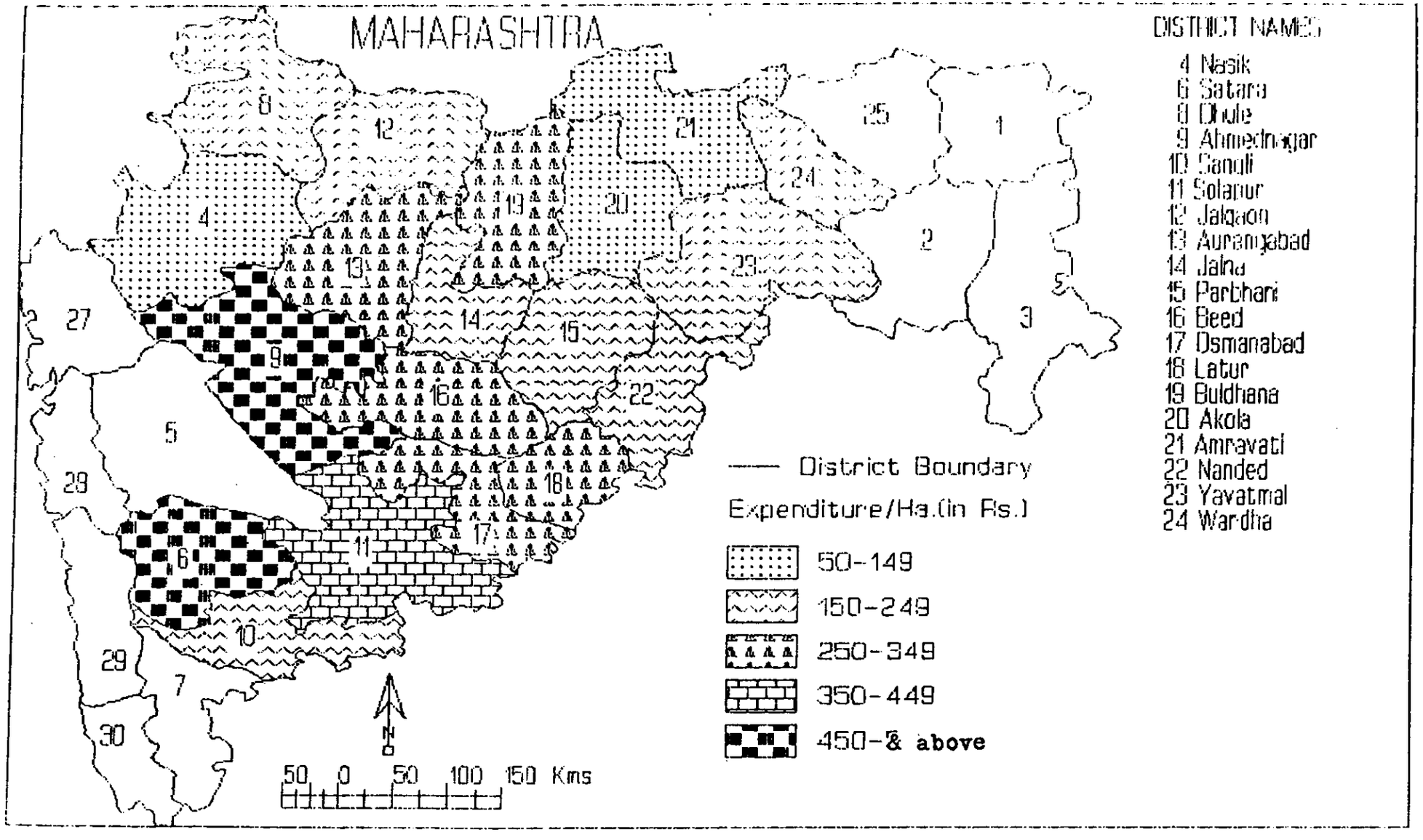


Fig. 2.2 : Expenditure Per Hectare on NWDPRA (1987-88 to 1989-90)



This suggests variations in the costs per unit of treatment across districts. As indicated earlier, the per hectare investment in the NWDPRA is quite low in the State, as compared to the suggested unit cost but the achievements are nevertheless impressive. In order to locate the lagging districts as against those with impressive performance, we categorised the districts into two groups based on a 50 per cent achievement threshold. Table 2.4 presents the picture at a glance. Run-off management, land development, keyline formation and contour bunding show better achievement for many districts, whereas diversion drains, contour bunding, graded bunding and terracing show a bunching of the districts in low achievement group. Among the districts Solapur, Beed, Nanded, Amaravati and Buldhana show an almost consistently good performance but Satara, Sangli, Nashik, Dhule, Jalgaon, Aurangabad, Parbhani, Osmanabad, Latur and Yavatmal show persistent lagging. Overall, the districtwise picture indicates four important issues. Firstly, there are wide variations across districts in the achievement levels. Secondly, among the components, a few have been quite successful and additional stress is needed to popularise the other. Thirdly, performancewise the districts indicate an agro-climatically bunding tendency (see Figures 2.3, 2.4, 2.5 and 2.6). Lastly, the expenditure does not commensurate with achievements, in fact, at a very low cost sizeable achievement could be attained. In other words, the present level of

Table 2.4 : Districts Categorised According to Componentwise Achievements

Sr. No.	Component	Code Numbers of the Districts	
		With more than 50% achievement of the target	With less than 50% achievement of the target
1.	Contour and Graded Bunding	2,12,16,18	1,3,4,5,6,7,8,9,10, 11,13,14,15,17,19
2.	Runoff Management Nalla Bunding,etc.	1,2,3,7,8,9,11, 12,15,18	4,5,6,10,13,14,16, 17,19
3.	Land Development cum Plantation	1,2,4,9,11,12,13, 17,18	3,5,6,7,8,10,14,15, 16,19
4.	Reclamation of ill drained soils	7,19	2,14,17,18
5.	Diversion drains	2,7,15,18	1,3,4,5,6,8,9,10,11, 12,13,14,16,17,19
6.	Keyline formation contour cultivation	1,2,3,4,10,11, 12,14,15,16,17,18	5,6,7,8,9,13,19

Notes : (1) Code Nos. of districts are : 1-Ahmednagar, 2-Solapur, 3-Satara, 4-Sangli, 5-Nashik, 6-Dhule, 7-Jalgaon, 8-Aurangabad, 9-Jalna, 10-Parbhani, 11-Beed, 12-Nanded, 13-Osmanabad, 14-Latur, 15-Amaravati, 16-Akola, 17-Yavatmal, 18-Buldhana, 19-Wardha

(2) The underlined districts show highest and lowest per cent achievements in the first and second group respectively. The same level of per cent achievement was observed in some of the districts, hence we find more than one district underlined under individual components and groups.

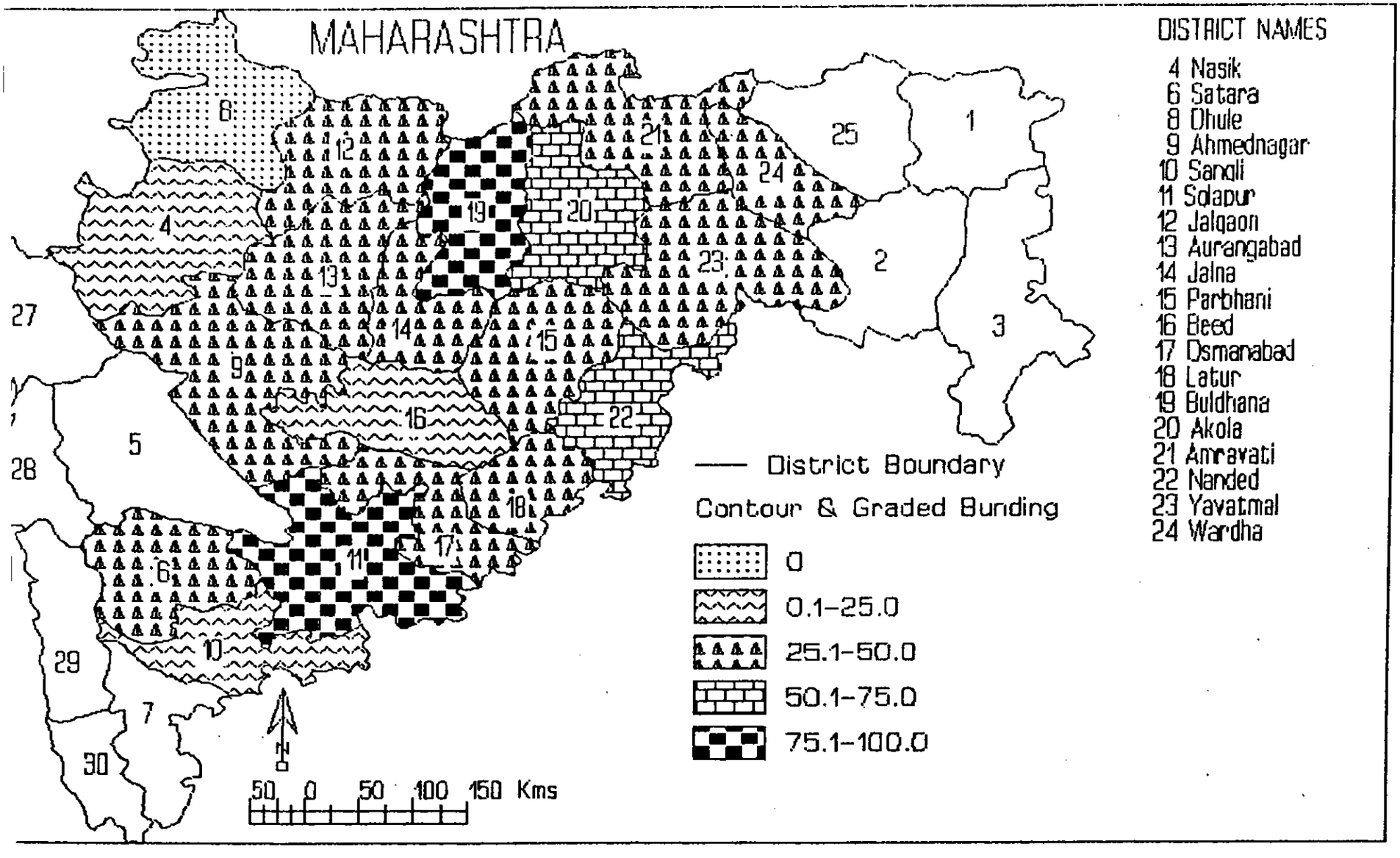

MAHARASHTRA
DISTRICT NAMES
4 Nasik
6 Satara
8 Dhule
9 Ahmednagar
10 Sangli
11 Solapur
12 Jalgaon
13 Aurangabad
14 Jalna
15 Parbhani
16 Beed
17 Osmanabad
18 Latur
19 Buldhana
20 Akola
21 Amravati
22 Nanded
23 Yavatmal
24 Wardha
District Boundary
Contour & Graded Bunding
0
0.1-25.0
25.1-50.0
50.1-75.0
75.1-100.0
N
50 0 50 100 150 Kms

Fig. 2.4 : Achievements Under Run-off Management and Nala Bunding (1987-88 to 1989-90)

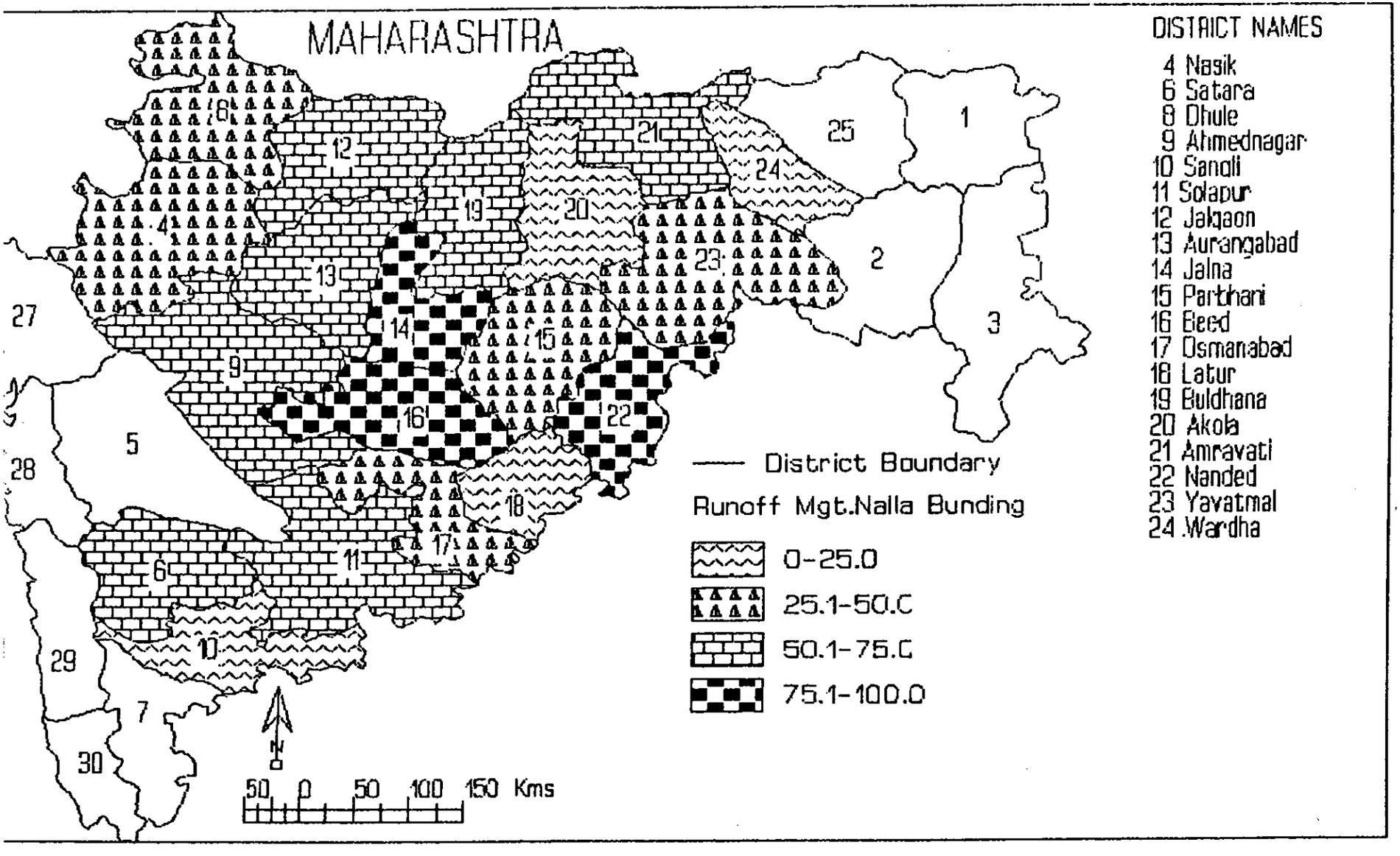


Fig. 2.5 : Achievements Under Land Development-cum-Plantation (1987-88 to 1989-90)

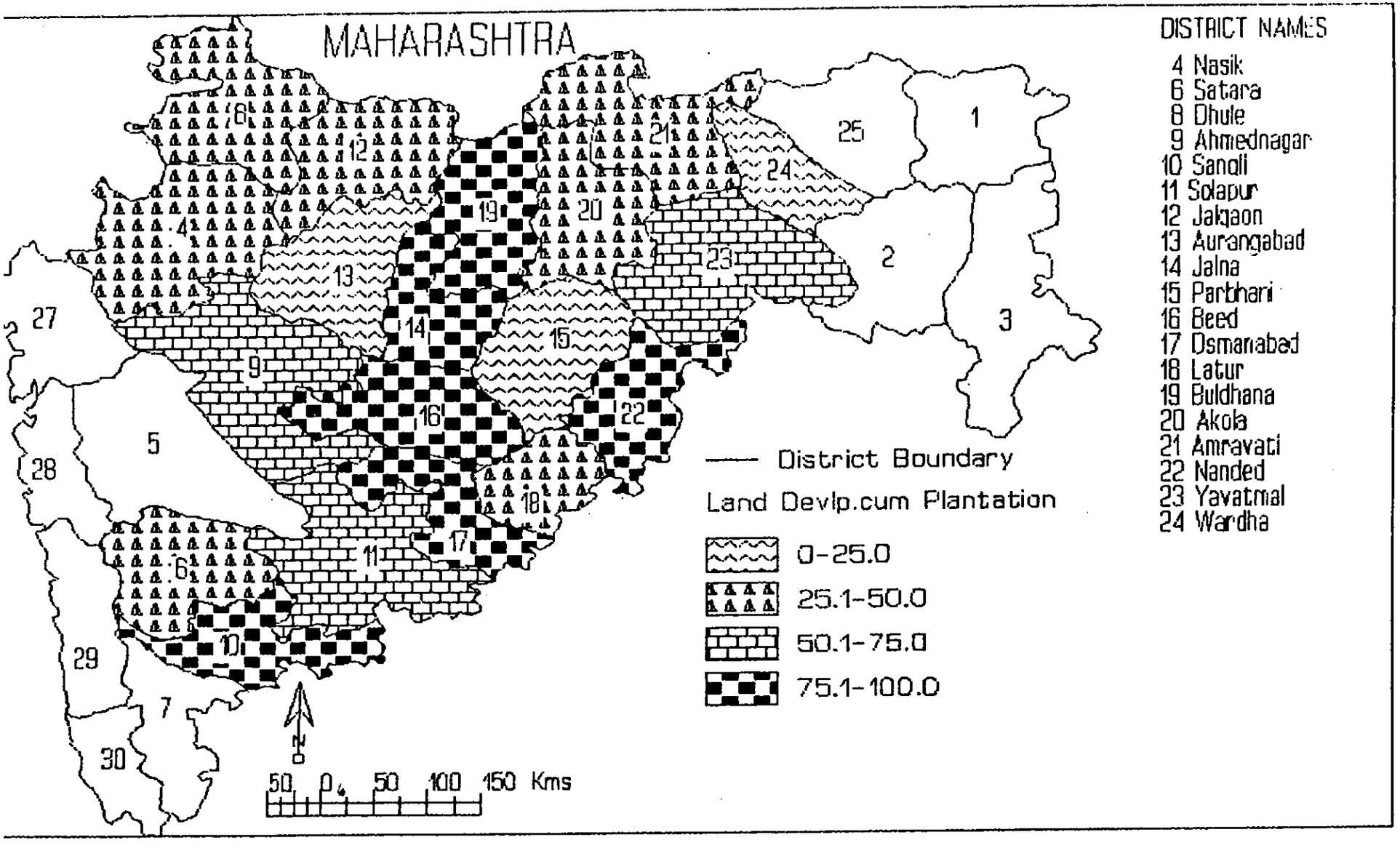
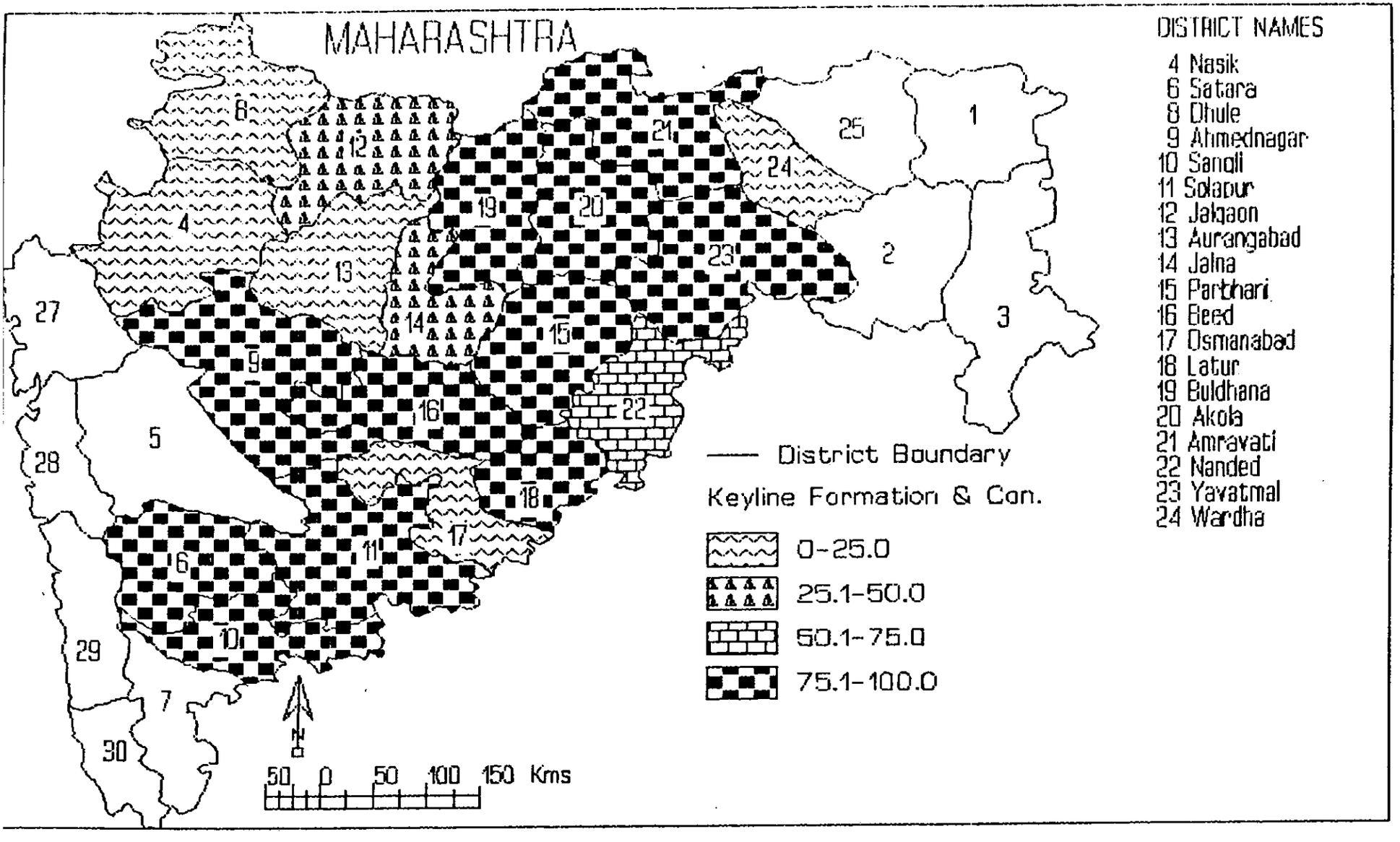


Fig. 2.6 : Achievements Under Keyline Formation (1987-88 to 1989-90)



accomplishment could have been surged ahead with an increase in expenditure.

2.5 Sample Region and Setting

In order to locate differential impact across agro-climatic zones we have chosen three situations falling in three distinct agro-climatic regions. First watershed belongs to Solapur district falling in the core scarcity zone of Maharashtra, with a long history of droughts and famines. The region is characterised by black soils of varying depth with dominance of shallow soils. The second watershed falls in moderate rainfall zone with deep vertisols. It is located in Malegaon taluka of Akola district. These two situations offer a good contrast as the assured rainfall region indicate asituation in between these two. The third watershed falls in Aurangabad district of assured rainfall region. The watershed area had shallow to deep black soils and very low vegetation.

Three situations chosen are agro-climatically different and also differ in terms of treatments. Table 2.5 presents some basic differences existing in the three situations. It is quite clear that given the terrain, agro-climatic characteristics and the soils, the package of treatment has to be different for these three locations. Ninth item in Table 2.5 indicates the activities covered in their order of importance. The difference in the location specific treatment is quite obvious. The proportion of irrigation varies across the watersheds, Krishnapurwadi having the highest proportion.

Table.2.5 : Basic Characteristics of Selected Watersheds

Characteristics	Wadegaon WS Solapur District	Krishnapur-wadi WS Aurangabad District	Ekamba WS Akola District
1. Agro-Climatic			
a) Annual rainfall(mm)	590	774	840
b) Precipitation characteristics	Low and variable	Moderate but fluctuating	High and moderately fluctuating.
c) Water availability	Low	Moderate	Moderate
d) Terrain	Flat	Hilly	Undulating
e) Soils	Ustrothents, Ustropepts	Pellusterts, Chromusterts Ustropepts	Pellusterts, Chromusterts
2. Total Population	2900	2126	1632
3. No. of cultivators	400	600	468
4. Area of Watershed	1098	1149	1196
5. Average Farm Size	2.68	1.91	2.56
6. % of Irrigated Area	3.17	18.90	12.10
7. % of Fallow Land **	8.80	12.50	12.60
8. Cropping Intensity*	125	131	116
9. Activities covered (By order of importance)	i) Land Development horticulture	Nala bunding and training	Contour and and graded bunding
	ii) Nala training	Contour and graded bunding	Reclamation of ill drained soils
	iii) Nala bunding	Afforestation and pasture development	Diversion drains
	iv) Graded and contour bunding	Land development and horticulture	Nala training

contd.

Table 2.5 (contd.)

Characteristics	Wadegaon WS Solapur District	Krishnapur-wadi WS Aurangabad District	Ekamba WS Akola District
	v) Dry farming practices	Dry farming practices	Nala bunding and other dry farming practices
10. % of Area Under Crops :			
Jowar	45.1	53.4	29.3
Wheat	-	7.6	4.6
Other cereals	44.3	20.1	6.9
Pulses	5.5	5.1	43.0
Groundnut	0.1	1.6	-
Sugarcane and cotton	-	10.8	15.6
Fruit crops	4.2	0.9	0.6
Fodder	0.8	0.5	-

Notes : * Annual crops are included only once while computing cropping intensity.

** Rows 7 and 8 are based on sample data.

Source : District Soil Conservation Offices at Akola, Aurangabad and Solapur.

Consequently, irrigation intensity in this watershed is also higher compared to the other two regions. As a result of this the cropping pattern has a significant presence of irrigated cash crops. Cotton, wheat and sugarcane find a place in the cropping pattern of this watershed. Surprisingly, the Ekamba watershed also has large share of its area under sugarcane and cotton despite having lower irrigation. Pulses

dominate in the crop pattern of Ekamba, whereas cereals hold an important place in the other two watersheds. In final analysis, we can say that these three interesting cases present conspicuous similarities along with curious contrasts. The preliminary analysis provokes to analyse the hypothesis relating regional peculiarities in the impact and implementation of watershed technology. (For details of the watersheds see the Figures 2.7, 2.8 and 2.9).

2.6 Summary

This chapter reviewed the design and implementation process of NWDPRA in Maharashtra. The programme initiated by the Central Government underwent a revision in late 1990. The lacunae in the 1986 guidelines were corrected in the revised guidelines. The process now begins with preparation of a detailed project report for each of the selected watersheds and the implementing authority has to prepare a stagewise programme for the developmental framework. The NWDPRA has now been extended to the areas falling in heavy rainfall region in contrast to the earlier philosophy of bringing the lagging regions at par with the developed ones and correcting the imbalances in the fragile eco-systems. Our review suggests that a regional differentiation is essential in the implementation of the programme, when we are faced with pockets of underdeveloped fragile eco-systems amongst the well developed commercial agriculture.

Figure 2.7 : Watershed in Scarcity Region

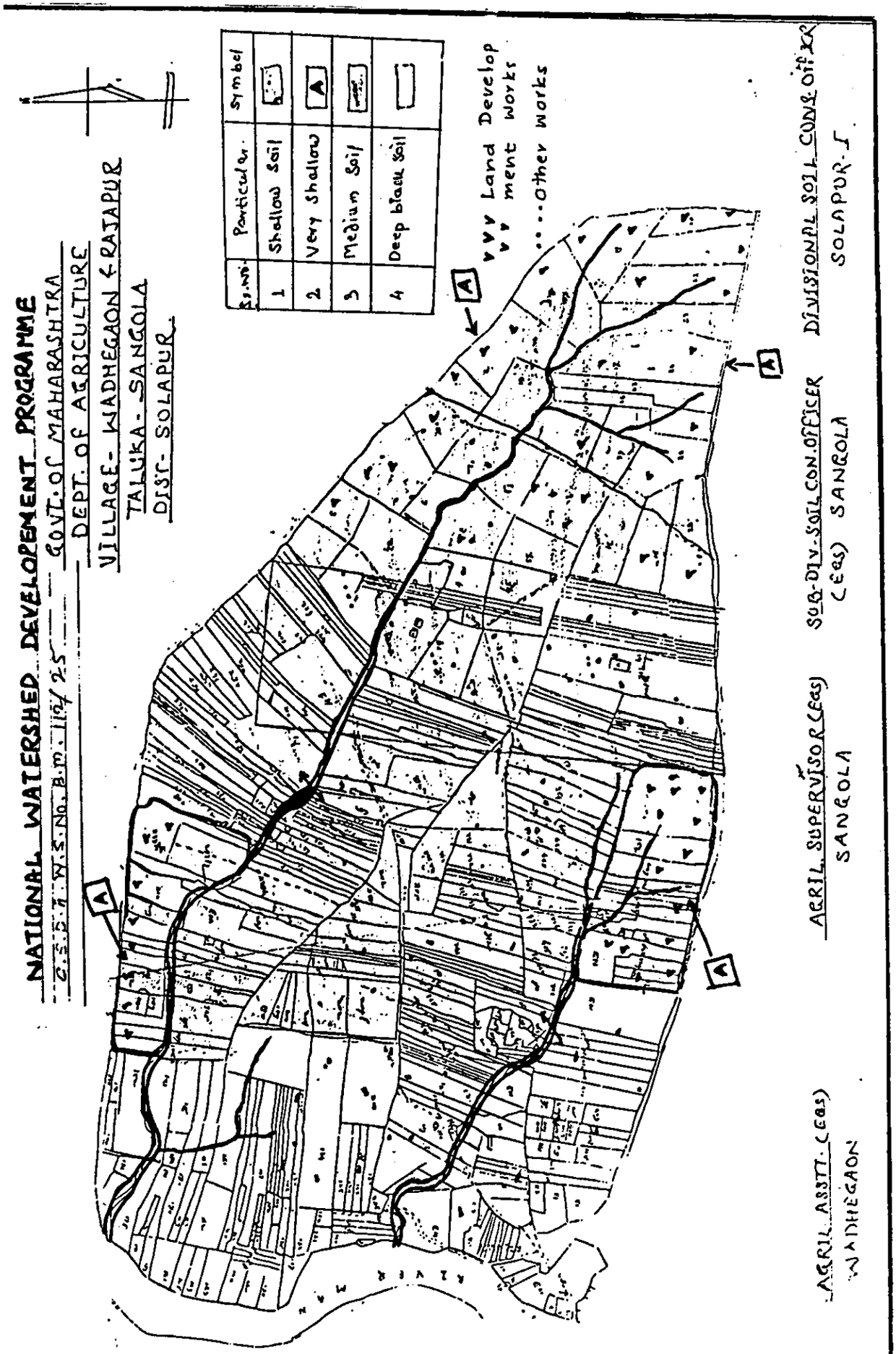


Figure 2.8 : Watershed in Moderate Rainfall Region

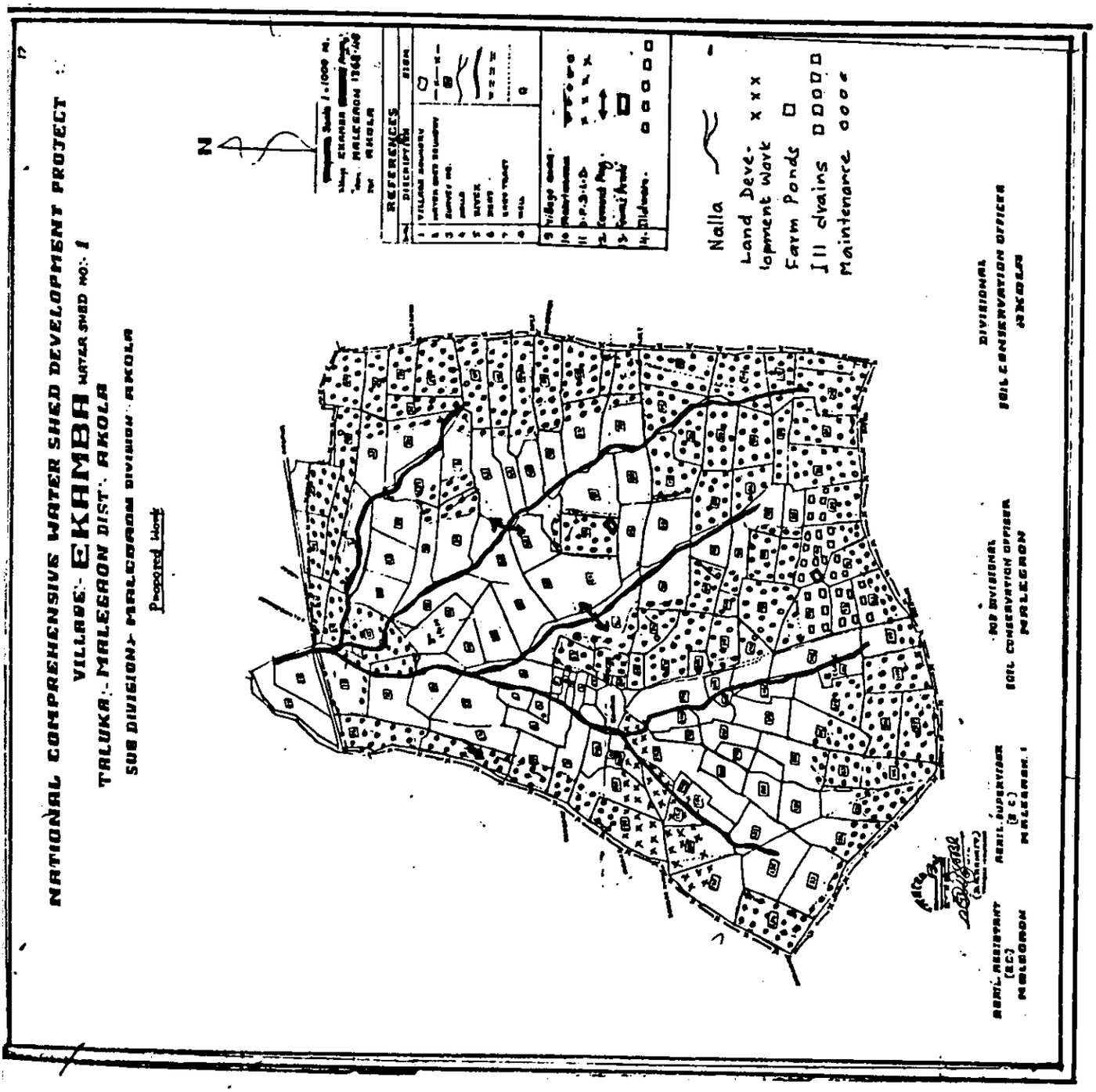
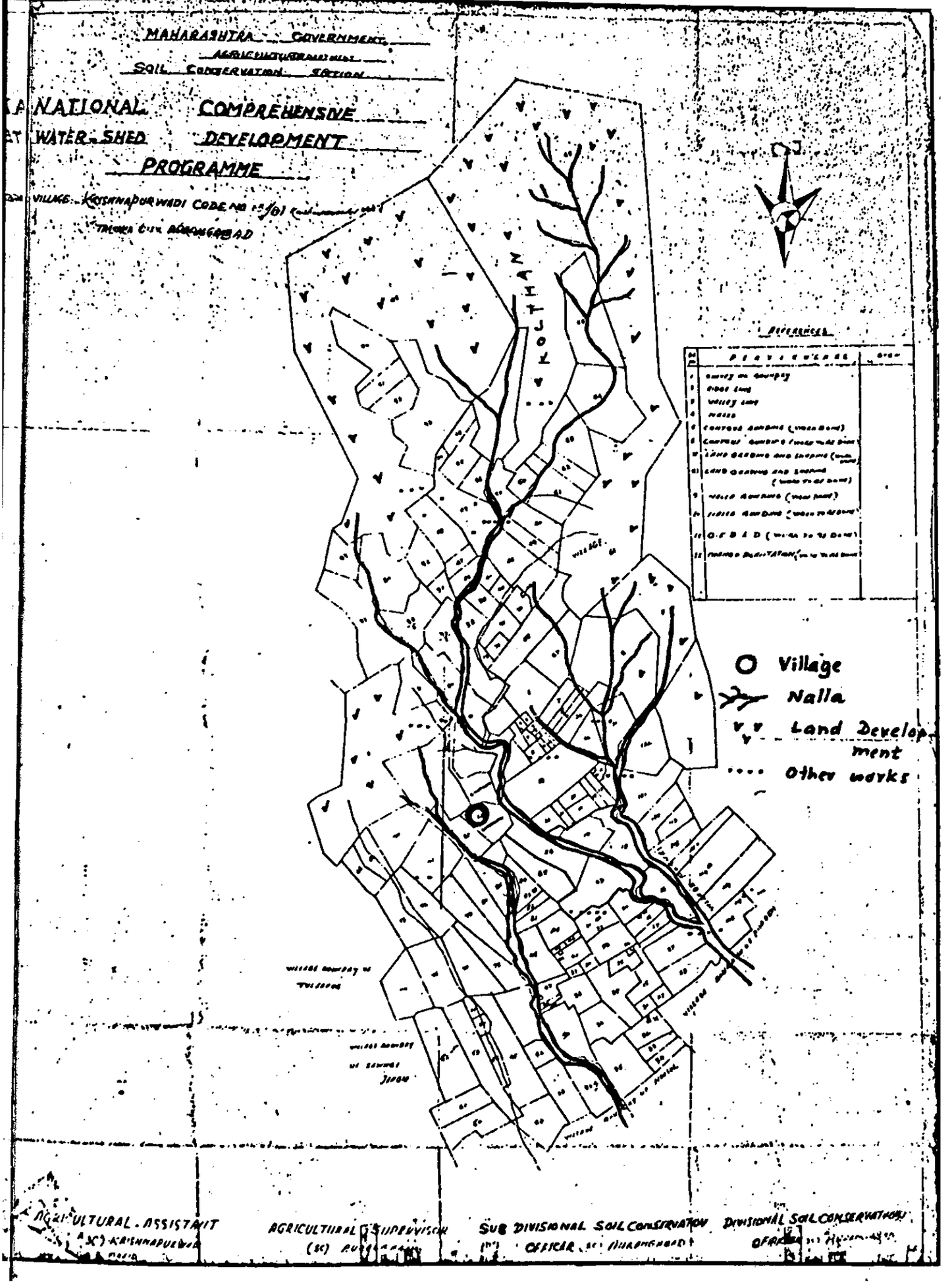


Figure 2.9 : Watershed in Assured Rainfall Region



The performance of the programme at State level across components and within components across districts showed wide variations. These variations are not chance factors and neither they are correlates of socio-economic parameters. Hence, more attention needs to be given to the districts and watersheds where the performance indicators showed consistently lower achievement rate. The administrative system working on implementation of the NWDPRA at watershed level needs a serious review, preferably on the experience of Karnataka programme. The technical input at the disposal of the functionaries at watershed level is extremely limited and needs to be enhanced. The State Government preferred not to utilise the 25 per cent of the grant on the staff, had this money been used to butress the skills at the lower level functionaries, the programme would have had exemplary results.

Appendix 2.1 : Componentwise Pattern of Allocation in NWDPRA

Sr. No.	Component	Pattern of assistance
1.	Land moisture management works for cropping systems introduction, dryland horticulture, fodder production and farm forestry.	50% of the cost which has a ceiling of Rs.2,500/- per ha. would be borne by Government of India as grant-in-aid to the State Governments who would meet the balance 50% cost from their own plan resources.
2.	(a) Contingency Seed Stocking	Cost to be charged by the Government of India and State Governments 50:50
	(b) Supply of seedlings and grass seeds/slips	- do -
3.	Training :	
	(1) Organization of short-term training courses, seminars, field tours for staff and farmers etc., within the State	Cost to be shared by the Government of India and State Governments on 50:50 basis.
	(2) Training courses, seminars, study tours etc., at regional/national level	100% by the Government of India
4.	Conducting of adaptive trials in small and marginal farmers' fields	Actual cost to be shared by the Government of India and State Governments on 50:50 basis and paid to SAU/Research Centre/Organisation undertaking the research activity.

contd.

Appendix 2.1 : contd.

Sr. No.	Component	Pattern of assistance
5.	Improved tools and equipment (1) Purchase of survey equipment	Actual cost to be shared by the Government of India and State Governments on 50:50 basis and paid to SAU/Research Centre/Organisation undertaking the research activity.
	(2) Fabrication of adequate number of prototypes of newly designed hand and draught powered tools for testing in the field.	Actual cost to be shared by Government of India and State Governments on 50:50 basis to be paid to Agro-industries Corporation, SAU, other organisations, including private entrepreneurs.
6.	Preparation of scientific field manuals, publicity materials, audio-visual aids for training including video cassettes and monitoring staff requirement at the Central level.	100% by Government of India to be paid to the concerned agency.

Notes : SAU = State Agricultural Universities.

Source : Government of India, Guidelines of National Watershed Development Programme, July 1986.

Appendix Table 2.2 : Statewise Annual Allocation of Funds and Physical Targets

Sr. No.	State	Annual Physical targets (1000 ha.)	Annual Outlay on works component @ Rs.2500	Central share (Rs. in crores--)	State share
1	2	3	4	5	6
1.	Andhra Pradesh	32	8.00	4.00	4.00
2.	Gujarat	32	8.00	4.00	4.00
3.	Haryana	2	0.50	0.25	0.25
4.	Karnataka	36	9.00	4.50	4.50
5.	Madhya Pradesh	28	7.00	3.50	3.50
6.	Maharashtra	40	10.00	5.00	5.00
7.	Himachal Pradesh	2	0.50	0.25	0.25
8.	Rajasthan	24	6.00	3.00	3.00
9.	Uttar Pradesh	16	4.00	2.00	2.00
10.	Tamil Nadu	8	2.00	1.00	1.00
11.	Bihar	4	1.00	0.50	0.50
12.	Orissa	4	1.00	0.50	0.50
13.	West Bengal	1.6	0.40	0.20	0.20
14.	Kerala	0.8	0.20	0.10	0.10
15.	Punjab	0.8	0.20	0.10	0.10
16.	Assam	0.8	0.20	0.10	0.10
Total		232	58.0	29.0	29.0

Source : Government of India, Guidelines, National Watershed Development Programme, July 1986.

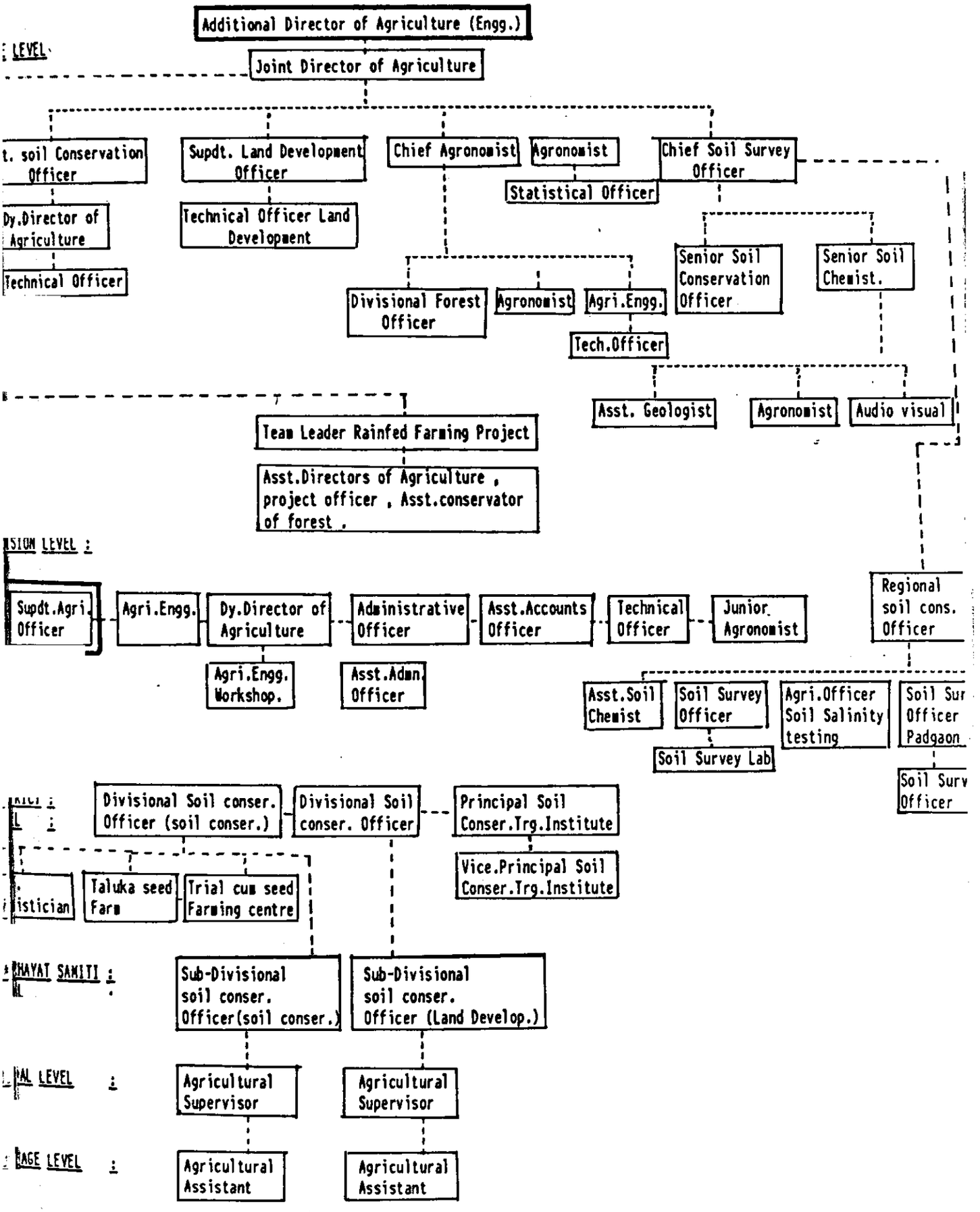
APPENDIX 2.3 : Districtwise Picture of Watershed Programme of Maharashtra (NWDPRA)

SR. NO.	District	No of Watershed	Geographical area	Cultivable Area	Componantwise Total potential					
					C.B. / G.B.	R.M. Nallbunding	L.D./P.P.	Keyline formation / contour cult	Reclaimation of ill-drained area	Diversion Drains(RMT)
1	Ahmednagar	20	17052	14278	1061	201	410	2083		46190
2	Solapur	20	19859	18691	1118	114	1144	9545	241	71444
3	Sangli	20	14975	10591	3715	173	475	8259		26100
4	Satara	20	15160	10563	1551	202	555	1026		82855
5	Nashik	17	14986	11394	281	126	467	1557		27580
6	Jalgaon									
7	Dhule	10	8620	5313	2	57	77	4580		70724
8	Amraoti	20	16602	14983	4894	28	34	4477	102	
9	Buldhana	20	22545	16822	5003	88	22	3234	322	
10	Yavatmal	20	20586	15501	4797	120	107	3382	85	36906
11	Akola	15	11132	10855	1261	19	90	6230	3	7400
12	Aourangabad	12	9862	7583	578	40	272	598		61770
13	Jalna	20	17889	16392	2524	39	96	1016		7400
14	Beed	11	9096	8024	548	28	231	586	5	
15	Nanded	6	5568	4806	663	10		300		19260
16	Osmanabad	19	14806	14630	1291	37	217	950		5220
17	Parbhani	20	18954	16639	4430	24	75	1037	54	8712
18	Latur	9	9196	8466	1620	13	327	464	207	800
19	Wardha	19	18756	16672	6287	80	1106	14387		25470
Totals		298	265644	222203	41624	1399	5705	63711	1019	497831

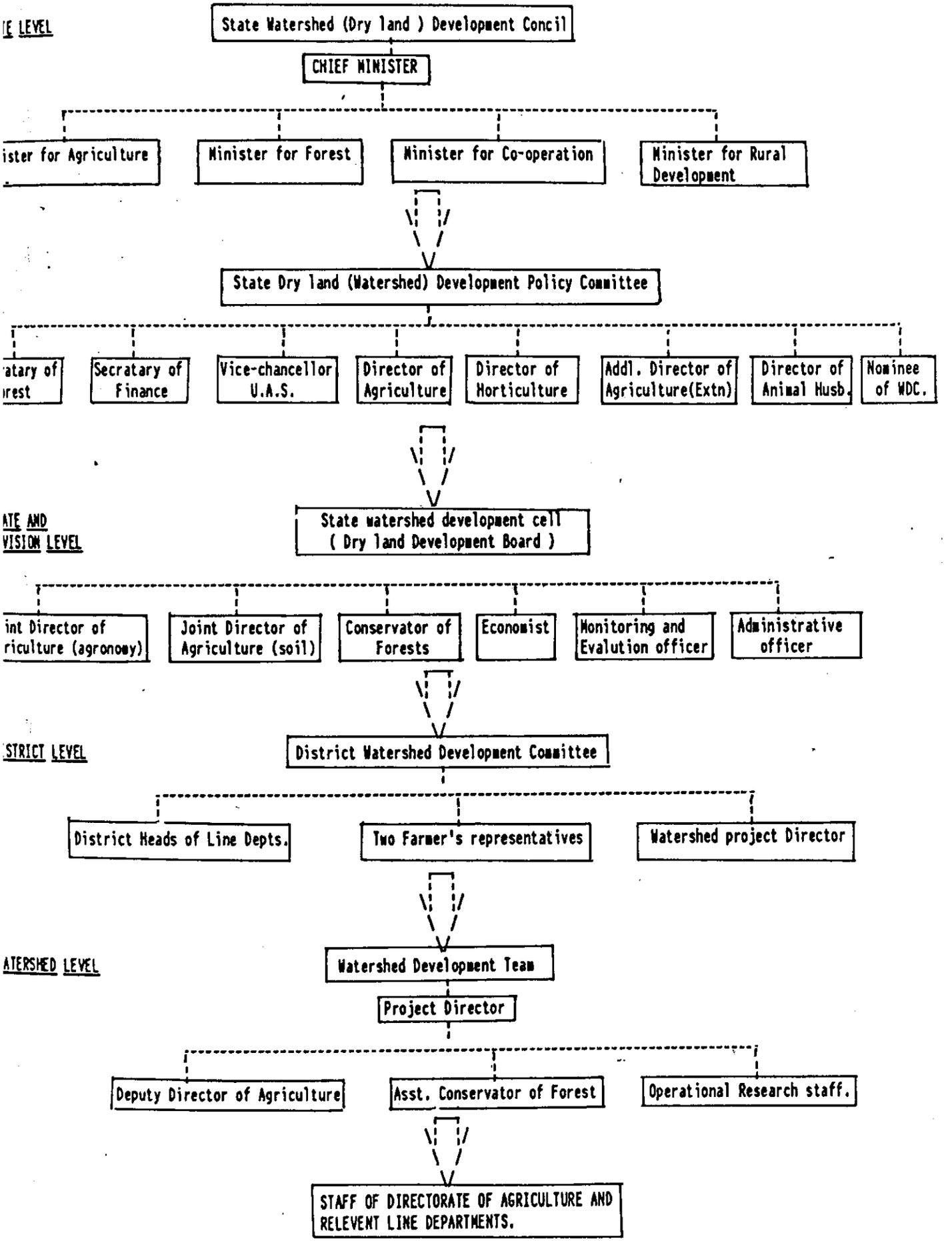
NOTE : C.B. & G.B.- Contour & Graded Burdings; R.M.- Runoff Management; L.D. & P.P.- Land Development & Plantation.

SOURCE : Statement showing componantwise work potential in (NWDPRA) National Watershed Development Project on Rainfed Agriculture in Maharashtra Directorate of Agriculture, Govt. of Maharashtra , Pune 1989

DIX 2·4 : ADMINISTRATIVE STRUCTURE FOR WATERSHED DEVELOPMENT (NWDPRA) MAHARASHTRA



NDIX 2·5 : ADMINISTRATIVE STRUCTURE FOR WATERSHED DEVELOPMENT
KARNATAKA



Appendix 2.6: Districtwise Achievements under different Components in NWDPRA

Sr. No.	Districts	Contour and Graded Bunding Terracing		Runoff Management Nalla bunding etc		Reclamation of ill drained soils		Land Development cum Plantation		Diversion Drains		Keyline Formation and contour		Expenditure per Watershed Rs.in Lakhs	Proportion of Non-arable land (%)	Expenditure per hectare in Rs.
		Total Potential in Ha.	Percent Achieved	Total Potential Nos.	Percent Achieved	Total Potential in Ha.	Percent Achievement	Total Potential in Ha.	Percent Achieved	Total Potential Rmt.(000')	Percent Achieved	Total Potential in Ha.	Percent Achieved			
01	Ahmednagar	1061	39.2	201	69.1	-	-	435	56.6	40.40	41.0	2134	90.5	4.039	3.0	552
02	Solapur	1156	84.7	117	71.8	241	22.4	1244	58.2	71.40	60.7	9599	76.4	4.356	6.7	442
03	Satara	1605	36.2	196	51.0	-	-	557	37.0	95.20	0.9	1293	100.0	3.121	5.4	573
04	Sangli	3731	9.4	173	11.0	-	-	500	100.0	26.10	0.0	8258	100.0	1.442	3.7	202
05	Nasik	270	1.1	145	35.2	-	-	622	35.4	26.90	0.0	11390	19.2	1.225	4.0	145
06	Dhule	755	-	141	45.4	-	-	354	35.0	103.50	6.8	9740	3.4	1.240	2.9	220
07	Jalgaon	987	32.9	145	66.2	5	100.0	287	26.1	42.50	78.1	12340	30.0	1.705	1.9	241
08	Aurangabad	2124	45.3	86	60.5	-	-	330	17.0	94.10	8.6	1048	2.4	2.288	2.2	300
09	Jalna	2524	36.0	49	100.0	-	-	146	100.0	7.40	0.0	1006	37.5	1.653	0.6	183
10	Parbhani	4159	36.1	21	47.6	-	-	204	9.8	8.30	0.0	1580	100.0	1.820	1.1	214
11	Beed	1145	21.6	71	78.8	-	-	317	100.0	21.40	11.9	1080	100.0	2.287	2.4	278
12	Nanded	1537	59.9	38	100.0	-	-	45	100.0	44.20	0.0	1000	52.3	1.877	0.0	237
13	Osmanabad	1291	40.8	39	43.6	-	-	217	76.0	6.80	0.0	1000	1.2	1.996	1.6	254
14	Latur	5741	42.6	25	20.0	760	12.1	800	26.4	22.40	0.0	1000	78.6	3.303	3.6	317
15	Amaravati	4894	43.5	28	53.6	102	-	35	37.1	0.04	100.0	7165	100.0	1.134	0.2	141
16	Akola	2020	53.8	33	6.1	69	-	196	28.6	13.40	29.9	9826	100.0	0.426	1.3	51
17	Yavatmal	4797	34.9	120	40.8	86	3.5	107	54.2	36.90	23.1	3560	100.0	1.768	0.7	214
18	Buldhana	5503	79.4	86	55.7	322	42.9	28	100.0	0.64	100.0	4314	100.0	2.585	0.2	264
19	Wardha	7230	31.5	81	3.7	32	100.0	1129	23.4	31.80	0.0	15441	18.0	2.031	5.6	179

Notes : (1) The data given in the table are cumulative totals for 1987-88,1988-89 and 1989-90 (till Feb. 1990) .

Source : Department of Agriculture , Government of Maharashtra , National Watershed Development Programme for Rainfed Agriculture , Pune , 1990 .

CHAPTER III

IMPACT OF WATERSHED TREATMENT IN SCARCITY ZONE

3.1 Introduction

The Deccan plateau has conspicuous characteristics with predominance of drought-prone areas and hard rock dominated acquifers. Famines and scarcities are the frequent calamities faced by the region. The portion of Central Maharashtra with the 9 districts spread over more than 70 talukas form the core of this region. Sukhathankar Committee delineated twelve districts as drought-prone districts in the State (GOM, 1973). Out of these,Solapur and Ahmednagar (excluding irrigated portions) are the chronic drought affected areas.It was brought out in the earlier chapter that the watershed treatment technology has large scope in the rainfed areas. The scarcity zone forms the core of the problem of rainfed agriculture. Hence, we attempt here an analysis of the impact of watershed treatment programme in the scarcity zone of Maharashtra.

The scarcity zone of the State is spread over eleven districts of Central Maharashtra falling in the immediate rain shadow region of the State. It is bounded by the isolines of 700 mm of annual average rainfall on both the sides and predominant in brown to black calcareous soils with varying depths. There are large patches of degraded lands with absolutely negligible forest cover. Historically, this

region has been one of the worst drought affected areas. The Mangalwedha famine has even been recorded in the writings of the Marathi saints. This zone gets included in the fragile resource region of the State with high intensity of ecological degradation. The sample region (Wadegaon watershed in Sangola taluka of Solapur district) is a typical representative of the core scarcity zone. In fact, the neighbouring villages have better eco-systems as compared to this watershed area.

Theoretically, the impact of watershed treatment in a scarcity zone would be mostly guided by six factors. Firstly, there are various levels of degradation present in the zone and the composition of treatment would vary according to the stage of degradation. Secondly, the scarcity zone is located in the hard rock region of the Deccan plateau and hence, the groundwater availability is constrained by the hard strata. Thirdly, the region is characterized by varying soil depths but dominated by shallow soils limiting the water holding capacity. Hence, the accumulated moisture cannot be sustained for a longer period and this phenomenon varies according to slope and vegetation present in the region. Fourthly, the treatment of watershed in a core scarcity zone has twofold objectives. It is necessary not only to increase the flow of cash but also to stabilize the net income. Many times, the stability of cash flows and survival from violent fluctuations undermine even the objective of achieving a high level of income. Fifthly, the deforestation and degradation of

biomass increases the gestation period for the watersheds falling in the scarcity zone. Higher the level of degradation of the eco-system, longer would be the time taken for its replenishment. The flow of benefits begin only at the time when the progess of degradation is partially averted. Lastly, the viability analysis of any watershed programme hence, should consider the local level parameters in order to arrive at a proper gestation period and computing the flow of funds.

As indicated earlier, we have chosen a comparison of beneficiaries from project areas with those of non-beneficiaries from a non-project region. We have carefully chosen the non-project region in the vicinity of the watershed area, though certain post-selection factors of the agrarian structure could not be excluded at the pre-selection stage. As noted above, the watershed treatment in a scarcity zone is expected to bring stability in the yield levels; replinishment of the soil structure and eco-system; increased availability of food, fuel and fodder and then increase in the cash flows.

In the present chapter, we intend to analyse the impact of watershed treatment in a typical watershed of scarcity zone. Our analysis involves not only assessing the pattern of differences revealed by the comparison but also to indicate possible future changes in the agrarian economy. The impact of the watershed treatment on the stability of income flow and the level of inequality is also analysed.

3.2 Impact on Land Use Pattern

The dominant components of watershed treatment technology are soil and water conservation. Hence, direct impact of watershed development activities will be on the land utilization pattern both at village and farm household level. It is expected that there would be significant differences in land use pattern, cropping intensity, crop combinations and resource intensity per unit of land between the beneficiary and non-beneficiary groups. It can be observed from Table 3.1 that average size of holding of beneficiary farmers is higher than that of non-beneficiary farmers, though this difference cannot be attributed to the NWDPRA programme. The proportion of area under irrigation is higher in the non-beneficiary group with groundwater as major source of irrigation. This need not indicate any relation with watershed technology and it is quite clear that in the short run watershed treatment may not immediately lead to an increase in irrigation facilities, especially in scarcity zones.[1] On the contrary, short run impact may suggest an improvement in moisture availability. This point gets confirmed when the cropping intensities of both the groups are observed. The differences in the cropping intensities of these two groups are not as large as the differences in the levels of their irrigation. In fact, when we look at the cropping intensity of

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1 In our earlier study also it was observed that there was no increase in area under irrigation in a low rainfall region after the advent of watershed. See R.S. Deshpande and V.Ratna Reddy, "Evaluation Study of the Centrally Sponsored Scheme of Assistance to Small and Marginal Farmers for Increasing Agricultural Production", GIPE, Pune, 1990.

Table 3.1 : Land Utilisation of Beneficiaries and Non-Beneficiaries

Parameters (Units)	Beneficiary Group Farm Sizes				Non-Beneficiary Group Farm Sizes			
	I	II	III	All	I	II	III	All
1. No.of Farmers (Nos.)	15	15	15	45	5	5	5	15
2. Average Farm Size (ha)	1.42	2.97	8.35	4.25	0.96	3.14	4.69	2.93
3. % Area Irrigated (%)	23.42	20.68	9.42	13.60	50.1	20.28	13.63	25.45
4. % of Fallow and Uncultivated Land	1.87	4.05	7.66	6.17	-	3.19	-	1.14
5. % of Cultivable Waste to Total Area Owned	-	-	3.99	2.62	-	-	-	-
6. Crop Intensity (%)	129	130	123	125	108	127	137	130

Note : Size Classes are: I - Below 2 hectares; II - 2 to 4 hectares;
III - Above 4 hectares.

unirrigated lands alone then the watershed region is in an advantageous position. In the watershed region cultivation is more intensive in relation to level of irrigation when compared to non-watershed region. In some of the size classes, we find higher crop intensities with low irrigation level. The argument of intensive cultivation in the watershed regions draws further support from the proportion of fallow and uncultivated lands. The higher proportion of fallow and uncultivated lands in the watershed region may be due to the location specific nature of the technology. The reduction in proportion of cultivated lands is caused by pushing the marginal lands under silvi-horti-pastoral treatments, especially in the regions where the lands are already degraded, in favour of intensive cultivation. It is possible that the changes might have been introduced by new cropping systems. Further, the reduction of cultivated area with increased cropping intensity under low moisture availability suggests higher resource intensity after the watershed treatment technology.

As far as the variations across size classes are concerned, an inverse relationship between farm size and level of irrigation, under utilization of land, and crop intensity can be observed in the case of beneficiary households. The non-beneficiary farms also reveal a similar pattern in the case of irrigation, though the relationship between farm size and crop intensity seem to be positive. Such a relationship arises due to the dominance of specific crops in the cropping pattern across size classes. Hence, it is also necessary to look into

Table 3.2 : Cropping Pattern of Beneficiaries and Non-Beneficiaries

(Per cent of Gross Cropped Area)

Crops	Beneficiary Group				Non-Beneficiary Group			
	Farm Sizes				Farm Sizes			
	I	II	III	All	I	II	III	All
1. Bajra	53.47	38.09	46.90	45.49	9.60	18.50	12.43	14.22
2. Jowar	17.69	23.83	13.15	16.42	76.77	61.48	61.40	62.91
3. Wheat	-	0.72	0.38	0.42	7.68	7.51	-	3.89
4. Cotton	-	-	0.31	0.19	-	-	6.54	3.69
5. Sunflower	-	-	5.50	3.38	-	4.90	-	1.66
6. Chillie	-	-	0.38	0.23	-	5.33	1.31	2.55
7. Tur	0.37	-	5.35	3.33	-	1.09	4.58	2.95
8. Matki	8.67	7.94	10.79	9.79	2.88	-	7.20	4.34
9. Hulga	10.95	8.86	9.28	9.39	3.07	-	-	0.30
10. Sugarcane	1.47	3.61	0.31	1.31	-	-	1.31	0.74
11. Vegetables	-	-	1.15	0.70	-	-	-	-
Others	7.38	16.95	6.50	9.35	-	1.19	5.23	3.35

the differences in cropping pattern of the group of beneficiaries as against that of non-beneficiaries.

The basic differences in cropping pattern show that bajra is a predominant crop in the watershed region while jowar takes the major share of area on the non-beneficiary farms. On the whole, the cereal crops occupy 80 per cent of the area in the non-watershed area as against 60 per cent in the treated region. The reduction in cereal dominance gives clue to the increased diversification in the beneficiary group. In the case of beneficiary households, crops like matki, hulga and other fodder crops also find place in the crop portfolio of farmers (see Table 3.2). Even sugarcane can be seen in all the size classes of beneficiary households, where as it is grown only by large farmers in the case of non-beneficiary group. On the whole, crop diversification is more in the watershed region than that of non-watershed region. This suggests increased level of commercialization in watershed region but it is confined only to some size classes. The cropping pattern across size classes indicate that small and marginal farmers are subsistence oriented irrespective of the technology adopted, where as, medium and large farmers allot a substantial portion of their land to other crops.

3.3 Productivity, Cost of Production and Income Inequality

The most important aspect of the impact of any programme is the change in yield rates. Changes in yield rates reflect the direct and tangible impact of the programme.

Hence, the acceptability of the programme mostly depends on its impact on yield rates and production. However, yield improvement cannot solely be attributed to the watershed technology. A complex set of variables cause the changes in levels of yield between the groups. We are only highlighting here the differences between the two groups.

On the face the differences in yield levels in watershed and non-watershed areas indicate that the performance of all the principal crops except sunflower in the latter region is better than those of the former region. However, across size classes the differences between the groups reveal that the yield rates on the small, marginal and medium farms in the watershed region are better than those of their counterparts in non-watershed region. This indicates that watershed technology is better adopted by the small, marginal and medium farmers which may be due to their increased resource intensity. On the other hand, the overall higher yield rates in the non-programme region may be due to the irrigation facilities and crop combinations. It can also be deduced that factors like irrigation are judiciously utilized by the large farmers of the non-beneficiary group than the beneficiary group. The explanations for this may be sought from the input use pattern.

The farm level input use pattern across size classes for both the groups is presented in Table 3.4. Though the cropwise input data would have helped us in deriving relationships between input use and yield rates, we are presenting here only

Table 3.3 : Yield Rates Per Hectare of Principal Crops

(In Quintals)

Crop	Beneficiary Group				Non-Beneficiary Group			
	Farm Sizes				Farm Sizes			
	I	II	III	All	I	II	III	All
1. Bajra	4.53	4.24	2.67	3.29	2.00	3.38	5.26	4.22
2. Jowar	4.06	6.76	1.86	2.88	7.50	4.51	5.01	5.14
3. Wheat	-	12.50	4.00	7.78	15.00	2.17	-	5.06
4. Sunflower	-	-	5.58	5.58	-	2.22	-	2.22
5. Tur	2.00	-	2.00	2.00	-	1.50	5.71	5.19
6. Matki	3.38	3.51	2.72	2.97	1.33	-	3.64	3.49
7. Hulga	2.61	2.70	3.83	3.37	-	-	-	-
8. Sugarcane (Tonnes)	45.00	24.50	112.50	40.00	-	-	75.00	75.00

Note : The other crops like Chillies, Vegetables and fodder crops are excluded due to aggregation problems and units of measurement.

Table 3.4 : Input Intensity Per Hectare in the Beneficiary and Non-Beneficiary Groups

Inputs (Units)	Beneficiary Group				Non-Beneficiary Group			
	Farm Sizes				Farm Sizes			
	I	II	III	All	I	II	III	All
1. Seeds: Q (Kgs)	21.81	172.34	28.13	64.83	15.74	13.52	105.69	65.76
V (Rs.)	70.91	111.00	45.00	66.00	75.00	73.00	76.00	75.00
2. FYM: Q (Qntl)	3.36	1.86	1.06	1.56	10.56	2.67	2.65	3.42
V (Rs.)	178.83	49.00	61.00	81.00	470.00	208.00	164.00	208.00
3. Fertilizers: Q (Qntl)	0.38	0.32	0.39	0.37	0.58	0.41	0.18	0.33
V (Rs.)	69.52	62.00	24.00	40.00	131.00	81.00	42.00	64.00
4. Pesticides: Q (Ml)	-	-	0.03	0.02	-	1.36	0.10	0.52
V (Rs.)	-	-	2.00	1.40	-	3.26	9.00	6.00
5. Irrigation: Nos.	2.34	2.00	0.31	1.07	3.26	0.98	1.36	1.70
V (Rs.)	72.64	39.00	28.00	37.00	226.00	42.00	34.00	55.00
6. Family Labour (MD)	61.50	40.42	23.82	32.95	87.91	41.73	39.91	45.14
7. Hired Labour: (MD)	21.76	23.49	21.27	21.93	28.60	42.55	49.20	45.70
Wages (Rs.)	240.00	266.00	242.00	275.00	327.00	548.00	493.00	496.00
8. Bullock Labour: Own (PD)	5.97	6.37	7.15	6.80	15.74	3.26	4.51	5.17
Hired (PD)	15.34	8.36	7.01	8.43	6.14	12.77	3.11	6.68
Wages (Rs.)	386.00	300.00	191.00	244.00	184.00	522.00	139.00	273.00

Note : Q = Quantity, V = Value, MD = Man Days, PD = Pair Days.

FYM = Farm Yard Manure.

the aggregate data in order to have a broad idea regarding input use pattern and also to avoid the complicated presentation of data for each crop. In addition to this, the input-output relations are not directly relevant here. The input use pattern between these two groups indicate that non-programme area has higher intensity of input use which is reflected in the per hectare yield levels. In fact, the higher levels of input use coupled with larger area under irrigation may be the main reason for better performance of this region. It can be observed that the variations in input use across size classes within the beneficiary group is higher than that of non-beneficiary group. Further, there is a large difference in the level of input use on the large farms of the two groups. This may be one of the reasons for the higher yield rates in the non-programme area. But, it is hard to explain why a clear inverse relationship observed between farm size and input use was not clearly reflected in the farm size and yield relationship. The plausible explanations can be located in the optimum allocation of resources between the groups across size of farms. It may be recalled that the beneficiary group showed in aggregate a type of inverse relationship between farm size and productivity and now that the input intensity also shows similar pattern indicating a better allocative efficiency in the beneficiary group and especially in the lower size classes. On the contrary, non-beneficiary group showed a direct relationship of size of holding with productivity coupled with inverse relation (though not consistent) with input intensity indicates the

lower level of allocative efficiency especially in some groups. But this picture would become clear only after taking into consideration the aggregate parameters.

Allocative efficiency and the economic viability of the programme are more clearly captured in the analysis of gross and net income per hectare. The profit-loss analysis has been undertaken to see whether the yield advantages of small and marginal, and medium farmers are resulting in their higher net profits? The gross income of these farmers should be naturally higher unless they have large price disadvantages. Our analysis (see Table 3.5) brings out clearly that the gross returns of small and marginal and medium farmers are higher than that of large farmers in the programme area, whereas, in the non-programme area the large farm group is slightly better due to higher yield advantages. The gross returns of the non-programme area are almost double than those of the programme area probably due to subtle differences in crop systems, input structure and level of degradation.

The cost structure of the farmers indicated that the cost of cultivation of the non-programme area is much higher than that of the programme area. However, these are more than compensated by the incremental gross income which is reflected in the farm business income. The size classwise data reveal that there is a gradual rise in the farm business income along with farm size in beneficiary group. This indicates that the higher cost of cultivation on the smaller size groups has reversed the negative relationship between farm size and gross

Table 3.5 : Gross and Net Income Per Hectare of Beneficiaries and Non-Beneficiaries

(In Rs. per hectare)

Item	Beneficiary Group				Non-Beneficiary Group			
	Farm Sizes				Farm Sizes			
	I	II	III	All	I	II	III	All
1. Gross Income	1087	1021	800	895	1833	1123	1920	1641
2. Paid out Cost	1023	857	593	744	1413	1070	957	1177
3. Imputed Cost	828	687	466	610	1477	671	601	701
4. Farm Business Income	64	164	207	151	420	53	963	464
5. Net Income	-764	-523	-259	-459	-1057	-618	362	-231

returns. In other words, the yield advantage gathered by the group of small farmers is dissipated by the unfavourable factor, market imbalances and prices. This is compounded by the croppin pattern of the beneficiary group which is more tuned to the stability of income flow than higher level of income. In additio to this, we may hypothesise that small farmers try to maximize their output through intensive cultivation while large farmers look for better profits. Such relationship is, however, not very smooth in the case of non-beneficiary farmers due to the disadvantageous position of the medium size group both in terms of gross income and farm business income.

The most interesting aspect of the impact analysis is the changes in the level of inequality. In a scarcity zone, the vicious circle of poverty has created wide gaps between the marginal and small farmers on the one hand and the large farmers on the other. It is usually hypothesised that in a watershed lower reach will have higher density of large owners (rich farmers) as against the upper reach. This will truncate the benefits in favour of large owners resulting into higher level of inequality. Such a position does not seem to be existing in the sample region. The Lorenz Curves presented in Figures 3.1 and 3.2 show higher level of inequality in the non-project area as compared to the watershed region. The Gini Concentration ratio in the watershed region is only 0.11 as against 0.27 in the non-project area. But, does this -necessarily signify a changed level of inequality due to watershed treatment alone?

Figure 3.1 : Lorenz Curve of Income Inequality Beneficiary Group : Scarcity Zone

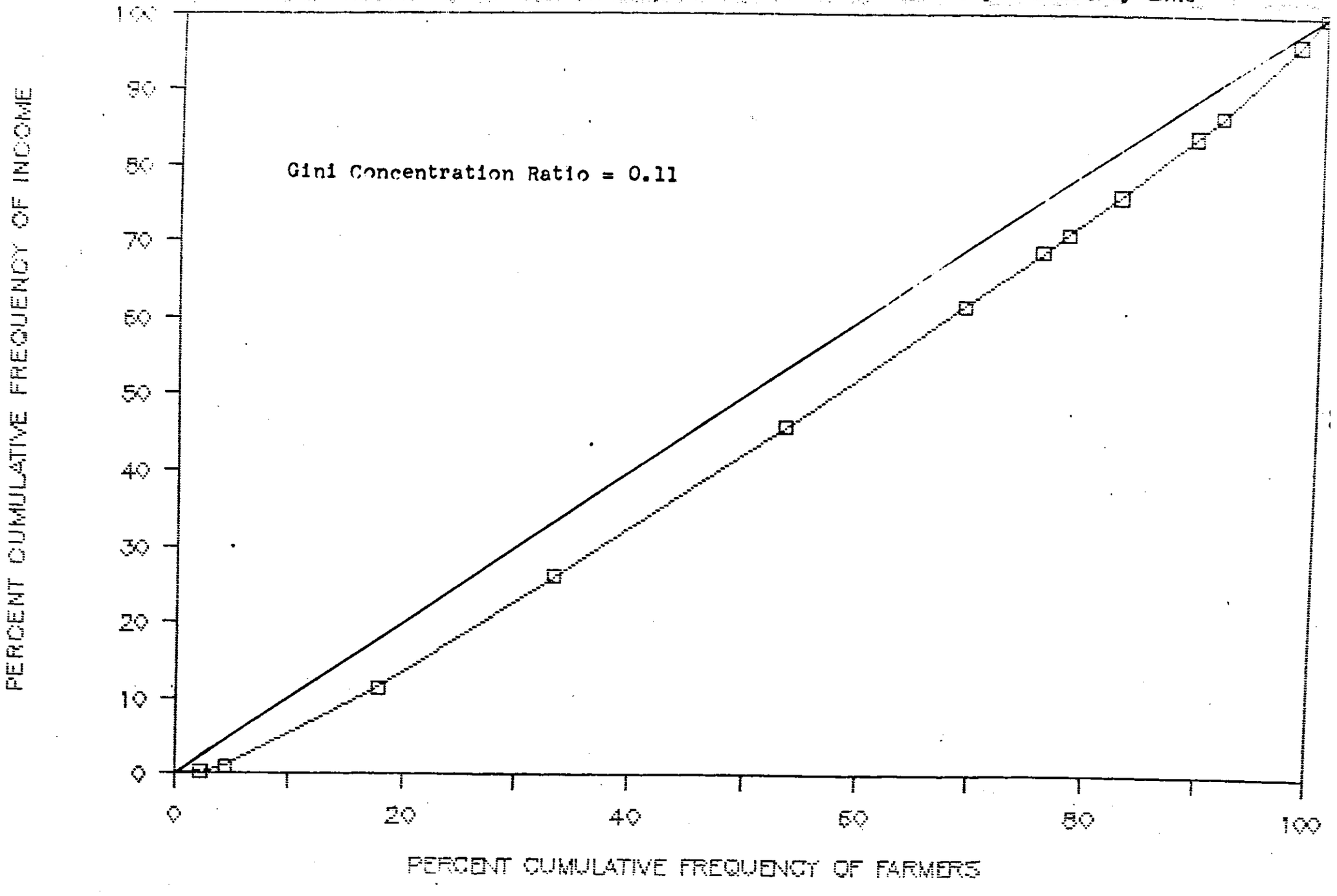
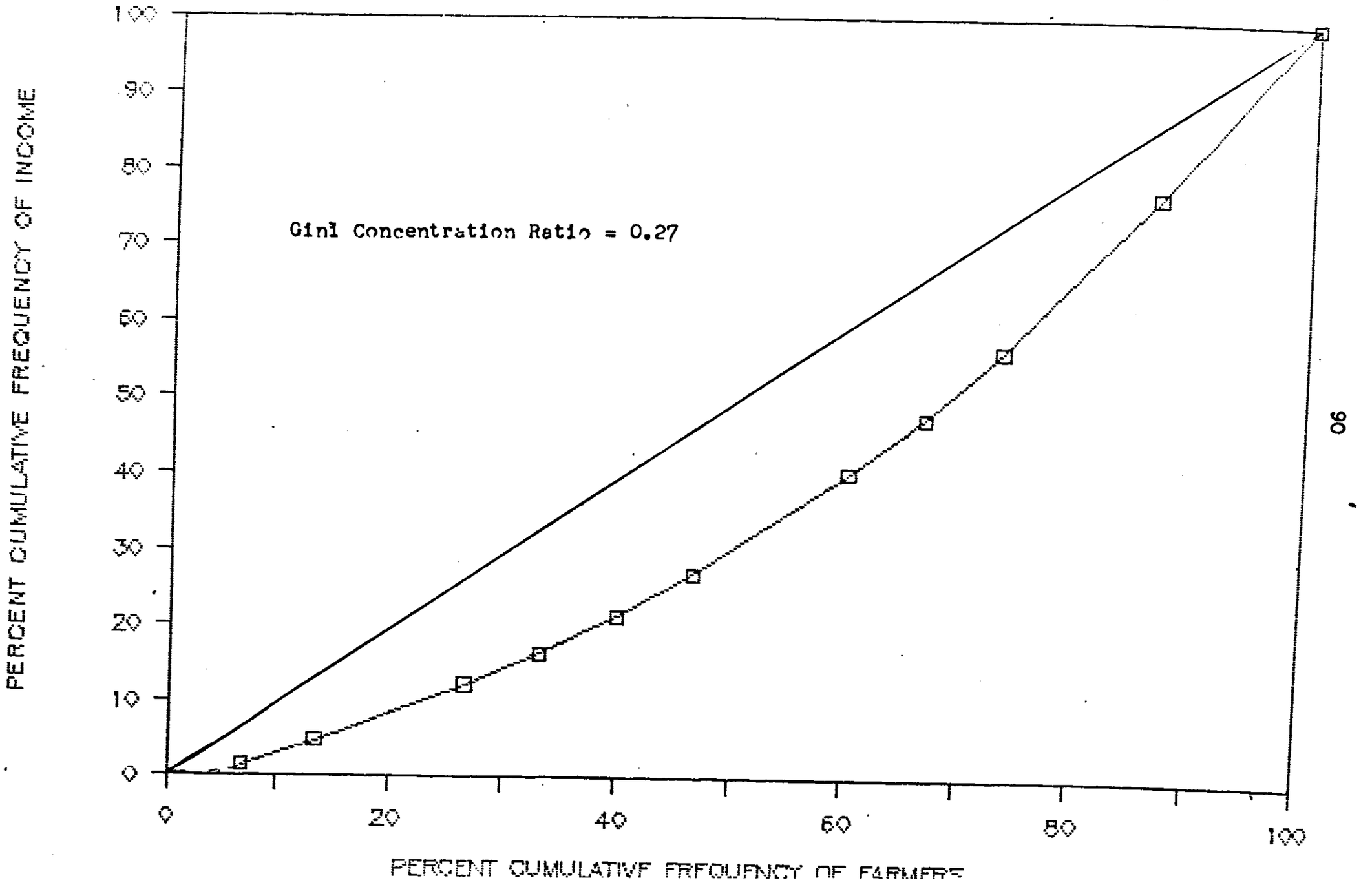


Figure 3.2 : Lorenz Curve of Income Inequality Non-Beneficiary Group : Scarcity Zone



So far, we have been discussing the impact of watershed technology on farm economy at the beneficiary level by comparing the beneficiary and non-beneficiary groups. In fact, we have been assuming that the observed differences are the result of the watershed treatment in the area. We have made an attempt here to examine the statistical significance of the differences between beneficiary and non-beneficiary group of farmers with the help of the "test of means" ('Z' test) between two samples (Table 3.6). None of the test results reveal that the differences observed earlier between beneficiary and non-beneficiary farmers are statistically significant. This leads us to conclude that the performance of programme area farmers is not statistically different from that of non-programme area farmers. In other words, the watershed technology does not seem to have made any considerable impact on the farm economy. This may be mainly due to two reasons: One is that the watershed technology needs on an average of at least 7 to 15 years of gestation period and thereafter the cash flows get stabilized. Another reason is that the local agro-climatic conditions and level of degradation in the region may have a greater influence on the impact of watershed technology. The scarcity zone with very low rainfall and limited irrigation facilities coupled with the degraded soils would take larger time to show any tangible benefits due to watershed treatment.

3.4 Food, Fodder, Fuel and Quality of Life

Apart from these direct benefits, there are other indirect benefits like increased levels of consumption,

Table 3.6 : Difference of Means Test for Various Indicators: Scarcity Zone

Sr. No.	Item	Mean of Beneficiary Group	Mean of Non-beneficiary Group	'Z' Value
1.	Value of fertilizers used (Rs.)	40	64	0.66
2.	Value of farm yard manure (Rs.)	81	208	1.08
3.	Family labour used (Mandays)	32.95	45.14	0.52
4.	Hired labour used (Mandays)	21.93	45.70	1.49
5.	Owned bullock labour used (pair days)	6.80	5.17	1.54
6.	Hired bullock labour used (pair days)	8.43	6.68	1.61
7.	Value of material input used (Rs.)	188	353	0.88
8.	Gross value of output (Rs.)	895	1641	0.96
9.	Net value of output (Rs.)	-459	-231	0.81

Notes: 1) All the indicators are expressed as per hectare of sown area.

2) Value of material inputs include value of seeds, farm yard manure, fertilizers and pesticides.

3) None of the 'Z' values are significant even at 10 per cent.

availability of fodder, etc., accruing to the farmers due to watershed technology. Our analysis of the consumption pattern indicates that there are no dramatic differences in per capita consumption per year between these two groups (see Table 3.7). However, it can be observed from the table that there are

Table 3.7 : Consumption Pattern of Beneficiaries and Non-Beneficiaries

(In Rs. per capita per year)

Farm Size	Beneficiary Group			Non-Beneficiary Group			% of expenditure on food items	
	Food	Non-food	Total	Food	Non-food	Total	Beneficiary Group	Non-Beneficiary Group
I	886	664	1550	357	642	999	57	36
II	843	787	1630	949	567	1516	52	63
III	775	548	1323	1031	700	1731	59	60
IV	826	653	1479	799	645	1444	56	55

Note: Per capita consumption is arrived on the basis of adult units by converting children into equivalent adult units.

certain subtle differences in consumption pattern across size classes. But what interests us more is the higher level of consumption expenditure in lower size classes coupled with the higher non-food expenditure. The poverty line is defined on the basis of consumption of food items, but in fact, the non-food expenditure is a better indicator of quality of life (V.M. Rao and Vivekananda, 1982). Any household budget will be planned first to satisfy food needs and the remaining income would be allocated to non-food items. If the expenditure on latter group exceeds that of a normative minimum or comparatively higher, then one can expect relatively better quality of life. This is totally borne out by the data presented in Table 3.7. In other words, the level of living in the beneficiary group is marginally better than that of non-beneficiaries.

Another important aspect of the impact of watershed technology is the availability of fodder to the cattle. It is expected that watershed technology leads to higher in situ moisture conservation and along with the silvi-pastoral and horti-pastoral systems it would result in higher fodder availability. For this purpose, we have collected data regarding number of hours the cattle are grazed on open lands during different seasons of the year. The data indicate that the availability of fodder is more in the programme areas (see Table 3.8).

It can be observed from the table that there is no significant difference in the number of hours cattle are grazed

Table 3.8 : Size Classwise Number of Hours of Cattle Grazing and Purchase of Fodder and Fuel

Farm Size	Number of hours of cattle grazing per day						Purchase of fodder/fuel per HH/ (in Rs.)			
	Beneficiaries			Non-beneficiaries			Beneficiaries		Non-beneficiaries	
	Summer	Winter	Rainy	Summer	Winter	Rainy	Fodder*	Fuel**	Fodder*	Fuel**
I	5.23	5.26	3.96	4.90	5.17	4.20	136	20	282	14
II	5.44	5.64	3.88	2.88	2.88	2.00	49	16	227	16
III	5.51	5.53	3.82	4.16	4.20	3.26	85	86	29	106
All farms	5.42	5.44	3.90	4.01	4.18	3.16	88	41	158	45

Notes: 1) * Purchase of Fodder is given in per cattle unit per year basis.

2) ** Purchase of fuel is given on per week basis.

on the open lands between the two areas. This indicates that no particular care is taken to avoid the degradation of land by restricting the cattle from open grazing even in the watershed region. This point needs to be taken care in order to control soil erosion, increasing soil moisture. Besides, we have also analysed the amount spent by the sample households on fodder and fuelwood. The data indicate that the dependency of beneficiary farmers on purchased fodder is much less when compared to non-beneficiary farmers. This can also be due to the lower fodder prices in programme area along with higher supply. Whereas, in the case of fuel, the beneficiary farmers do not seem to have any advantage over their counterparts. This may be due to the time lag required for the afforestation programme to yield fuel even through the lops and tops.

Methodologically, it is difficult to ascribe the changes in watershed area to the treatments alone as the spill over effects of other developmental programmes intervene in the process. Hence, the most preferred approach would be to ask the reactions of beneficiaries to the changes noticed by them and their views would confirm the direct impact parameters. This approach has the limitation of not getting to the magnitude of impact but it only indicates the direction. The questions posed to the respondents were not of leading type but open ended and their open reactions were grouped into the groups. We present below in Table 3.9 these reactions.

Table 3.9 : Distribution of Farmers According to the Changes Noticed by Them

Farm size	Percentage of farmers reporting improvements in				
	Level and stability of yield rates	Net farm income	Availability of fodder	Availability of fruits and vegetables	Employment and wages
Upto 2 ha.	67	7	20	0	100
2 to 4 ha.	11	7	27	7	100
Above 4 ha.	40	13	20	0	100
All farms	47	9	22	2	100

It can be noted from the table that wages, employment and yield levels are the basic components in which the farmers have noticed changes with the advent of watershed technology. The improvement in yield rates noticed by farmers indicate that watershed technology has led to yield improvement which we could not capture in our earlier comparative analysis. It may be restated here that when the farmers report yield improvement they compare the yields of their own farms before the programme with that of prevailing, whereas, our comparison in the earlier part of this chapter was based on the "with and without" approach. Hence, the two results are not strictly comparable.

As far as the size classwise differences are concerned, it is observed that relatively more number of small and marginal farmers (67 per cent) have felt that their yield rates have gone up when compared to their counterparts. It can be deduced that watershed benefits are accruing more to

small and marginal farmers resulting in the reduction of inequalities indicated by our earlier analysis. But, the picture does not hold good when it comes to net farm income though only 9 per cent of the beneficiary farmers have felt an improvement in their net incomes. The availability of fodder has increased but the treatment of wastelands has not received its due priority. In other words, the fodder availability has further scope for improvement. Very few farmers felt that the availability of fruits and vegetables has improved after the implementation of watershed. On the other hand, all the farmers noticed the improvement in employment and wages though the level of employment is lower in the watershed area as compared to non-watershed area. There was no reporting of any change in watertable.

As far as the awareness of the farmers regarding the watershed activities, they appear to have adequate level of understanding of the ongoing watershed activities, though they were not posted with the reasons behind each of the components. Moreover, almost all the farmers have expressed their satisfaction regarding the extension support they received.

3.5 Resume

The impact of NWDPRA in the scarcity zone indicated quite a few interesting issues. The scarcity zone with a highly degraded and fragile natural resources would take a longer gestation period first to recoup the natural losses and the incremental gains would begin only after this. In fact, watershed technology being location specific its

gestation period would vary with the factors like - agro-climatic conditions, level of degradation, type of the reactions from society and composition of the programme. The area based programme for agricultural sector in a scarcity zone should be necessarily aimed at stability (avoidance of the overt yield fluctuations), equity, sustainability, eco-balance and improved cash flows (in that order).

Our comparison between the project and non-project area was hampered by the unusual presence of irrigation wells in the control region. The basic factor governing the choice of control region was the similarity in the watershed parameters like slope, soil type, vegetation and water flows. In these parameters, the control was most suitable area, however, at the time of survey we found out that a few of the selected control farmers have irrigation wells. To some extent this could have caused difficulties in comparison. But to a large extent, it did not really vitiate the results. We have noted higher level of stability and equity oriented results in the watershed region. Being a survey at a point of time and also in the absence of any bench mark we are constrained to comment on the improvements expected in the eco-system. The improvement in fodder, fuel and food availability was noted in the programme area. More interestingly the farmers found the technology of in situ moisture conservation as yield improving, stabilising and net income increasing. Quite possibly the scarcity zone impact analysis should have a longer gestation period and a comparison with the bench mark surey conducted earlier would yield better results.

CHAPTER IV

IMPACT OF WATERSHED TREATMENT IN MODERATE RAINFALL ZONE

4.1 Introduction

A variety of agro-climatic changes can be witnessed in the State of Maharashtra from the heavy rainfall belt of western coast to the eastern heavy rainfall region. The moderate rainfall zone constitutes a transitory region bounded on one side by the assured rainfall region and the eastern heavy rainfall area on the other side. In fact, our sample region almost borders the assured rainfall zone. The average annual precipitation in the moderate rainfall region ranges between 900 mm to 1200 mm. It does not have large variations in the rainfall, hence the farmers are less risk averse.

The region is spread over 40 talukas (including parts of some talukas) from 8 districts of the state. The major portion of the zone falls in Vidarbha region with large parts of Nanded and Parbhani districts of Marathwada forming one portion. The soils are brown to deep black with varying depths and higher water holding capacity. The region has sizeable forest cover. Jowar, groundnut, cotton and wheat are the dominant crops with pulses and oilseeds supporting the farm economy. Economically the region is moderately developed with slightly higher commercialisation as compared to scarcity zone.

The impact of watershed treatment in the moderate rainfall region would be guided by seven factors. Firstly, the region is characterised by well drained deep black soils and hence *in situ* conservation of moisture would be more effective.

But at times the deep vertisols may cause a problem of water logging and kharif fallows due to higher rainfall. Hence, if the excessive water is not allowed a vent through run off it can cause crop losses. Proper waterways and drains form an important component of the programme. Secondly, since the soils have better water holding capacity, it is possible that the farmers would take a second crop on the residual moisture with protective irrigation by increasing cropping intensity. Thirdly, the depth of the soil and the type of acquifers allow a larger ground water potential. The highest net ground water balance can be tapped in this and also the eastern region of the State (GOM, 1983). This suggests that the watershed treatment in this region should include exploration of ground-water and its use for protective irrigation. It is also possible that if the technology is not supported by regular draft from shallow tube wells the problem of kharif fallows may become acute. Fourthly, the region has a lower level of degradation of natural resources as compared to the scarcity zone. But,the speed of degradation in this region is quite alarming. It is expected that the watershed technology would arrest the speed of degradation and recoup the losses. Fifthly, the crop pattern indicates a slightly higher level of commercialisation, fortunately this is not characterised by high water requiring crops. But, it is quite possible that the farmers' preference may turn towards sugarcane. The watershed technology and accompanied extension services are expected to play a larger role in this direction. We do not expect dramatic

yield gaps due to watershed treatment. It would be more income stabilising and efficiency improving rather than a mere income increasing. Sixthly, the treatments recommended under watershed plan in this region should be different than those in the scarcity zone. Here, waterways, graded bunds, farm ponds, nalla training, gully and ravine check structures should dominate the list of treatments along with afforestation and dryland horticulture. Lastly, it comes out very clearly that the treated area in the moderate rainfall zone would have lower gestation period but then the maintenance of the structures should be on top priority. Moreover, we cannot expect dramatic changes in these regions unless accompanied by a high yielding new technology.

In the present chapter, we propose to bring out the differences in the beneficiary and non-beneficiary groups. We, however, indicate that these changes cannot be fully ascribed to the watershed technology alone. Moreover, in a moderate rainfall zone with commercially oriented crop pattern the only expected differences would be in the efficiency of farming and conservation of the eco-system. Being a survey at a point of time and in the absence of bench mark, we are constrained to comment on the eco-system but our efforts are to bring these out as clearly as possible.

4.2 Impact on Land Use Pattern

As indicated earlier, this zone has a dominance of deep black soils with lower level of degradation. The land use pattern hence should indicate higher intensity of resource

use, better diversification and well developed risk adjustment practices. The land utilization particulars of beneficiary and non-beneficiary farmers show that the differences are quite prominent (See Table 4.1). The average farm size is smaller in the programme area than that of non-programme area despite higher area under irrigation in the latter. However, the average size of the small farmers in the beneficiary category is higher than that of their counter parts in the non-beneficiary category. This indicates better distribution of land in the watershed region. But, the irrigation facilities truncate the distribution in favour of the medium farmers who have a large share of irrigation followed by large and small farmers in both programme and non-programme regions. In fact, the small and marginal farmers in the non-watershed region do not have any irrigation at all.

Watershed treatment is expected to increase the ground-water availability in the project area but such an inference cannot be drawn from the existing levels of irrigation and from a comparison with the non-project area. In fact, the conservation measures would improve the draft capacity, change the draft-recharge ratio and sustain the water yield in the wells for longer time. This can be seen from the last section. Here, we restrict the comparison to the existing irrigation facilities. It can be observed from the table that the cropping intensity is considerably higher in the watershed region when compared to non-watershed region. These differences are more prominent in the lower and medium size classes. Higher crop

Table 4.1: Land Utilisation of Beneficiaries and Non-Beneficiaries

Parameters (Units)	Beneficiary Group				Non-Beneficiary Group			
	Farm Sizes				Farm Sizes			
	I	II	III	ALL	I	II	III	ALL
1. No.of farmers	15	16	14	45	5	5	5	15
2. Average Farm Size (Ha)	1.56	2.72	7.51	3.82	1.47	3.36	8.56	4.46
3. % of Area Irrigated	3.4	23.5	12.9	14.3	-	37.5	17.3	20.46
4. % of Fallow & Uncultivated lands to total area owned	10.2	10.1	14.2	12.6	0.8	7.1	7.9	6.96
5. Crop Intensity	133	145	125	131	111	124	123	122

Note: Size Classes are - I - Below 2 hectares;
II - 2 to 4 hectares;
III - Above 4 hectares

intensities in this region may be attributed to the moisture conserving nature of the watershed technology. The argument of intensive cultivation in the watershed regions draws further support from the fallow and uncultivated lands in the watershed region. The higher proportion of fallow and uncultivated lands in the watershed region may be due to the location specific nature of the technology which may cause a reduction in the cultivated lands by pushing marginal lands out of cultivation especially where the lands have already degraded, in favour of

intensive cultivation. These lands, however, will be eased out of cultivation and put under different uses such as horticulture, forestry and pasture development. Moreover, these lands have a symbiotic relationship with cultivated lands, and hence it is possible that the changes might have been introduced by new cropping systems. As far as the variations across size classes are concerned, the relationship between farm size and irrigation, and crop intensity appear to be in the shape of inverted 'U' indicating the favourable position of medium size farms in both the programme and non-programme region. However, an inverse relationship can be observed between farm-size and under utilization of land in both the cases.

Cropping pattern in the moderate rainfall region is well diversified across various crops. (See Table 4.2). The marginal differences between these two regions are that jowar is the dominant crop (23 per cent) in the watershed region whereas, cotton dominates the non-watershed area. Similarly, pulses seem to be the dominant crop group in watershed region with 39.61 per cent share of area compared to 32.98 per cent in the non-programme zone. Among pulses, blackgram takes the major share followed by mung and others in both the regions. In the oilseed crops, safflower is the dominant crop with 14.58 per cent and 13 per cent of area devoted to it respectively in programme and non-programme regions. Though, the differences in the two regions are not very prominent, a few interesting observations can be made here. Firstly, the crop pattern in the project area is better diversified as compared

to non-project area with inclusion of some of the new crops (Soyabean, Groundnut, Mosambi, etc.). Secondly, commercialisation alone does not seem to be the decision factor in project area whereas, the non-project region crop pattern seems to have been weighted by commercial crops. Thirdly, unlike the control region crop specialisation across the size classes seem to be breaking in the project region though not completely absent.

Table 4.2: Cropping Pattern of Beneficiary and Non-Beneficiary Groups

(Per cent of Gross Cropped Area)

Crop	Proportion of Area under the Crop in							
	Beneficiary Group				Non-Beneficiary Group			
	Farm Sizes				Farm Sizes			
	I	II	III	All	I	II	III	All
1. Jowar	23.81	13.50	26.90	22.98	25.35	10.58	20.58	18.50
2. Wheat	1.53	7.84	1.14	2.93	-	10.05	4.11	5.23
3. Rice	3.25	3.94	1.29	2.26	-	1.06	1.65	1.34
4. Gram	2.30	1.74	2.08	2.03	-	2.12	0.82	1.07
5. Udid	26.80	17.64	20.84	20.89	14.08	12.70	21.81	18.77
6. Mung	14.74	16.55	17.05	16.58	9.86	13.23	11.52	11.80
7. Tur	-	-	0.19	0.11	2.82	2.12	0.82	1.34
8. Cotton	11.49	21.60	14.40	15.83	36.62	37.04	22.22	27.35
9. Saf-flower	14.55	13.72	14.97	14.58	11.27	11.11	13.99	13.00
10. Ground-nut	1.53	-	1.14	0.90	-	-	-	-
11. Soyabean	-	0.44	-	0.11	-	-	-	-
12. Mosambi	-	3.05	-	0.79	-	-	1.64	1.07
13. Sugar-cane	-	-	-	-	-	-	0.82	0.54

4.3 Productivity, Cost of Production, Income and Inequality

Moderate rainfall region has better level of climatic stability and lower degradation. This in turn facilitates quick adoption of new technology and the gestation period is also lower. The well drained soils also allow better in situ conservation of water. Apart from this, the levels of yield in the pre-investment period are also not very low, which means that the immediate differences would not be dramatic unless accompanied by a package of high yielding technology. But, it is expected that the watershed technology would bring in higher resource efficiency and better intensity.

As can be seen from the Table 4.3 there are no substantial yield differences between the project and non-project region, except in the case of wheat, cotton and paddy. In the case of wheat, pulses, cotton and oilseeds the watershed area has a distinct edge over the control region even though the non-project region has higher level of irrigation. In fact, if the yield rates are standardised by an appropriate weight of irrigation the better performance of the watershed area can be highlighted. The size classwise comparison reveals that medium size farms have better performance as compared to their counterparts. In other words, this may be one of the reasons for the changing levels of inequality in the sample zone.

Besides, the explanation for this and the sizeclasswise differences in yield rates, can be sought from the input use pattern of these farmers. The input use pattern of beneficiary and non-beneficiary farmers are presented in Table 4.4. The data

Table 4.3: Yield Rates Per Hectare of Principal Crops

(In Quintals)

Crop	Beneficiary Group				Non-Beneficiary Group			
	Farm Sizes				Farm Sizes			
	I	II	III	All	I	II	III	All
1. Jowar	13.10	15.97	9.42	10.98	7.61	22.50	9.60	11.5
2. Wheat	20.0	30.56	30.83	29.11	-	16.84	17.50	17.1
3. Paddy	3.82	11.05	7.35	8.27	-	15.00	15.00	15.0
4. Gram	4.67	11.25	2.27	8.40	-	6.25	10.00	8.1
5. Udid	3.63	5.56	5.04	4.89	3.00	6.46	3.44	3.9
6. Mung	3.39	5.39	4.06	4.31	3.93	6.80	3.04	4.1
7. Cotton	10.0	6.80	7.63	7.59	6.83	10.71	3.40	6.5
8. Safflower	2.99	6.17	3.86	4.53	3.75	4.17	4.04	4.0
9. Groundnut	3.12	-	4.17	3.91	-	-	-	-

Note: Yield rates of crops with minor area share are not given here. As also the crops where problems of units of measurement were there are avoided.

Table 4.4: Input Intensity Per Hectare in the Beneficiary and Non-Beneficiary Groups

Inputs	Beneficiary Group				Non-Beneficiary Group			
	Farm Sizes				Farm Sizes			
	I	II	III	All	I	II	III	All
1.Seeds:								
Q (kgs)	13.55	23.23	28.25	24.79	5.93	6.16	11.45	9.58
V (Rs.)	147.00	213.00	100.00	137.00	163.00	219.00	155.00	172.00
2.FYM:								
Q (Qtls)	5.55	4.20	3.59	4.04	4.23	5.98	5.45	5.47
V (Rs.)	182.00	200.00	132.00	157.00	177.00	260.00	236.00	236.00
3.Fertilizer:								
Q (Qtls)	1.51	1.37	1.24	1.31	0.92	2.12	1.31	1.47
V (Rs.)	348.00	331.00	301.00	316.00	203.00	522.00	271.00	328.00
4.Pesticides:								
Q (ML)	0.45	0.93	0.44	0.56	0.53	0.82	0.47	0.57
V (Rs.)	158.00	106.00	94.00	107.00	101.00	147.00	82.00	100.00
5.Irrigation:								
Nos.	2.16	1.15	0.63	0.67	-	0.58	0.29	0.34
V (Rs.)	50.72	34.00	17.00	26.00	-	79.00	46.00	50.00
6.Family Labour:								
(MD)	72.36	83.61	50.16	62.07	116.48	50.42	31.00	43.90
7.Hired Labour:								
(MD)	45.71	41.85	27.35	33.80	22.96	22.70	29.00	26.68
Wages (Rs.)	240.00	268.00	179.00	176.00	236.00	154.00	249.00	224.00
8.Bullock Labour:								
Own(PD)	14.24	21.10	19.54	19.16	-	14.18	19.18	16.09
Hired (PD)	11.91	12.76	1.33	5.84	25.63	2.22	1.07	3.70
Wages (Rs.)	326.00	283.00	31.00	140.00	668.00	56.00	27.00	95.00

Note: (1) Q = Quantity, V = Value, MD = Mandays, PD = Pair Days
FYM = Farm Yard Manure, ML = Milli Litre

indicate that the non-beneficiary farmers seem to spend substantially higher amounts of money on seeds and farm yard manure. In the case of modern inputs both the groups seem to be at the same level of technology. The watershed area appears to be more labour intensive as compared to the non-watershed region. Thus, the labour intensity and adequate quantum of capital are the strong points of the beneficiary group as against the lower labour intensity of the other.

The higher level of seed utilization may be attributed to the predominence of cotton in non-programme area. Thus, the input use pattern of these two groups is in line with their yield differences. Even the size classwise differences in input use are reflected in the yield rates. Therefore, a direct relationship between input use and output performance can be established.

At this juncture, it is pertinent to examine whether the dominance of medium size farms in yield levels (consequent to higher usage of inputs) is carried further in terms of net returns per unit of cultivated land. The allocation of inputs and production efficiency together lead to better returns in final analysis. It is always possible that either the allocation decisions or production inefficiency can fritter away the intended benefits of any technology. The gross returns are expected to reflect the yield levels unless there are price variations between the two groups and crops due to market imperfections. Our analysis (Table 4.5) indicates that non-beneficiary farms have higher gross income per hectare

though the difference is marginal (i.e. Rs.102). This difference, however, is not in accordance to the level of commercialisation indicated in the crop pattern. In fact, the dominance of cotton area could not lead to large differences in gross value of production.

Table 4.5: Gross and Net Income Per Hectare of Beneficiaries and Non-Beneficiaries

(In Rs. per hect.)

Item	Beneficiary Group				Non-Beneficiary Group			
	I	II	III	All	I	II	III	All
1. Gross Income	2759	4131	2753	3078	3139	5718	2205	3180
2. Paid out Cost	1452	1435	854	1059	1548	1437	1066	1205
3. Imputed Cost	770	1003	784	783	1197	700	291	782
4. Farm Business Income	1307	2696	1899	2019	1591	4281	1139	1975
5. Net Income	537	1693	1115	1236	394	3581	848	1193

But when we compare the net income across groups it can be seen that the farmers from watershed area with the cost efficiency score over their counterparts at least marginally. It can be observed that in the non-beneficiary group small and medium farmers earn higher farm business income per unit of land as compared to the beneficiary group. But the large farmers from the watershed area have a substantial advantage than their counterparts from the project region. Overall, we

have noted that though the gross income is higher in the non-beneficiary group the cost efficiency and family labour intensity in watershed area finally leaves marginal advantage to these farmers. In other words, better allocative efficiency can be seen in the watershed region.

The preceding analysis and observations have to be validated statistically because they are based on absolute differences between the groups. It is quite possible that the intra-group variations may be larger than the inter-group variations, making the earlier results unstable. Therefore, we made an attempt here to examine the statistical significance of the differences between beneficiary and non-beneficiary farmers by testing the differences between means for certain parameters. The results of the analysis reveal that except in the case of crop intensity and hired labour use, none of the differences observed earlier between beneficiary and non-beneficiary farmers are statistically significant. This indicates that the performance of programme area farmers is not dramatically different than that of the control region. The only significant difference between these two groups is that the watershed technology has led to higher cropping intensity and it also leads to higher employment generation. Therefore, we can deduce that the watershed technology has a totally different impact in a moderate rainfall region characterised with deep vertisols. The technology enhances the cropping intensity and allocation efficiency along with creation of larger employment opportunities. However, these

changes also have far reaching effects on the pattern of distribution of income generated from agricultural sector. These changes in the distribution should be directly related to the resource structure in the respective groups.

We have attempted an analysis of the impact of watershed technology on income distribution in the watershed and non-project region. Lorenz ratios (Gini concentration coeff.) are estimated for watershed and non-watershed regions (see fig. 4.1 and 4.2). The watershed region seem to have higher Gini ratio (0.28) compared to the non-watershed region (0.23) indicating slightly higher inequalities in the former region in terms of net incomes per hectare. This is possible either due to the intended benefits of watershed technology being unequally distributed or the prevailing structural differences between the regions.

4.4 Food, Fuel, Fodder and Quality of Life

Though our preceding analysis does not provide any evidence of higher incomes to beneficiary farmers, they are expected to gain in terms of indirect benefits through availability of non-market goods. The other benefits include better living standard, availability of food, fodder and fuel for the households. Increase in employment opportunities was observed earlier, this also results in changed consumption pattern. It may be recalled here that the group of non-beneficiaries has a higher level of commercialisation as compared to the beneficiary group which also leads to differences in pattern of consumption.

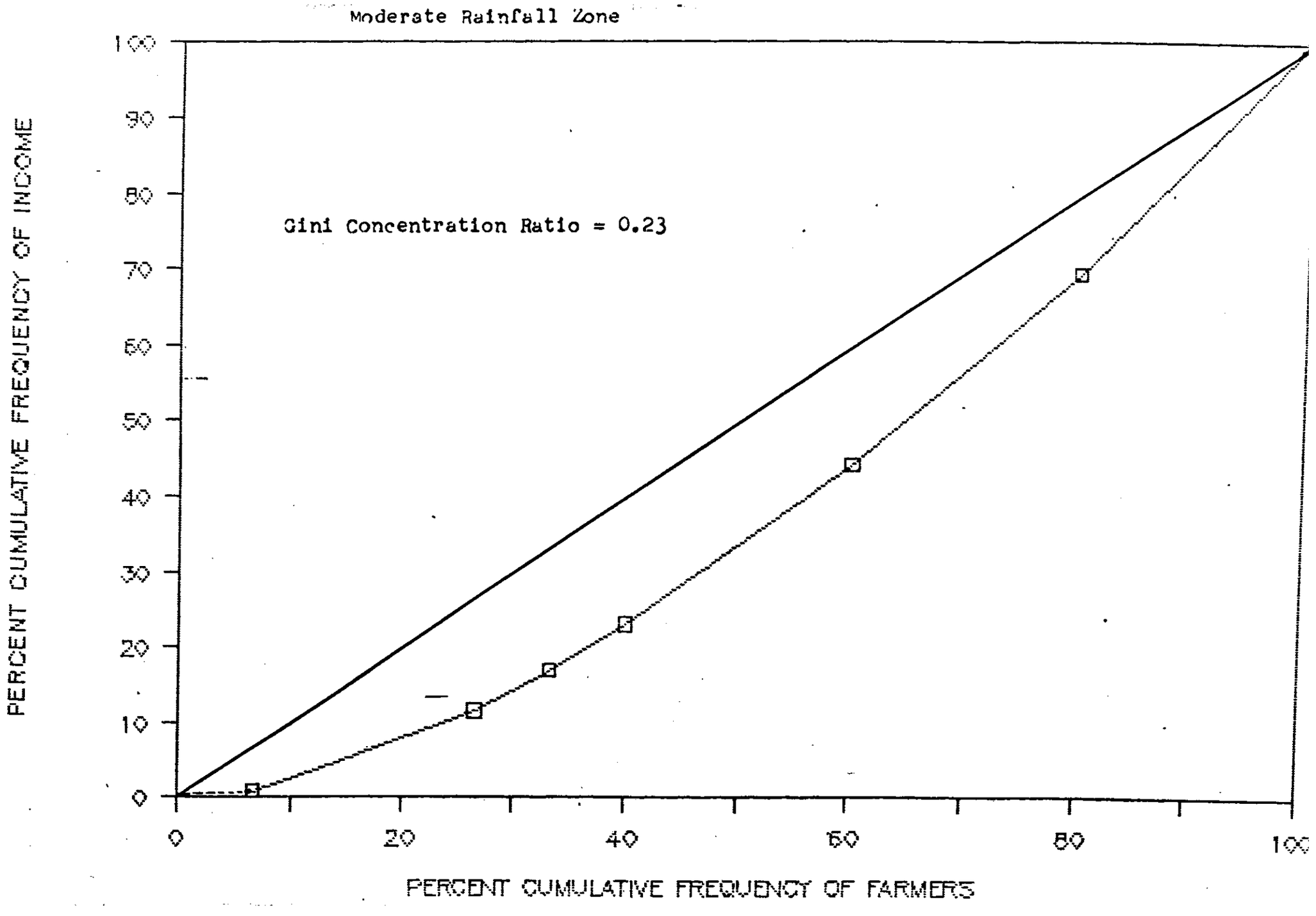

Moderate Rainfall Zone
Gini Concentration Ratio = 0.23
PERCENT CUMULATIVE FREQUENCY OF INCOME
PERCENT CUMULATIVE FREQUENCY OF FARMERS
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100

Table 4.6: Difference of Means Test for Various Indicators: Moderate Rainfall Zone

Sr. No.	Item	Mean of		'Z' Value
		Beneficiary Group	Non-Beneficiary Group	
1.	Value of Fertilizers Used (Rs.)	316	328	0.68
2.	Value of Farmyard Manure Used (Rs.)	157	236	1.33
3.	Family Labour Used (Mandays)	62.07	43.90	0.24
4.	Hired Labour Used (Mandays)	33.80	26.68	1.76***
5.	Owned Bullock Labour Used (Pairdays)	19.16	16.09	1.39
6.	Hired Bullock Labour Used (Pairdays)	5.84	3.70	0.51
7.	Gross Value of Output (Rs.)	3078	3180	0.42
8.	Crop Intensity (%)	131	122	2.43*

Notes: 1) All the indicators are expressed as per hectare of sown area

2) Value of material inputs include value of seeds, farm yard manure, fertilizers and pesticides.

3) 'Z' values indicated with * and *** are significant at 1 and 10 per cent respectively.

It can be observed from Table 4.7 that per capita per year consumption of the two groups is more or less the same. The differences are marginal even between size classes

Table 4.7: Consumption Pattern of Beneficiaries and Non-Beneficiaries

(Rs. Per Capita Per Yr.)

Farm Size	Beneficiary			Non-Beneficiary			% of Exp. on Food	
	Food	Non-Food	Total	Food	Non-Food	Total	Beneficiary	Non-Beneficiary
I	981	624	1605	998	608	1606	61	62
II	1107	629	1736	1130	723	1853	64	61
III	1011	843	1854	1086	710	1796	55	60
All	1032	709	1741	1076	684	1760	59	61

Note: Family size is taken in terms of adult units by converting children into equivalent adult units.

across groups. The total consumption of beneficiary farmers goes up along with farm size whereas, the same is not true in terms of food consumption. This may be due to the income elasticity of food being less than one. On one side this is reflected in the proportion of expenditure on food which shows that large farmers are spending about 55 per cent of their expenditure on food as against 61 and 64 per cent respectively for small, marginal and medium farmers. Similar is the case with non-beneficiary group. On the other side, we may note slightly more expenditure on the non-food items by the group of beneficiaries. Expenditure on non-food items can be taken as an indicator of better living standards because the food expenditure has a threshold level. Among the classes, it is

obvious that the group of large farmers spend more on non-food consumption. It is only the group of medium farmers which lags in the beneficiary group when compared with non-beneficiaries. On the whole, the consumption differences between groups are not conspicuous and possibly marked due to the level of commercialisation in non-project area.

Consumption at the level of households analysed above excludes fodder and fuel. One of the important aspect of watershed technology is the availability of fuel and fodder to the cattle. It is expected that watershed technology leads to higher in situ moisture conservation resulting in higher fodder availability. For this purpose, we have obtained data regarding number of hours of grazing in open lands across seasons of the year. The data indicate that more number of hours cattle are grazed in the non-programme area. This reflects in a way, the availability fodder in both the regions and also shows sufficient availability of fodder in open lands in the watershed region. Data on purchase of fodder points at higher overall fodder availability in the watershed region, though the difference between beneficiary and non-beneficiary groups is not so high. On the contrary, the availability of fuel, reflected through purchase of fuel wood, appear to be much less in the watershed region. It can be observed that the money spent on fuel per week by each household is about 60 per cent higher in watershed region indicating the higher dependency on purchased fuelwood. This may be due to the time lag required for the afforestation programme to yield benefits.

As indicated earlier, the real difference due to any technology can only be assessed from the responses of the farmers. This essentially incorporates an innate process of decomposition of impact from the point of view of beneficiaries. It is certainly difficult otherwise to alienate the exact benefits of the watershed technology when other half a dozen programmes are operating in the region. We have got the responses of the beneficiaries to certain broad indicators. It can be observed from the Table 4.8 that a considerable number of farmers have noticed changes in employment, wages, yield rates and its stability. There are wide variations across size classes in the observations noted by the farmers. Contrary to the observations in earlier analysis, only 38 per cent of the medium size farmers have felt that their yield rates have improved as against 79 per cent in case of large farmers and 60 per cent in case of small and marginal farmers. This is despite the fact that medium size class farmers have recorded high yield rates. However, when it comes to net income more of medium size farmers have felt that their net incomes have gone up which is in line with our earlier analysis. Quite a few of the farmers recorded increase in water table but their proportion was small. As far as the availability of fodder, fruits and vegetables are concerned none of the beneficiary farmers have noticed any improvement. This is contrary to our findings in scarcity zone. On the other hand, 67 per cent of the farmers felt that there is an improvement in employment and wages. As far as the awareness of the farmers regarding

Table 4.8: Size Classwise Number of Hours of Cattle Grazing and Purchase of Fodder and Fuel

Farm Size	Number of Hours of Cattle Grazing Per Day						Purchase of Fodder/Fuel Per HH(Rs.)			
	Beneficiaries			Non-Beneficiaries			Beneficiaries		Non-Beneficiaries	
	Summer	Winter	Rainy	Summer	Winter	Rainy	Fodder*	Fuel**	Fodder*	Fuel**
I	3.86	4.43	3.26	3.84	3.84	3.48	107	34	100	19
II	3.97	4.24	3.63	4.39	5.14	4.89	104	27	390	21
III	2.69	3.03	2.74	2.87	2.99	2.71	300	35	40	18
All	3.24	3.57	3.12	3.55	3.83	3.42	166	32	177	19

Notes: 1) * Purchase of Fodder is given per cattle unit per year basis

2) ** Purchase of Fuel is given on per week basis

the watershed activities most of the beneficiaries have expressed their understanding of the ongoing activities. More than 90 per cent of the watershed farmers have expressed their satisfaction regarding the extension support they received.

Table 4.9: Distribution of Farmers According to the Changes Noticed by Them

Farm Size	Percentage of farmers reporting improvements in		
	Level and Stability of Yield Rates	Net Farm Income	Employment and Wages
I	60	20	80
II	38	31	50
III	79	7	71
All	58	20	67

Note: The farm households did not report any dramatic change in fodder, fuel and fruits availability

4.5 Resume

Moderate rainfall zone presents a challenge to the watershed technology in two forms. Firstly, the degradation is at a lower level but the speed of degradation is so alarming that it would not take another quarter of a century to bring this region at par with scarcity zone in this respect. Secondly, present economic standards and farm management is slightly commercial and hence it does not allow the yield gap due to watershed technology to look very attractive. Hence, it is quite possible that there would be lower response from the

participants which in itself would form a austere hurdle. All this syggests a more careful planning of the recommended treatment in this zone, so as to avert the speed of degradation, increase the farm efficiency and improve the living standards. Groundwater availability adds another dimension to the treatment planning and in fact, in the absence of this draft the in situ conservation may lead to bringing up the water table.

As indicated in the initial pages of this chapter, the watershed treatment in this zone did not show dramatic results especially in the yield rates, income levels, levels of inequality and ecological changes. But then, the base level (non-project area) itself was better in these aspects and as stated above the level of degradation is not so bad to affect these parameters. On the contrary, we found better diversification, higher intensity of cropping, non-commercialised cropping pattern, increased resource intensity on cultivated lands by releasing the marginal lands out of cultivation and better quality of life with increased biomass availability in the watershed region. On the whole, the treatment is yield stabilising and hence the effects of it would be more clearly seen in the event of climatic stress like drought or scarcity.

CHAPTER V

IMPACT OF WATERSHED TREATMENT IN ASSURED RAINFALL ZONE

5.1 Introduction

Assured rainfall zone falls in between the moderate rainfall zone and scarcity zone. In fact, the nomenclature of the region suggests relatively higher precipitation and lower variation in this region compared to moderate rainfall zone but it is not so. The average annual precipitation in the assured rainfall region ranges between 700 to 900 mm. A portion of the region also falls under the drought-prone areas classified by the Fact Finding Committee 1973 (GOM, 1973). Hence, we find varying agro-ecological situations in the region.

Assured rainfall region covers 55 talukas spread over 10 districts of Marathwada, Vidarbha, North Maharashtra and Solapur. With the elevation of 600 meters the region has very little forest cover mostly constituting shrubs and bushes. The soils are black calcarious with varying depths formed from basalt and well supplied with potash and phosphate but low in organic carbon (Bangar et al, 1983). The natural resources and eco-system have various levels of degradation. The cropping system has a mixed combination of high value commercial crops existing along with low density cereals and pulses.

The impact of watershed treatment in this region would be guided by four factors. First factor is common

to the scarcity zone, viz., the treatment has two fold objectives to stabilise the flow of returns and to enhance the net income. Secondly, the assured rainfall zone is characterised by medium to deep black soils and hence the water holding capacity is higher than the scarcity zone. This increases the possibility of investing on water harvesting structures. Thirdly, this zone also has a higher level of degradation of the eco-system. Hence, the initial work of watershed planning and it's influence has to be quantified in terms of recouping the eco-system. Lastly, the region has better groundwater potential and to a large extent the potential is being utilised in different areas of the zone. This has resulted in small patches with higher density of wells. The availability of water has turned the cropping pattern in favour of commercial crops. In any watershed treatment, the hierarchy of impact would be stoppage of the process of degradation of eco-system and its restoration - increased bio-mass - higher moisture conservation - stabilisation of crop yields - increased livestock activity - changes in cropping system - improvement in yields - availability of irrigation - shift of cropping pattern in favour of commercial crops. The availability of irrigation prior to the treatment breaks this hierarchy and introduces the last lap first. It is quite possible that this may mask the other expected changes due to the treatment.

In the present chapter, we intend to look into the interesting case of assured rainfall region with the presence of irrigation. Here, also we keep the order of impact analysis exactly the same as followed for the earlier two chapters.

5.2 Impact on Land Use Pattern

The land utilisation pattern is typically characterised by presence of well irrigation in the project area. The average farm size both in project and non-project area is low and more so in the latter. This has caused us a difficulty in choosing the control group in the category of above 4 hectares. The demarcated control area did not have even a single household with holding size above 4 hectares. Presence of well irrigation masked quite a few effects of the watershed treatment but at the same time highlighted some new aspects. The proportion of fallows and cultivable wastes is higher in the project area as compared to the non-project region. This can either happen as a backlash effect of irrigation or due to increased resource intensity in the post treatment of the watershed. But this is not supported by the cropping intensity. It is surprising that with more than 30 per cent of irrigation in the sample area, the intensity of cropping is only 116 per cent and compares exactly with the non-beneficiaries. Possibly, the single counting of annual crops like sugarcane, vegetables and sapota in the cropping intensity might have led to this problem. The influence of irrigation can be seen on the crop pattern and its diversification.

It can further be seen that the differences in the land use pattern exist across the size classes. There is a direct relationship between proportion of area irrigated and size class of holding. More interesting is the fact that both the group of farmers use the irrigation facilities in different

manner or in other words the decision making process differs not only across size of farm but also between the watershed and non-watershed area. This can be clearly seen in the analysis of cropping pattern.

Table 5.1: Land Utilisation of Beneficiaries and Non-Beneficiaries

Parameters (Units)	Beneficiary Group				Non-Beneficiary Group		
	Farm Sizes				Farm Sizes		
	I	II	III	All	I	II	All
1.No. of Farmers	15	15	15	45	12	3	15
2.Average Farm Size (Ha)	1.11	3.04	7.18	3.78	1.50	3.01	1.80
3.% Area Irrigated	70.38	32.65	25.64	31.89	25.06	13.30	21.12
4.% Fallow and Uncultivated land	13.25	8.85	13.99	12.54	11.69	6.87	10.08
5.Crop Intensity*	159	107	113	116	116	119	117

Notes: 1. We could not get any non-beneficiary belonging to size class III. Hence, the column is deleted.

2. * Annual crops are counted only once while arriving at cropping intensity.

3. Size classes are : I - Below 2 hectares; II - 2 to 4 hectares; III - Above 4 hectares.

Table 5.2: Cropping Pattern of Beneficiaries and Non-beneficiaries

(Per cent of Gross Cropped Area)

Crop	Beneficiary Group				Non-Beneficiary Group		
	Farm Sizes				Farm Sizes		
	I	II	III	ALL	I	II	ALL
1. Bajra	27.26	19.89	35.43	30.40	34.13	48.00	39.00
2. Jowar	16.62	22.23	27.05	24.48	40.41	20.00	33.24
3. Wheat	12.72	16.45	5.33	9.15	7.58	8.00	7.73
4. Tur	8.31	19.73	8.95	11.61	4.88	14.00	8.08
5. Cotton	16.17	16.69	15.05	15.62	10.83	6.00	9.14
6. Safflower	-	-	1.52	0.93	1.08	-	0.70
7. Groundnut	3.50	-	-	0.93	-	-	-
8. Sugarcane	5.77	-	4.00	3.22	-	-	-
9. Vegetables	5.77	0.91	0.38	1.24	-	-	-
10. Others	3.88	4.10	2.29	2.42	1.09	4.00	2.11

The discrepancies in the relationship between levels of irrigation and crop intensity between watershed and non-watershed regions may be attributed to the differential cropping patterns followed in the two regions (See Table 5.2). The data on the cropping pattern of the two regions indicate that the cropping pattern is more diversified and highly commercialised in the watershed region than that of non-watershed region. For example, cereal crops cover as much as 80 per cent of the area in non-watershed region, and most of the remaining area is devoted to cotton and tur. Whereas, about 60 per cent in watershed region is allocated to cereal crops and remaining area to the commercial crops like sugarcane, cotton, groundnut and sunfflower. The presence of sugarcane, though only 3 per cent of the area, brings out that better irrigation facilities are available in the watershed region and also explain the low cropping intensities in the region. As far as size classwise variations in cropping pattern are concerned it can be observed that the crop pattern of the small and marginal farmers is more diversified probably to reduce the risk of gross crop failure by spreading it. Accordingly, there are variations in the allocation of area to each crop across size classes.

5.3 Productivity, Cost of Production and Income Distribution

In an assured rainfall region characterised with availability of groundwater the presence of commercial crops can not be ruled out. In an agrarian economy dominated by commercial crops, it is well expected that the low density cereals and pulses would receive relative neglect in terms of resources.

The presence of sugarcane in the cropping pattern also reflects tendency towards reducing the role of family labour and hence possibly lower role of personal supervision. We may put this watershed at a higher level of development as compared to the earlier two regions and hence would reflect the influence of the intervention through minor irrigation.

Table 5.3: Yield Rates Per Hectare of Principal Crops

(In Quintals)

Crop	Beneficiary Group				Non-Beneficiary Group		
	I	II	III	All	I	II	All
1. Bajra	6.29	10.29	4.84	5.92	13.81	8.33	11.44
2. Jowar	7.11	4.23	6.12	5.78	12.60	22.00	14.59
3. Wheat	19.76	14.58	20.27	17.57	17.14	22.50	19.10
4. Tur	6.18	3.63	4.47	4.27	6.67	4.29	5.21
5. Cotton	13.72	10.27	8.61	9.77	12.50	10.00	11.92
6. Sugarcane	109.84	-	63.10	74.28	-	-	-

Note: The crops like Safflower, Groundnut and vegetables where the shares are negligible, are not included.

Comparison of yield per hectare between the project and non-project area indicates higher yields for most of the crops compared to other regions but higher in non-project zone. This is possible due to four reasons. Firstly, the most improbable reason may be that the non-project areas have extremely good resource structure and the watershed activities have depressed the farming efficiency in the project area.

Secondly, the presence of irrigation may be causing strain on the moisture conserved in the subsoils inflicting a stress situation on the other crops. Thirdly, the presence of sugarcane in the cropping pattern may be attracting larger share of resources starving the other crops of these vital inputs and the overall resource intensity might be lower coupled with low efficiency in the production process. In order to check on these points and other related issues we look further with the data on input use, production, income and it's inequality.

The farm level input use pattern across size classes for both the groups is presented in Table 5.4. Though the cropwise input data would help us deriving direct relationships between input use and yield rates, here we are presenting only the aggregate data in order to have a broad idea regarding input use pattern and also to avoid the complexity of presenting data for each crop. The input use pattern between these two groups indicate that non-programme area has higher intensity of input use which also gets reflected in the per hectare yield rates. It can be observed that except in the case of seeds and pesticides, the non-beneficiary farmers appear to be spending more on all the inputs. The low level of expenditure in case of seeds may be attributed to the differential cropping pattern followed by the two groups. In fact, for crops like sugarcane and groundnut, which are grown only by beneficiary farmers, the seed requirements are very high. And the higher level of pesticide usage may be due to the higher proportion of area under cotton which is the major crop needing pesticides. On the other hand, the

Table 5.4: Input Intensity Per Hectare in the Beneficiary and Non-Beneficiary Groups

Inputs	Beneficiary Group				Non-Beneficiary Group		
	Farm Sizes				Farm Sizes		
	I	II	III	All	I	II	All
1.Seeds:							
Q (Kgs)	294.75	13.30	4.68	45.53	11.97	9.94	11.25
V (Rs.)	309.00	181.00	231.00	228.00	158.00	118.00	144.00
2.FYM:							
Q (Qtls)	7.91	3.77	4.88	5.00	8.78	1.20	6.11
V (Rs.)	366.00	179.00	221.00	230.00	396.00	78.00	284.00
3.Fertilizer:							
Q (Qtls)	2.37	1.76	1.15	1.47	2.09	1.25	1.79
V (Rs.)	495.00	318.00	274.00	315.00	432.00	302.00	387.00
4.Pesticides:							
Q (ML)	1.03	1.23	0.78	1.10	0.35	0.20	0.30
V (Rs.)	150.00	96.00	79.00	93.00	70.00	41.00	60.00
5.Irrigation:							
Q (Nos)	8.96	2.38	2.75	3.48	3.41	1.80	2.85
V (Rs.)	191.00	100.00	57.00	85.83	81.53	38.00	66.00
6.Farm Labour:							
(MD)	72.23	66.51	42.58	52.64	88.84	56.20	77.37
7.Hired Labour:							
(MD)	32.49	25.23	24.52	25.77	43.99	25.20	37.39
Wages(Rs.)	369.00	255.00	269.00	279.00	425.00	248.00	363.00
8.Bullock Labour:							
Own (PD)	20.77	18.38	17.30	18.04	23.29	21.40	22.63
Hired (PD)	6.95	3.15	2.42	3.21	15.60	4.20	11.59
Wages (Rs.)	168.00	77.00	60.00	79.00	395.00	105.00	293.00
9.Machine Labour:							
Charges (Rs.)	9.00	38.00	4.00	14.00	27.00	-	18.00

Note: Q = Quantity, V = Value, MD = Man Days, PD = Pair Days.

utilization of fertilizer and farm yard manure are more in the non-watershed region despite the lower irrigation levels. However, the variations in input use across size classes indicate that there are more reasons for the lower yield rates in the programme area than just the lower input usage. It can be observed from the data that the small and marginal farmers are using more or less the same amount of material inputs (FYM, Fertilizer and Pesticides) when compared to small and marginal farmers in the non-programme area. The only substantial difference that can be observed between these two groups is in terms of labour use. Even the per hectare usage of machine labour is also higher in the non-beneficiary group.

Another plausible explanation may be the level of degradation of lands that are brought under watershed. The watershed technology though brought in improvements in irrigation, it would take longer time to vitalise the degraded soils and bring them at par with the better eco-systems. However, the improvements in irrigation facilities is a first step in this direction. Further, there appears to be a clear inverse relationship between farmsize and input use in most of the cases though it is not reflected in the yield rates. This may be due to the nature of resource allocation coupled with the poor quality of soils.

The allocative efficiency and the economic viability of the programme are more clearly captured in the analysis of gross and net income per hectare. The profit-loss analysis has been taken up in order to analyse the yield advantage of

non-beneficiary farmers in terms of net profits. The various components of income and costs are presented in Table 5.5. Our analysis bring out clearly the differences in the gross income earned by the farm households in project and non-project area. It is interesting to note that despite the disadvantages in yields per hectare, the gross income in watershed area exceeds that of the non-project region. This can be attributed to higher level of commercialisation and allocative efficiency in cropping pattern in the watershed region. Therefore, it can be deduced that beneficiary farmers are overcoming the disadvantages of lower input use and soil quality by following a more remunerative cropping pattern and thus earning more income per hectare possibly with an ecological trade off. It is necessary to see whether the gross income advantage is sustained even after deducting the costs. The table shows it very clearly that the cost of cultivation in the non-programme area is much higher than that of the programme area. The lower per hectare costs coupled with higher gross income has resulted in higher farm business income and net profit in watershed region. On an average, the net per hectare income is more than 7 times higher for beneficiary farms when compared to non-beneficiary farms. The size classwise analyses reveal that medium size farms in the watershed region are at a disadvantageous position both in terms of gross and net income. It can be recalled that these farmers do not grow sugarcane and/or groundnut and their per hectare input use was also low. Interestingly, small and marginal farmers are earning higher gross as well as net income per hectare compared to the large farmers in the

Table 5.5: Gross and Net Income Per Hectare of Beneficiaries and Non-Beneficiaries

(In Rs. per hectare)

Item	Beneficiary Group				Non-Beneficiary Group		
	Farm Sizes				Farm Sizes		
	I	II	III	All	I	II	All
1. Gross Income	5345	2875	3051	3312	3312	2751	3115
2. Paid out Cost	2057	1244	1195	1324	1985	930	1660
3. Imputed Cost	1322	1122	896	1014	1448	1088	1323
4. Farm Business Income	3288	1631	1856	1988	1327	1821	1455
5. Net Income	1966	509	960	974	-121	733	132

programme area. In fact, the per hectare profit of small and marginal farmers is more than double of that of the large farmers.

On the whole, the cash flow in the watershed region is much stronger than the cash flow in non project area. In terms of farm business income, none of the farm groups are incurring losses whereas in the case of net income the smallest size class in the non-watershed region is incurring losses due to higher imputed costs. Moreover, this group of farmers seems to prefer intensive cultivation. It is only due to very high gross returns per hectare in the watershed region that the small and marginal farmers are able to earn profits there.

This indicates that the aggregate value productivity is higher in the watershed region which may be attributed to the watershed technology.

Thus far we have been discussing the impact of watershed technology on farm economy at the beneficiary level by comparing beneficiary and non-beneficiary farmers. The observed differences are taken as a result of the technology. But, the statistical validity of the analysis can be questioned as our conclusions are based on absolute differences between the groups. The validity of the analysis improves if the variations within the groups are taken into account and there by checking whether the absolute differences between the two groups are statistically significant or not. Therefore, here we have made an attempt to examine the statistical significance of the differences between beneficiary and non-beneficiary farmers with the help of 'difference of means test'. The results are presented in Table 5.6. The test results reveal that most of the differences observed earlier between beneficiary and non-beneficiary farmers are not statistically significant. The only variables that turned out with a significantly different means are family labour (Human) and hired bullock labour. Surprisingly, the difference in net income, which is substantial, also did not appear to be statistically significant due to high intra-group variations. This leads us to conclude that the performance of programme area farmers is not statistically different from that of non-programme area. In other words, the watershed technology does not seem to have made any

considerable impact on the farm economy. This may be due to the reason that the watershed technology needs larger gestation period and the benefits accrued have both real and inherent forms.

Table 5.6: Difference of 'Means Test' for Various Indicators : Assured Rainfall Zone

Sr. No.	Item	Mean of		'Z' Value
		Beneficiary Group	Non-Beneficiary Group	
1.	Value of Fertilizers used (Rs.)	315	387	0.77
2.	Value of Farm Yard Manure used (Rs.)	230	284	1.36
3.	Family Labour used (Mandays)	52.64	77.37	1.84***
4.	Hired Labour used (Mandays)	25.77	37.39	1.59
5.	Owned Bullock Labour used (Pair days)	18.04	22.63	0.75
6.	Hired Bullock Labour used (Pair days)	3.21	11.59	2.03**
7.	Value of Material Inputs used (Rs.)	866	875	0.01
8.	Gross Value of Output (Rs.)	3312	3115	0.74
9.	Net Value of Output (Rs.)	974	132	0.02

Notes: 1) All the indicators are expressed as per hectare of sown area

2) Value of material inputs include value of seeds, farm yard manure, fertilizers and pesticides.

3) Z values indicated with ** and *** are significant at 1 and 10 per cent respectively.

Further, we have attempted to analyse the impact of watershed technology in terms of per hectare net income distribution across the farmers. For this we have estimated the Gini concentration ratios for watershed and non-watershed regions (see fig. 5.1 and 5.2). The estimates reveal that inequalities are more in the non-watershed regions 0.30 as against 0.15 in the project area. Therefore, like in the case of scarcity zone, watershed technology seems to have reduced the income inequalities by providing better opportunities to small and marginal farmers. Apart from this, the lower level inequalities may be due to the indirect benefits, which are not reflected in the aggregate analysis.

5.4 Food, Fuel, Fodder and Quality of Life

We have noted in earlier two cases that in the final analysis the consumption pattern, fodder, fuel use and the responses of the beneficiaries bring out the core of the impact parameters. Table 5.7 presents the per capita expenditure on consumption of food and non-food items. As between the groups, the differences do not seem to be very sharp, rather the beneficiary group shows consistently lower per capita consumption.

The per capita expenditure in watershed region is more evenly spread as compared to non-watershed region. Surprisingly, the higher net returns in the watershed region are not reflected in the consumption possibly due to the presence of conspicuous consumption and asset formation. The higher level of consumption expenditure in the non-beneficiary group can also be due to the earnings of hired out labour, which is quite prevalent

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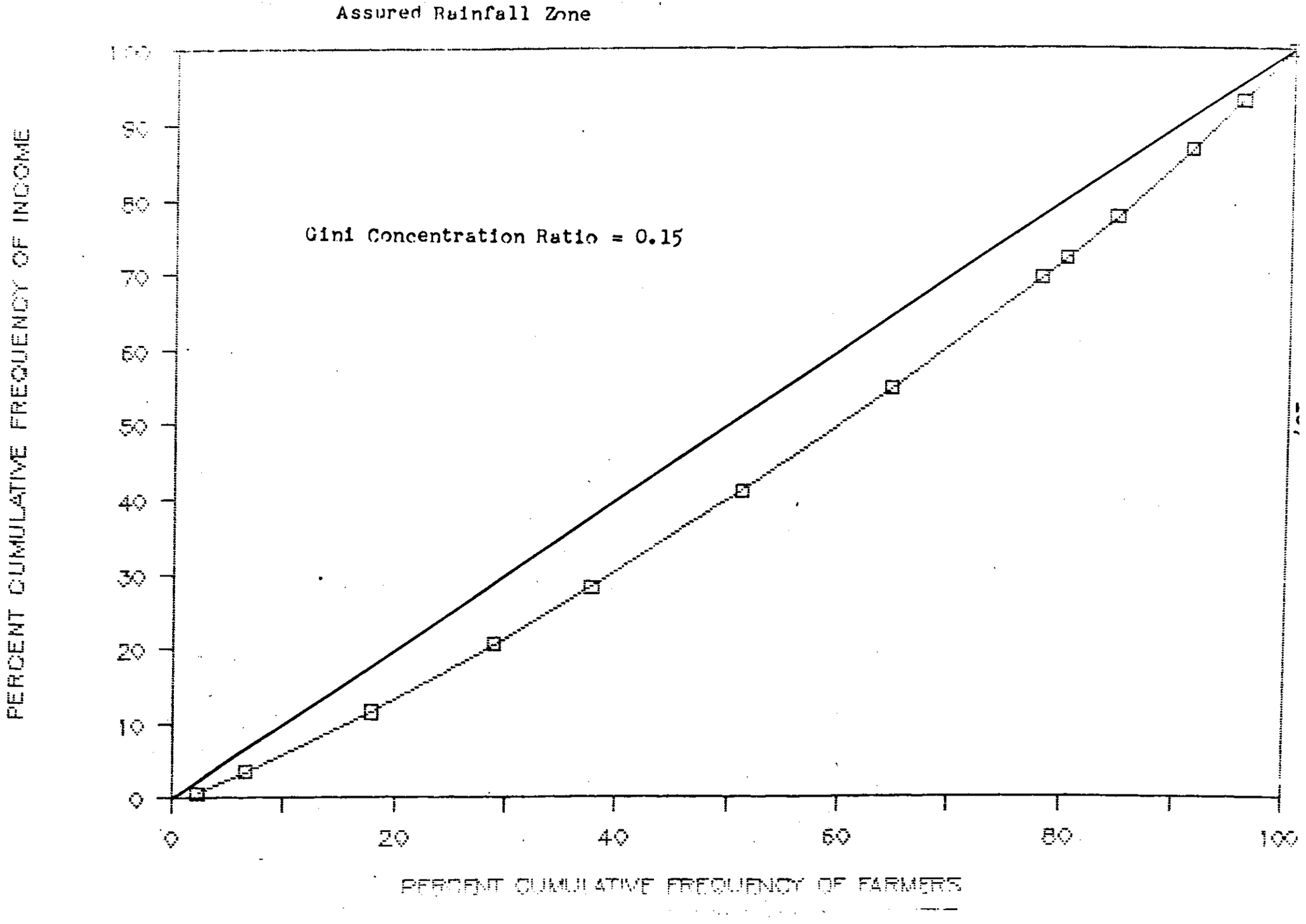
Assured Rainfall Zone
Gini Concentration Ratio = 0.15
PERCENT CUMULATIVE FREQUENCY OF INCOME
PERCENT CUMULATIVE FREQUENCY OF FARMERS
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100

Table 5.7: Consumption Pattern of Beneficiaries and Non-Beneficiaries

(In Rs. per capita per year)

Farm Size	Beneficiary Group			Non-Beneficiary Group			% of Expenditure on Food Items	
	Food	Non-food	Total	Food	Non-food	Total	Beneficiary	Non-Beneficiary
I	988	694	1682	1156	642	1798	59	64
II	1079	667	1746	1181	963	2144	62	55
III	1100	818	1918	-	-	-	57	-
All	1061	729	1790	1162	722	1884	59	62

Note: 1) Per capita consumption is arrived on the basis of adult units by converting children into equivalent adult units.

in the non-project area. Another important aspect of watershed technology is the availability of fodder to the cattle. It is expected that watershed technology should lead to higher fodder availability. For this purpose, we have obtained data regarding number of hours the cattle are grazed on open lands across seasons of the year. The data indicate that the number of hours cattle are grazed is more in the non-programme area (Table 5.8). This reflects the higher availability of fodder in this region. Quite possibly, the level of degradation is also reflected in lower availability of fodder and fuel in the project area. Moreover, the money spent on fodder in both the areas indicate that the dependence on purchased fodder is much higher in watershed region when compared to the non-watershed region. Further, no particular care is taken to avoid the degradation of land through restricting the cattle from open land grazing in this region. Similarly, the availability of fuel also seems to be less in the watershed region. It may be due to the time required for the afforestation programme to yield benefits. This indicates that due importance is not given to afforestation and grass planting in the project region. Another reason may be that farmers in this region are giving more importance to the high remunerative crops like cotton, sugarcane,etc., to the neglect of these programmes which are beneficial in the long run.

We have noted that the agro-ecological parameters do not indicate any dramatic change in project area as compared to the non-project areas from hinterlands. A possibility of the higher level degradation in watershed region

Table 5.8: Size Classwise Number of Hours of Cattle Grazing and Purchase of Fodder and Fuel

Farm Size	Number of Hours of Cattle Grazing						Purchase of Fodder/Fuel Per Day Per HH (in Rs.)			
	Beneficiaries			Non-Beneficiaries			Beneficiaries		Non-Beneficiaries	
	Summer	Winter	Rainy	Summer	Winter	Rainy	Fodder*	Fuel**	Fodder	Fuel
I	3.28	3.70	3.31	3.69	4.04	3.23	181	25	37	21
II	1.94	2.36	2.38	3.12	3.97	3.87	139	25	-	22
III	2.55	2.76	2.56	-	-	-	132	21	-	-
All	2.55	2.84	2.70	3.54	3.92	3.42	150	24	29	21

Notes: 1) * Purchase of fodder is given on per cattle unit per year basis

2) ** Purchase of fuel is given on per week basis.

and relative neglect of the treatments due to presence of minor irrigation with higher commercialisation cannot be ruled out. It is possible that only the farmer's reactions to the treatment can indicate the proper level of impact of the technology. Their reactions to non-leading (no clues were given before putting the question) specific questions are presented in Table 5.9. It can be observed from the table that a considerable number of farmers have noticed improvements in employment, wages, level and stability of yield rates. Contrary to our earlier analysis, the proportion of farmers noticing improvement in net income are 29 per cent as against 67 per cent reporting improvement and stability in yield rates. Our earlier data showed that the net incomes are higher in the watershed region inspite of lower yield rates due to different cropping systems. And, the variations across the size classes are marginal, though higher proportion of large farmers have noticed improved yield rates and the reverse is true in the case of wages and employment. In the case of employment and wages, the higher labour demand and wages might have prompted the large farmers to reduce the labour input. On the other hand, only a few farmers have noticed improvements in the availability of fodder (18 per cent) and fruits and vegetables (11 per cent).

Among the various activities of watershed development programme, the popular activities are contour and graded bunding (100 per cent), and land shaping (95 per cent) followed by nalla bunding (84 per cent), horticulture (62 per cent) and

Table 5.9: Distribution of Farmers According to Changes Noticed by Them

Farm Size	Percentage of farmers reporting improvements in				
	Level and stability of yield rates	Net farm income	Availability of fodder	Availability of fruits and vegetables	Employment and wages
I	60	27	13	0	80
II	67	27	27	13	73
III	73	33	13	20	67
All	67	29	18	11	73

afforestation and grass planting (44 per cent). The low level of awareness in the case of afforestation and grass planting reflects the low availability of fodder and fuel, further stresses the need for concerted efforts in this activity. On the whole, farmers expressed fairly good knowledge about the watershed activities. Moreover, about 95 per cent of the farmers have recorded their satisfaction regarding the extension support they received.

5.5 Resume

Assured rainfall zone comes very close to the scarcity zone in terms of its agro-climatic characteristics. The level of annual normal rainfall and its variation in this region is in the close proximity with that in the scarcity zone. Similarly, the level of degradation of natural resources was also quite high making the need for integrated watershed development as the most essential developmental programme. As

discussed in the first chapter, the impact of an area based programme like watershed development is characterised more by the complexities of the locale than the programme contents. In the case of assured rainfall region (specifically the sample watershed) we came across the most interesting results. The watershed represent one of the highly degraded lands with hardly any green cover before the treatment, but along with this degradation the sample region had good potential of ground-water since it comes under the lower reach of the larger river basin. The presence of irrigation made difficult the segregation of the impact of watershed technology.

In a situation where the degraded watershed with sizeable proportion of area under irrigation is there the impact analysis has to take note of four factors. Firstly, the in situ conservation of water would stabilise the draft from the irrigation sources. Secondly, the presence of irrigation would bring in the commercial crops with larger share of resources diverted to them. This would in turn lead to a neglect of the non-commercial food crops and hence yield levels of these crops would be lower. Thirdly, the presence of commercial crops would cause higher net income, lower share of family labour and lower personal supervision. Lastly, on the background of this, some of the components of the watershed treatment are likely to be neglected.

Our results of the analysis of assured rainfall zone indicates somewhat similar picture. The cropping pattern, cost of cultivation and the land use indicates a higher weightage to

high value commercial crops like sugarcane. The proportion of waste lands (permanent fallows and cultivable wastes) is slightly higher in the project region indicating larger resource intensity on cultivated lands. But the yield gaps showed that the resources are cornered by sugarcane and other commercial crops reflecting in lower yields for the food crops and low density cereals. The level of degradation was recouped to a large extent and the results have shown incremental net income. But the major part of this incremental net income comes from sugarcane and hence cannot be totally ascribed to watershed technology. In the final analysis, the farmers have shown a positive and encouraging impact through their reactions to the technology.

CHAPTER VI

SUMMARY AND CONCLUSIONS

6.1 An Overview

Experience of agricultural development in the country suggests wide regional differentials in the growth performance, along with a serious neglect of the balance of eco-system. Large portions of Maharashtra situated on the Deccan Plateau are the fragile eco-regions bypassed by technology. These areas contribute a sizable share to the foodgrain economy of the State. Poor irrigation, improper water harvesting, largely degraded soils and eco-system, predominance of low value crops coupled with lower precipitation make these regions vulnerable to droughts and famines. Major portion of the Central Maharashtra has always been categorised as drought-prone by various Irrigation Commissions and under many other agro-climatic classifications. Rainfed farming technology seemed to be the only answer for the problems of these areas.

A review of the constraints of dry-farming technology suggested five main issues viz., (i) lack of holistic planning, (ii) absence of precision plans and very low yield gaps, (iii) weak technological options which are unsustainable under risky environment, (iv) heterogeneity of environment, and (v) languid societal responses. This led to a thinking of an integrated resource region approach, which was translated into a watershed development programme during VII Plan. The working group on

dry land farming constituted by the Planning Commission and the Approach Paper to Eighth Plan reiterated further the need for watershed development approach as resource region.

Many sporadic experiments were already in progress in the country mainly through the initiative of Indian Council of Agricultural Research, Central Soil and Water Conservation Research and Training Institute, World Bank, Various Voluntary organisations and Agricultural Universities. Apart from these, the State Governments like Maharashtra and Karnataka had initiated watershed development programmes under different schemes.

Maharashtra has a large share of the chronically drought-prone areas of the country. This coupled with low level of irrigation gets reflected into lower yields and poor rates of growth in agricultural sector. In the presence of large patches of highly degraded lands and lower irrigation potential, the only plausible alternative is to bring the rainfed tracts under watershed development. The Agro-climatic Zonal Planning exercise suggested the following programme for the State.

The targeted programme is quite a huge task but this was suggested to be achieved by pooling together different schemes. In other words, a Comprehensive Land Use Management and Planning (CLUMP) approach was suggested by bringing together all ongoing schemes under one umbrella. The State has been divided by the Groundwater Survey and Development Agency into 1481 watersheds. These are relatively bigger watersheds and are further sub-divided into smaller units. Such smaller

Table 6.1 : Sub-Regionwise Programme for Watershed Development

Districts	No.of watersheds proposed to be completed in Eighth Plan	Area to be covered (000 ha)	Investment required (Rs. in Millions)
1. Bhandara, Chandrapur, Gadchiroli	471	141.3	353.25
2. Pune, Satara, Nashik, Kolhapur	146	219.0	547.50
3. Ahmednagar, Solapur, Sangli, Dhule	171	256.0	640.00
4. Jalgaon, Aurangabad, Jalna, Beed, Parbhani, Nanded, Osmanabad, Latur, Buldhana, Akola, Amaravati	310	465.0	1162.50
5. Nanded, Yavatmal, Wardha, and Nagpur	124	186.0	485.00
6. Thane, Raigad, Ratnagiri, and Sindhudurg	540	72.1	180.25
7. State	1762	1339.4	3348.50

Source: Agricultural Planning for the State of Maharashtra, Agro-Climatic Zonal Planning Unit, Ahmedabad, 1990.

units should be taken as planning units which incidentally match with the Comprehensive Watershed Development Programme (COWDEP) of the State.

Government of Maharashtra undertook a massive watershed development activity under Comprehensive Watershed Development Programme (COWDEP). This programme was undertaken by pooling funds under different schemes (like EGS, DPAP, RLEGP, MASSIVE). Under COWDEP, the State Government delineated 28,236 watersheds out of which the work is in progress on 17,377 watersheds.

A review of the COWDEP undertaken earlier (Deshpande and Reddy, 1990) suggested four main issues, viz., (i) Absence of the ground-level plans for each watershed, (ii) Mismatch between components needed and those in progress, (iii) Insufficient technical skills at the watershed level, (iv) Multiple responsibilities to the implementing authorities.

The Central Government initiated the programme of National Watershed Development for Rainfed Agriculture (NWDPRA) in 1986 with elaborate guidelines. The objectives of the NWDPRA included conservation and upgradation of soil, local level technology for crop production, stabilisation and to augment fruit, fodder and fuel economy. This was later expanded to include eco-system balance with the standard of living of the population (GOI, 1990). In other words, the task set forth by the objectives of the programme seems to be difficult though not a formidable one. The initial design of the programme included only the rainfed tracts falling within the isohytes of normal annual rainfall of 500 to 1150 mms. But in the 1990 guidelines, this restriction was lifted to include the high rainfall zone, but excluding watersheds where the proportion of irrigated area is more than 30 per cent. The philosophy behind this "cover all the regions" stems out of the planning for large basin watersheds. This is advisable provided the projectisation keeps in view the holistic plan as major objective. Two important aspects of the new guidelines (GOI, 1990) are the training and peoples' participation which hitherto did not get their due share.

In the present study we have undertaken an analysis of the Impact of NWDPRA in Maharashtra. Initially, in the first chapter we reviewed the progress and constraints of dry farming technology in the country and subsequently elaborated on the suitability of watershed development approach. The planning for resource region like watershed is discussed at length followed by an in-depth precise review of the existing studies. The chapter finally sets forth the task of the present study in terms of objectives and highlights the constraints and the methodological problems in impact analysis of an area based programme. This is followed by a chapter analysing the design and implementation of NWDPRA in the State of Maharashtra. The analysis suggested location specific aspects dominating the impact parameters, hence, care should be exerted to incorporate these specificities while preparing the plan of implementation. It was found that certain districts and regions are showing consistently lower achievements whereas, some other districts showed better achievements at lower cost. The administration of the programme is done through an elaborate structure under the Directorate of Agriculture. It would be beneficial if this structure is reformulated by using the Karnataka pattern. The impact analysis of the programme at sample level is carried out in the next three chapters under three agro-climatic situations. One important aspect coming out of this analysis is, that not only the agro-climatic situations but also the location specific aspects influence the impact parameters.

The study was undertaken with four-fold objectives:

i) to discuss and discern the methodological problems in the impact analysis of an area based programme like watershed development;

ii) to analyse the administrative structure and overall design of the programme with the help of the analysis of the data on components at the State and district level;

iii) to ascertain the impact of the programme on land utilization pattern, emerging cropping systems, water availability, production, productivity, employment and adoption of new technology;

iv) to bring out the constraints operating on the programme and suggest ways and means to overcome these.

Maharashtra has a wide agro-climatic diversity. Keeping in view these situations, we chose three districts falling under three different agro-climatic zones. One watershed from each of these districts was selected with the help of the district level implementing authorities. A list of the beneficiaries falling in the watershed was taken and stratified into three groups to select 15 beneficiaries randomly from each stratum. Apart from this, a control area was identified in the close proximity of the watershed with similar topographic features. After making a list of the farmers from control group these were stratified into three strata as above for selecting five households from each stratum.

Impact analysis of an area programme can be accomplished either by comparing the pre-project situation with that prevailing after the implementation of the project. Alternatively a comparison of "project area" parameters with those of "non-project area" give the incremental benefits due to project by filtering out the temporal influences which enter the earlier approach. But then in the analysis of area programme the choice of control should be such that it has similarity with the important parameters of the benefited zone. Such matching becomes extremely difficult when we come to practical situations. In the case of a watershed programme, the matching parameters should include (i) flow of water and water-ways, (ii) level of precipitation and its intensity, (iii) type of soils and rock formations, (iv) slope and topography, (v) water availability period, (vi) crops and vegetation, (vii) groundwater availability, (viii) size of holding and level of inequality in land holding. Apart from these there are quite a few others. More than this, even the non-economic parameters like domination of scheduled castes/scheduled tribes, or even the presence of a locally important temple can also vitiate the comparison between control and beneficiary groups. Hence, it is necessary to arrive at the direction of impact rather than precise magnitudes in the case of programme like watershed development. In chapter one of the study we have indicated a schematic representation of the impact analysis.

6.2 Summary of Findings

6.2.1 A review of the selected studies on watershed develop-

ment approach suggested that the methodology of impact assessment in the case of a watershed development programme needs to be carefully looked into. An interdisciplinary approach for project planning, monitoring and appraisal would yield better results. A proper administrative framework needs to be evolved at watershed level on the lines of the Karnataka watershed development programme. Economic analysis for the resource region keeping in view the differences across agro-climatic zones would yield better results.

6.2.2 Analysis of the design, administration and progress of the NWDPRA suggested six issues. Firstly, the Central Government issued two sets of guidelines one at the beginning of the programme in 1986 and the other in 1990. There are quite a few diverging points in these two sets. Especially, the extension of programme to heavy rainfall regions and in doing so the intensity of investment in rainfed regions would go down. Secondly, the State Governments were given little time in 1986 to prepare groundwork for the programme and in order to cover this, flexibility was given to dovetail the programme with on-going programmes. Possibly, such dovetailing has hybridised the otherwise systematic attempt on the part of the State Government. Such systematic preparedness can be seen after the 1990 guidelines were issued. Secondly, the watershed development approach is an integrated area development approach and not an "add on" programme. It is supposed to have the network of all the developmental programmes under one umbrella and not treat NWDPRA as an additional independent

programme. Thirdly, the programme needs an interdisciplinary administrative machinery at each watershed level (or at least for a group of watersheds). The participation of relevant line departments like hydrology, meteorology, horticulture, animal husbandry, etc., is minimal. Fourthly, the functionaries at grass-root level have multifold responsibilities and watershed treatment is one of their multifarious activities. Fifthly, the programme has shown differential impact across districts and components. Improved tools, equipments, field manuals, audio visual aids, adaptive trials, supply of seedlings and slipes and training seem to be the lagging components. The State Government did not fully utilize the establishment charges provided at 25 per cent of the total expenditure towards increasing the skilled manpower. Among the districts, Solapur, Beed, Nanded, Amaravati and Buldhana show almost consistently good performance across components whereas, Satara, Sangli, Nashik, Dhule, Jalgaon, Aurangabad, Parbhani, Osmanabad, Latur and Yavatmal are lagging in the achievements across components. Lastly, since the NWDPRA was dovetailed to the existing programmes in soil and water conservation it was difficult to seggregate the macro-level impact of the programme.

6.2.3 The impact of the programme in the searcity zone was characterized by the level of degradation, scarcity of groundwater, lower water holding capacity due to larger area under shallow soils, wide yield fluctuations, deforestation and poor economic environment (a comparative picture of all the zones is presented in Appendix 7.1). Proportion of fallow

lands was higher in the watershed region indicating higher resource intensity on cultivated lands by releasing marginal lands out of cultivation. The cropping intensity in the project area is slightly lower but keeping in view the proportion of irrigated area in both the regions, one can infer that the unirrigated cropping intensity is higher in project region. It was noted that the watershed treatment led to higher diversification and risk spreading. The only point of concern was the presence of sugarcane in the water scarce economy. The yield levels do not show any persistent increment across crops and size classes of operational holdings but there is enough evidence to indicate an increased stability in yield levels. The higher cost of cultivation caused dissipation of the benefits gathered out of higher yields both in the group of beneficiaries and non-beneficiaries. This is quite sharp in the case of small farmers than the other two groups. However, in the final analysis, it was noted that small and marginal farmers of the project area gained on income front as compared to their peers from non-project zone. The differences in the parameters between project and non-project area did not show statistically significant difference largely due to the high intra-group variances. Fodder and fuel availability in the watershed region is not dramatically different than that in the control region. In fact, it was noted that fuel would be available in the watershed area only after sufficient time lag.

The hard impact parameters show feeblish changes in the watershed region and further it is methodologically

difficult to ascribe these to watershed programme alone in the presence of other interventions. Hence, the reactions of the beneficiaries were taken on important impact parameters. These reactions indicate higher yield level and stability, increased fooder availability and higher employment with an upward shift in wages. It was quite clear from the analysis that the scarcity zone would need a longer gestation period as compared to the other regions mainly due to the level of degradation.

6.2.4 Moderate rainfall region is climatically better placed as compared to the scarcity zone. The region has a sizable forest cover and the level of degradation is not as high as in the scarcity zone. Economically the region has better growth rates and higher commercialization. The impact of watershed programme is determined by: well drained deep black soils with higher water holding capacity; possibility of protective irrigation; increased cropping intensity; larger availability of groundwater; lower level of degradation; its alarming speed; higher level of water consuming commercial crops and though the gestation period is lower, it would require larger maintenance.

The sample watershed area had existing wells even prior to the programme. Hence, the presence of irrigation and other related agricultural parameters have masked the impact of watershed treatment. Keeping this in view, we compared the impact parameters of the watershed region with those of the non-project region. Proportion of fallows and uncultivated lands and the cropping intensity were higher in the watershed

region, indicating thereby higher resource intensity. The cropping pattern in the project region is well diversified as compared to non-project area indicating risk spread. Commercialization alone does not seem to be the prominent decision factor in project area, whereas, the non-project region seem to have been weighted by this factor. Except in the case of jowar and paddy the watershed area has a distinct edge over the control region even though the latter had slightly higher irrigated area. The gross income of the non-beneficiaries is slightly higher than that of beneficiary group. However, this difference is not in accordance to the level of commercialization indicated by the cropping pattern. The higher gross income of the non-beneficiary group does not sustain when we consider the cost of cultivation. The cost efficiency of the beneficiary group helps not only in wiping out the differences in gross income but also show higher net income in the beneficiary group. The test of means for the important parameters in the beneficiary and non-beneficiary groups indicate that the differences were statistically significant only for hired labour use and cropping intensity. This again points to the higher resource intensity.

Quality of living as indicated by the per capita consumption expenditure on non-food items is relatively better in the watershed region. The level of income inequality is higher in the programme area as compared to the non-programme area, which is not surprising if we note the level of commercialization in small farm size group in the later region. The

availability of fodder has increased slightly but that of fuel has not changed substantially. This may be due to the gestation time required for the generation of fuel wood. The moderate rainfall region showed better results in terms of increased income, yield improvement with stability and employment along with wage level increase. This region has a good promise for watershed technology and it is essential to arrest the speed of degradation in this area.

6.2.5 Assured rainfall zone has a wrong nomenclature in the agro-climatic classification because it has lower level of annual precipitation and higher variation as compared to moderate rainfall region. Agro-climatically, this zone is quite close to scarcity zone and quite a few talukas from this region are classified as drought-prone areas by Sukhthankar Committee (GOM, 1973). The impact of watershed treatment would have three prominent features viz., (i) stabilization and increase of yield rates, (ii) higher waterholding capacity with medium to deep black soils providing protective moisture availability, (iii) higher level of degradation of the eco-system. Hence, initial work of the watershed goes in recouping the earlier damage caused.

The impact analysis indicated higher proportion of fallow lands in the watershed area but lower cropping intensity. If the annual crops are counted twice this indicates higher resource intensity per unit of cultivated land. The impact analysis is marred by the unusual presence of well irrigation among the sample beneficiaries. It was noted that

unlike the earlier two regions, the project area cropping pattern is more commercialised, though diversified. In other words, this would mean commercialisation and risk spreading achieved together, which we may term as a case of impact of watershed technology in the presence of irrigation. Resources are not only concentrated on better quality of lands by releasing marginal lands out of cultivation but also on the highly remunerative crops (sugarcane, wheat, cotton) by reducing on others. This has resulted in lower yield rates in the commercialised agriculture (watershed region) for the food crops but got compensated by generating higher income per unit of land in this region. The watershed region here has also better cost efficiency thereby keeping the net income per hectare higher than the control region. The most interesting aspect of the income generation is the inverse size-productivity relationship in project region as against a direct relation in the control area. Finally, this results into lower inequality in watershed region as compared to control area. Fodder and fuel availability does not show significant differences possibly due to the neglect of the non-arable area on the face of commercialisation or because of the higher level of degradation. Farmers' responses indicate increased yield with higher stabilization, increased income, higher wages and employment availability. Some of these do not correspond with the quantitative comparisons presented earlier but then the final judgement should be that of the beneficiaries. Most of the farmers showed awareness and understanding of the programme. The

assured rainfall region watersheds are likely to yield better results in short run as compared to those from scarcity zone.

6.2.6 Watershed development programme of Maharashtra has a longer history compared to many other States. The Bombay Dry farming practices and soil conservation department has a long history and an experience gathered over years. But the state of agriculture in Maharashtra, its agro-climatic and institutional constraints pose a challenge to the state of art technology in rainfed farming. It was argued by many analysts that only an integrated approach for development of a resource region can lead to the amelioration of the situation. The experience of COWDEP has shown that the watershed development approach has potential to bring the lagging regions into the mainstream of development. Impact of the programme, however, varies across regions and districts. Hence, the location specificity of watershed technology should be a starting point at the time of projectisation. An interdisciplinary project level administration would probably bring out exemplary results. More important is the fact that unlike other developmental programmes watershed does not have a culminating point. Hence, a completed (completely developed) watershed is a misnomer, the treatment is dynamic and continuous in nature. It should be clear that it is a resource region approach for development and all the developmental programmes should be culminating into it as final unit of implementation.

6.3 Policy Imperatives

6.3.1 Any programme on the basis of a resource region, should

be based on the macro parameters. In the case of a watershed the projectisation must begin by planning for the river basin culminating into a small watershed of a few hundred hectares. This establishes the internal linkages of the resource regions. Such an approach would yield better results than planning for individual watersheds.

6.3.2 Every project preparation should follow the guidelines of 1990 in spirit so as to give a map of targeted treatments. This should also include phases of work and expected patterns of impact for the purpose of monitoring.

6.3.3 The preparation of project report must involve technical experts including social scientists. Active involvement of scientists from Agricultural Universities in the projectisation at watershed level supported by the concerned line departments would bring better results. In order to accomplish this smaller groups of scientists should discuss project reports prepared on each watershed and also help in monitoring the programme.

6.3.4 In order to evolve the participation at local level within the watershed, publicity material in the form of illustrative pamphlets, audio-visual aids may be used. This can be dovetailed to the existing extension programme. Night meetings in the villages illustrating the watershed treatments would bring better involvement. This was experienced in Karnataka programme. The Mitra Kisan concept advanced in the guidelines (1990) may not yield intended results, because most likely influential village leader would be taken as "Kisan Mitra" and they would not have sufficient time to devote for

organizing the watershed beneficiaries. This can be replaced by another concept of "watershed Panchayat", wherein a few persons belonging to different economic strata sit together to decide about the beneficiary participation and component planning.

6.3.5 Presently the cost of the structures erected and most of the treatments, is borne out of public funds. No contributions from the beneficiaries are sought for this purpose. It is suggested that some nominal contribution should be charged to the beneficiaries so that they will have a sense of involvement in the programme. This may be decided in consultation with the "Watershed Panchayats".

6.3.6 The componentwise review suggests that the farm ponds got least attention in scarcity zone. This may be due to the higher cost of the structure. A scheme of farm pond credit through Land Development Banks or Nationalized banks would help the farmers to take up such structures either individually or jointly. Such a scheme would also indirectly help in maintenance of water conserving structures feeding the farm ponds by the farmers so that the farm ponds get the required water.

6.3.7 It was noted that the administrative structure of watershed development programme in Karnataka provides technically trained team upto watershed level. Moreover, the Karnataka experiment also indicates stronger verticle and horizontal linkages along with participation of beneficiaries at watershed level. The administrative structure also provided for internal monitoring and evaluation. Programme implementation

Appendix 7.1: A Comparison of the Impact of NWDPRA Across Agro-Climatic Zones

Sr. No.	Particulars	Beneficiary			Non-Beneficiary		
		SZ	MRZ	ARZ	SZ	MRZ	ARZ
1	2	3	4	5	6	7	8
1.	Average Size of farm	4.25	3.82	3.78	2.93	4.46	1.80
2.	% of Irrigated Area	13.60	14.30	31.89	25.45	20.46	21.12
3.	% of fallow and uncultivated land	6.17	12.60	12.54	1.14	6.96	10.08
4.	Cropping Intensity	125	131	116	130	122	117
5.	Proportion of Area under low value cereals	61.91	22.98	54.38	77.13	18.50	72.24
6.	Proportion of Area under commercial crops	5.81	32.10	21.94	8.64	41.96	9.84
7.	Proportion of Area under foodgrains	84.84	67.89	75.64	88.01	58.05	88.05
8.	Proportion of Area under non-foodgrains	15.16	32.11	24.36	11.99	41.96	11.95
9.	Yield rates per hect. of major subsistance crops						
	crop - 1	3.29	10.98	5.92	4.22	11.57	11.44
	crop - 2	2.88	4.89	5.78	5.14	3.93	14.59
10.	Yield per hect. of major commercial crops	5.58	7.59	9.77	2.22	6.56	11.92
11.	Expenditure on fertiliser and pesticides in Rs. per hectare	41	423	408	70	428	447
12.	% of Hired labour to total labour	39.96	35.26	32.87	50.31	37.80	32.58
13.	Gross income per hectare	895	3078	3312	1641	3180	3115
14.	Imputed cost per hectare	610	783	1014	701	782	1323
15.	Farm Business income per hectare	151	2019	1988	464	1975	1455
16.	Expenditure on non-food in Rs. per year	653	709	729	645	684	722
17.	No. of hrs. of open grazing average per season per day	4.92	3.31	2.70	3.78	3.60	3.63
18.	Purchase of fodder per year per HH	88	166	150	158	177	29
19.	Purchase of fuel per week per HH	41	32	24	45	19	21
20.	Gini ratio of inequality	.11	.28	.15	.27	.23	.30
21.	Most prominent changes: Increase in	1) Employment & wages	Employment & wages	Employment & wages	-	-	-
		2) Yield rates & stability	Yield rates & stability	Yield rates & stability	-	-	-
		3) Fodder	Net farm income	Net farm income	-	-	-

Notes: 1) SZ : Scarcity Zone, MRZ : Moderate Rainfall Zone, ARZ : Assured Rainfall Zone

2) At sr.no.5 low value cereals crops are i) under SZ : Bajra, Jowar
ii) under MRZ : Jowar
iii) under ARZ : Bajra, Jowar

3) At sr.no.6 commercial crops are i) under SZ : Cotton, sunflower, chillie, sugarcane and vegetables
ii) under MRZ : Cotton safflower, G.nut, Mosambi, sugar sugarcana
iii) under ARZ : Cotton, safflower, G.nut, sugarcane and vegetables

4) At sr.no.9 major crops are i) under SZ : Bajra, Jowar
ii) under MRZ : Jowar, Udid
iii) under ARZ : Bajra, Jowar

5) At sr.no.10 major commercial crops i) under SZ : Sunflower
ii) under MRZ : Cotton
iii) under ARZ : Cotton

through the existing structure always causes a procedural overlapping, multiplicity of functions, weak horizontal linkages and marginal updating of the skills. All these are vital components at watershed level. Hence, the Karnataka model of administration of the watershed programme is suggested at watershed level (or for a group of watersheds).

6.3.8 Watershed development approach is a resource region development approach. This signifies that thinking about all the developmental programmes should have watershed as an ultimate planning region. In other words, all the ongoing programmes should be taken as components of the larger envelop programme operating in a watershed. A comprehensive land and eco-system management programme by bringing together all the developmental programmes would be a better alternative.

6.3.9 Any area developmental programme should be continuously monitored and evaluated at specific intervals to incorporate the new alternatives. It would always be advisable to assign such evaluation and monitoring to independent positively oriented organizations. These evaluations can bring out both the strong and weak points of the programme in order to increase its effectiveness. Any watershed cannot be called completed because both its development and treatment are continuous dynamic processes. Hence the concurrent evaluations would help in modifying the process whenever necessary.

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