

An Appraisal of Watershed Development Programme Across Regions in India

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FOREWORD

The technological change of the mid-sixties has certainly brought a significant change in the agricultural economy of the country, but it also threw up quite a few policy issues. Despite a substantial share of rainfed areas in the aggregate food economy of the country, the crops and population of these areas suffered in terms of resource allocation both from public and private sources. Considering the importance of rainfed agriculture in Indian economy, a strategy towards watershed development was worked out for the country as a whole during the mid-term review of Seventh Five Year Plan with an aim to improve the overall performance of the rainfed agriculture. The programme was entitled "National Watershed Development Project for Rainfed Areas" (NWDPA). This programme either replaced or supplemented the ongoing programmes at the State level. After a few years of experience and evaluation of the programme, a complete review was taken by the committee of secretaries. The guidelines were subsequently changed during the Eighth Plan period and revised to incorporate the feedback received from various researchers.

At the Gokhale Institute of Politics and Economics, we have conducted a series of studies on watershed development focusing on the evaluation and the impact of various programmes. In the process, a methodology to review such impact was also developed. The Agro-Economic Research Centre of the Institute was rightly chosen as the co-ordinator for the studies evaluating the impact of NWDPA in ten States in India. The studies were carried out by the Agro-Economic Research Centres from these ten States. The research reports prepared by these Centres were combined and brought together as a consolidated report. This study includes the findings of these reports as well as the insights gathered during the conduct of the various studies relating to watershed development programme, carried out by us as well as others. This study was conducted by Dr. R. S. Deshpande and Dr. A. Narayanamoorthy of our Institute. In the meanwhile, Dr. Deshpande left the Institute to join as Professor at the Institute for Social and Economic Change, Bangalore. He subsequently helped to put together this volume.

This study, besides presenting the impact of NWDPA on cropping pattern, input use, water availability and productivity of crops, also incorporates the environmental impact of this programme in detail. Effectiveness of the administrative machinery in implementing the programme, people's participation, sustainability and adequacy of the programme are also examined systematically in this study. The results of this study show that while the watershed programme has increased the productivity of crops, availability of moisture and irrigation in most of the States, people's participation in the programme, which is essential for the sustenance of the programme, is less than satisfactory.

The results of this study have immense relevance for making policies for the persisting problems related to drought across different parts of the country. I am sure that the findings of this study will be quite useful to the policy makers and researchers working in the area of watershed programme in particular and rainfed agriculture in general.

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V.S.Chitre
Director

25 May, 2000

PREFACE

The new agricultural technology introduced during the mid-sixties bypassed the rainfed areas and fragile resource regions. This has given rise to a large number of area based programmes as well as problem specific interventions on the part of the State. Rainfed areas not only contribute largely to the food economy of the country but also carry the major share of poor of the nation. A comprehensive programme entitled "National Watershed Development Project for Rainfed Areas" (NWDPR) was introduced at a massive scale across different regions of the country during the Seventh Five Year Plan period along with other programmes to improve the condition of the rainfed agriculture. As per the advise of the Ministry of Agriculture, Government of India, New Delhi, studies were undertaken to evaluate the impact of watershed development under NWDPR across ten States by different Agro-Economic Research Centres. In this study, we bring together the varied experiences of the researchers on watershed development programme across different States in the country including our own experiences from Maharashtra in detail.

While working on this study, we have benefited from different people at various stages. At the outset, we gratefully acknowledge the help rendered by different Agro-Economic Research Centres (AERCs) by completing the study based on the guidelines. The participating AERCs are located in Andhra Pradesh, Assam, Gujarat, Haryana, Himachal Pradesh, Madhya Pradesh, Maharashtra, Tamil Nadu, West Bengal and Uttar Pradesh. We had asked for the secondary data from all the above States to analyse the programme at macro level. However, it was not available for all the States in the similar pattern. We are grateful to the AERCs that have sent these data.

Dr. Ghorai and Dr. Chitranjan, Advisers, Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi, have taken substantial efforts in getting us the data for such an analysis and provided continuous support. We would like to place on record our gratitude to both of them.

We are grateful to Prof. V.S. Chitre, Director and Prof. D. C. Wadhwa, former Director, Gokhale Institute of Politics and Economics, Pune for their constant encouragement and continued support. This is the first study which brings together researchers from two social science Research Institutes and this was made possible because of the administrative support of these two Institutions. We wish to thank Smt. Anuja Chandrachud, Smt. Vidya Kher, Shri Dete and Shri V. B. Lokare of Gokhale Institute of Politics and Economics for providing research assistance in completing the study. Shri D. N. Bhagti helped us to compute a few tables and getting the study in the present shape. We are grateful to him. Shri T. Srinivasa Murthy and Shri M. K. Mohankumar of Institute for Social and Economic Change, Bangalore have been responsible for neatly typing the manuscript through its various drafts.

Finally, we are also grateful to an anonymous referee of the journal for offering constructive comments on the study which helped to improve the overall presentation of the study. However, none of the above are responsible for errors, if any.

R. S. Deshpande
A. Narayanamoorthy

25 May, 2000

CONTENTS

Foreword	
Preface	
List of Tables	
List of Figures	
Chapter 1 Introduction	315
Chapter 2 Impact of Watershed Technology: A System Approach	333
Chapter 3 NWDPR: Western and Central Rainfed Zone	347
Chapter 4 NWDPR: Southern Plateau and Hills Region	359
Chapter 5 NWDPR: Northern Gangetic Plains	366
Chapter 6 NWDPR: Hills Region and Assured Rainfall Zone	372
Chapter 7 Watershed Approach in Fragile Resource Region	381
Chapter 8 Summary and Conclusions	393
References	411

LIST OF TABLES

Table No.		Page No.
1.1	Treatments under Watershed Development Approach	317
3.1	Strategy of Watershed Management	347
3.2	Allocations on NWDPRAs: 1986-87 to 1988-89	348
3.3	Incremental Yield due to Watershed Treatment	350
3.4	Yield per Hectare of Principal Crops of Beneficiaries and Non-Beneficiaries in Madhya Pradesh NWDPRAs	353
3.5	Incremental Yield per Hectare under NWDPRAs in Maharashtra	355
4.1	Agro-Climatic Sub-Regions of the States under Southern Plateau and Hills Region	359
4.2	Yield per Hectare of Beneficiaries and Non-Beneficiaries	362
4.3	Net Income of Beneficiaries and Non-Beneficiaries	364
5.1	Allocation of NWDPRAs during Eighth Plan	366
5.2	Yield per Hectare of Participants and Non-Participants in Haryana NWDPRAs	368
5.3	Proportion of Unutilised Funds in Total Allotment of NWDPRAs in Uttar Pradesh	369
6.1	Crop-wise Net Returns of Beneficiaries and Non-Beneficiaries in Himachal Pradesh	373
6.2	Year-wise Funds Released and Expenditure Incurred in West Bengal under NWDPRAs	375
6.3	Productivity per Acre of Beneficiaries and Non-Beneficiaries in West Bengal NWDPRAs	376
6.4	Productivity of Crops in Kakodonga and Lakhinizaras Watershed in Assam	379
7.1	Basic Characteristics of Selected Watersheds in Maharashtra	382
7.2	Land Utilisation of Beneficiaries and Non-Beneficiaries in Maharashtra	383

7.3	Cropping Pattern of Beneficiaries and Non-Beneficiaries In Maharashtra	384
7.4	Yield Rates per Hectare of Principal Crops in Maharashtra	385
7.5	Input Intensity per Hectare in the Beneficiaries and Non-Beneficiaries Groups in Maharashtra	386
7.6	Gross and Net Income per Hectare of Beneficiaries and Non-Beneficiaries	387
7.7	Difference of Means Test for Various Indicators: 'Z' Value	388
7.8	Zone-wise Number of Hours of Cattle Grazing and Purchase of Fodder and Fuel	390
7.9	Distribution of Farmers According to the Changes Noticed by Them	391
8.1	List of Watersheds Selected for Study by Different States	397
8.2	State-wise Allocation Proposed During Eighth Plan	405
8.3	Impact of NWDPRAs Parameters at a Glance – Western and Central Rainfed Zone	406
8.4	Impact of NWDPRAs Parameters at a Glance – Southern Plateau and Hill Regions and Northern Gangetic Plain	407
8.5	Impact of NWDPRAs Parameters at a Glance – Hill Region	408

LIST OF FIGURES

Figure No.		Page No.
2.1	Watershed Impact System Model	336
2.2	Production Sub-System in the Impact of Watershed Treatment	338
2.3	WISM-SEP Model	340
2.4	Environmental Sub-System: Positive Externalities in Watershed Development Programme	342
2.5	Impact of Watershed Treatment Programme	345

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R. S. Deshpande*
A. Narayanamoorthy**

CHAPTER 1

INTRODUCTION

1.1. Introduction

With the positive and firm steps towards liberalisation, the policy towards agricultural development in India has more complex problems to deal with than ever before. Infrastructural development takes equal priority as that of the development of the bypassed regions, crops and peasant classes which did not receive the benefits of the technological change of mid-sixties. Rainfed areas, crops and the population of these areas suffered both in terms of resource shares and the consequent decline in investment in agricultural sector. This had a telling effect on the overall agricultural growth of these regions. As a result, rainfed areas remained more or less out of the ambit of the seed-water-fertiliser technology. The constraints of water availability were quite strong in these regions so also the level of resource degradation. The most vital input for enhancing the technological change namely the capital formation (both from public and private sources) did not take place at required pace. In this context, Jodha surmised that even the research inputs also catered to superior crops, regions and groups of cultivators (Jodha, 1979; 1991). From this perspective assimilation of the rainfed areas in the mainstream process of economic growth becomes more important for four specific reasons. Firstly, the optimum limits to resource augmentation in irrigated areas are being reached at a very fast rate. This necessitates need for diverting added research attention to the rainfed areas for area augmentation. Secondly, in order to sustain the present rate of growth as well as to obtain higher rate of growth in the agricultural sector, it is necessary to enhance the aggregate productivity of agricultural sector. Role of the rainfed areas in such process of productivity enhancement is inevitably important. Thirdly, it is necessary to secure and induce the market participation of the population from rainfed areas both as producers as well as consumers so as to strengthen the market forces. This can ensure the required impact of the market in the process of growth through liberalization. Lastly, the equity consideration overrides the growth calculus in this context because the rainfed areas have a larger concentration of poor and thus it requires

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larger doses of inputs in terms of investment in technology. Hence it becomes crucial to involve these regions in the mainstream process of development.

Recognising the pressing need of getting the rainfed areas in the main-stream agricultural growth early initiatives in the post-independence period were taken in terms of Grow More Food Campaign, Drought Prone Area Programme (DPAP) and Desert Development Programme (DDP). But the first comprehensive step and integrated approach towards this came in the form of watershed development programme at the time of mid-term appraisal of the Seventh Five Year Plan. Watershed based planning for agricultural development was suggested by Mahatma Jyotiba Phule during 1883 in his famous Marathi book on Farmers' Whip and later on featured even in the Report of Famine Commission. It is often argued that rainfed farming is constrained due to the availability of natural resources, but in fact it is the cropping system which should be held more responsible for weakening the structure of rainfed farming. The cropping system, vegetation, cultivation practices are not suitably tailored taking into account the natural constraints. Rainfed farming is more influenced by the farming practices in the river basins (with ample availability of water). It is natural that the farming systems initially developed in river basins and then extended further to the less endowed regions. But while such cultivation practices yielded good results in well endowed irrigated river basins, these practices under rainfed conditions led to slow erosion of their natural resource base. The non-compatibility of these farming systems with the heterogeneous eco-systems under rainfed conditions failed to produce similar results. No doubt, over centuries of experience, the farming in the rainfed areas have got naturally tuned to the existing eco-system by developing proper adjustment mechanisms (Jodha, 1978), but such efforts could not arrest the process of degradation of vast patches of land, forests and pastures due to predominance of subsistence farming and over dependence on forest resources. It is pointed out clearly that if the existing water resources are used judiciously, it would be possible to sustain the growth in productivity levels and at the same time arrest the process of degradation. Thus establishing an inter-dependent system of resources confined to a well defined resource region can only serve as a programmed solution for the problem.

Water and land are the two basic resources which interact with the bio-system in a watershed region and proper use of these two resource systems can lead to an optimum production level with least damage to the resource base. Watershed is defined as a drainage area of which the run-off leads to a single water body (Tamhne, 1967; Magrath and Doolette, 1990). It is an eco-system or bio-geo-physical unit in which the inter-dependence are internalised. As Barrow defined it - "..... within a watershed physical and biological resources are linked by a complex of processes" (Barrow, 1987). These resource regions can thus appear in different forms or sizes and are not easily amenable to standardisation in terms of mini, micro or macro typologies. The ridge line marks the boundary and the waterways created by the run off help to plan the treatments across slopes. The ridge to valley area incorporates seven interdependent bio-systems, namely. (i) Silvicultural; (ii) Silvi-pastoral; (iii) Silvi-horti-pastoral; (iv) Horti-pastoral; (v) Horti-agri-pastoral; (vi) Rainfed low density agriculture; and (vii) Rainfed and protectively irrigated cropping system (Deshpande and Reddy, 1991). These cropping systems are supported by various land treatments as mentioned in Table 1.1.

The treatments mentioned here are only indicative and do not represent an exhaustive list of the treatments in practice in the country. In fact the treatment/management of watershed is a completely localised phenomena and the treatments will depend entirely local

conditions. There can be some general guidelines in the form of indicative measures but such measures have to be suitably altered keeping in view the local conditions.

Table 1.1: Treatments under Watershed Development Approach

Treatment	Brief Description of the Purpose
1. Arable Land Treatment:	
i. Vegetative bunds/key lines	To arrest soil erosion and run off, moisture conservation.
ii. Contour and vegetative hedges	To arrest soil erosion and run off
iii. Contour guide lines	Facilitates contour cultivation, water conservation and moisture retention
iv. Grades bunds	Terracing so as to break slope and create flow barriers.
v. Opening dead furrows	Moisture conservation
vi. Gully controls	To arrest the run off and ravine formation
vii. Surface drains	To direct the run off
viii. Loose boulder bank embankment	To strengthen the bunds
ix. Farm ponds	Water conservation
2. Non-Arable Land:	
i. Plantations-vegetative cover	Management of soil run off and degradation, moisture conservation
ii. Live fencing	Wind erosion, moisture conservation
iii. Live check dams and brush wood dams	Arrest soil erosion and increase moisture conservation
iv. Drain lines	Manage run-off
v. Vegetative contour hedges with furrows	Reduce erosion and increase moisture conservation
vi. Live check dams, brush wood dams, loss boulder check dams, other nalla check measures	Manage run-off, reduce soil erosion and gully formation
vii. Stabilisation of nalla banks	Reduce side cutting
viii. Gully treatment with vegetative measures	Check the gully formation and stop further erosion
ix. Run-off management, dug out ponds	Run-off management, water conservation

1.2 A Review of the Studies

Economics of watershed management as a subject has been handled by various researchers in different ways. There are a few reviews of the ongoing watershed development programmes in India (Vaidyanathan, 1991; Deshpande and Reddy, 1991; Chopra, 1998; Shah, 1998). Broadly we can find four groups of studies dealing with different aspects of watershed management. First group of studies includes the work carried out by the analysts of rainfed farming in India and elsewhere. Keeping in view the constraints on availability of water under rainfed farming, the studies direct more towards enlisting the constraints and management of soil moisture by undertaking proper measures to utilise the available

precipitation. The second group of studies deals with the impact assessment of watershed based treatments incorporating the individual components of the management strategy. The third group includes the studies done by researchers covering the overall aspects of a watershed where the impact of treatments covers the entire watershed and the impact parameters include the agricultural as also the environmental sector. The last group of studies comprises of the work done by hydro-geologists exclusively analysing the changes in the groundwater parameter of the impact. We attempt to take up the review of these in the following paragraphs.

Research on the technology of rainfed farming began in the country in early thirties with the establishment of dry farming research stations at Solapur (1933), Bijapur (1933), Hagari (1934), Raichur (1934) and Rohtak (1935). Early research on dry farming was mainly confined to the conservation of soil moisture through bunding and understanding the rainfall behaviour in these regions (Kanitkar and Sirur, 1960). Though the programme began with manifold objectives and started yielding some results the work at most of these research stations was stopped due to Second World War. Only exceptions were Solapur and Bijapur dry farming research stations. The work on these stations continued within the given framework but their research was directed more towards soil conservation. This was also remarked in the review taken in an official study of Planning Commission, Government of India (GOI, 1986a). The emphasis on soil conservation also yielded significant improvement in rainfed areas. The results of crop cutting experiments in Maharashtra, Karnataka and Tamil Nadu by mid-seventies showed 11 to 25 per cent increase in yields in the banded fields (Jodha, 1979). Among the important constraints identified in the dry farming improvement programme with major emphasis on soil conservation programme are: (i) Over-emphasis on engineering components; (ii) Lack of biological components and (iii) Neglect of institutional support for the work (Jodha, 1979, p. 494). These constraints however continued to dominate the developmental initiatives in rainfed farming even now.

At institutional level the All India Co-ordinated Research Project for Dry Land Agriculture (AICRPDA) was established to work on research and development of dry lands and dissemination of the results through testing the technology on pilot projects. The emphasis of AICRPDA was more on the development of location specific technologies and testing these under field conditions (AICRPDA, 1982). Similarly, the contributions of International Crop Research Institute for Semi-Arid Tropics (ICRISAT) and Central Arid Zone Research Institute (CAZRI) have been quite significant on technological front. ICRISAT pioneered the development of rainfed agricultural technology, though initially the work was mainly confined to a specific research agenda but soon the dissemination of the results started and ICRISAT technology became a more household word in certain rainfed areas of Maharashtra and Andhra Pradesh (Walker and Ryan, 1990). The development of technology at CAZRI however, involved mainly the research on agronomic practices, crop variety research, fodder and forest trees etc. ICRISAT not only developed and disseminated 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 (Walker and Ryan, 1990).

Intensive Area Development Programme (IADP) and Drought-Prone-Area Development Programme (DPAP) were taken up for the development of rainfed areas with an objective of boosting up the adoption of technology in these regions and creating employment opportunities. Fifty-four districts spanning over 13 States were taken up for the purpose of DPAP programme. However, the emphasis of the programmes on civil works,

seasonal employment generation and the top-down approach were responsible for not allowing it to gain a foothold in the rural areas as a rainfed farming policy intervention. These programmes thus had only a momentary influence on the status of rainfed farming and the impact of DPAP and DDP Programme have been analysed recently by a Committee appointed by the Planning Commission, Government of India and headed by Prof. C. H. Hanumantha Rao. The Committee strongly recommended an approach based on watershed area development (GOI, 1994).

Initial efforts towards watershed development in India began in terms of soil conservation activities. During the framing of the First Five Year Plan and early in the Second Five Year Plan, a group of nine Soil Conservation Research, Demonstration and Training Centres were established (Dehradun, Chandigarh, Ootacamund, Bellary, Kote, Vasad, Agra, Hyderabad and Chattrra). These centres were established during 1954-56 and were transferred to the Indian Council of Agricultural Research in the year 1967. One of the major objectives of the soil conservation programme was "the conservation of land and water resources under different land use systems" (Tripathi and Singh, 1993). The work of the soil conservation programme cannot be equated to the present days watershed development programme, however, about 10 million hectares of area was covered under this till the beginning of the Fifth Plan. All India Coordinated Research Project for Dryland Agriculture was started during this time. Similarly, Integrated Dryland Agricultural Development Project was also launched at 24 locations in the country. The Drought-Prone Area Development Programme (DPAP) was initiated and it also included some aspects of the watershed development technology. The Technical Committee on DPAP and DDP (1994) under the chairmanship of Dr. C.H. Hanumantha Rao stressed the need for a holistic participatory approach to dryland development emphasizing a well designed watershed development programme (GOI, 1994).

†The subject of development of watersheds was transferred to State sector in the year 1979. Immediately, during the early eighties, Pilot Project for Propagation of Water Conservation/Harvesting Technology for Rainfed Areas on Watershed basis and Popularization of Seed-cum-Fertilizers drill programmes were taken up (GOI, 1992). Almost at the same time, the Government of Maharashtra started the scheme of Comprehensive Watershed Development Programme (COWDEP), which was rather a mutation of the on-going soil conservation programme and taken up under Employment Guarantee Scheme and the Centrally sponsored Scheme (see Deshpande and Reddy, 1990). This was followed by the introduction of the first phase of National Watershed Development Programme for Rainfed Agriculture. During this phase, other similar programmes were also operating in the country as well as in the States

Various programmes implementing watershed development under various sectors can be broadly grouped into six major groups. First group of programmes includes the extension of the work of the soil conservation department under the revised State schemes such as COWDEP of Maharashtra. The second group covers the projects aided by the World Bank under special grants to the State Governments to initiate pilot projects for watershed development. The technical guidance, feasibility as well as the weightage of the components was guided and monitored by the World Bank. Third group of projects includes the Operational Research Projects taken up by the State Agricultural Universities on one hand and the specialist research organizations like ICRISAT, AICRPDA, etc., on the other. These projects were technically superior but had operational bottlenecks. Fourth group incorporates the projects undertaken by voluntary organizations (Non-Governmental Organizations) with or without external support.

These projects have, to their credit, a perfect and effective implementation but the scale of such projects is too small and face difficulties in replication. Fifth group of watershed projects are those taken up by the State Governments with their own resources (pooling resources from various schemes). Last group includes the Central Government sponsored scheme under National Watershed Development Project for Rainfed Areas (NWDPA) introduced during the Seventh Five Year Plan covering 99 districts in 16 States. The scheme was improved in the year 1990 following the recommendations of the Committee of Secretaries constituted for this purpose.

The important mile-stone in the policy towards rainfed farming emerged from the beginning of the sixth plan. Rainfed farming was always considered as an important component of the agricultural sector in the plan documents. Before the sixth plan there were references in the plan documents stressing the requirement of a systematic approach to deal with the problems of rainfed agriculture however, no holistic approach was adopted to understand and deal with the constraints of rainfed farming in the planning process. The sixth plan first time attempted to put the framework of rainfed farming in the watershed development approach to check the spread and deterioration by erosion of arable land and to encourage natural vegetative cover of non-arable land. Water harvesting and development of small watersheds of about 50 to 100 hectares was suggested as a strategy (GOI, 1981). The policy was strengthened during the seventh plan and the National Watershed Development Project for Rainfed Agriculture (NWDPA) was taken up with three fold objectives: (i) to harvest rain water; (ii) to conserve soil moisture; and (iii) to extend cropping systems and farming practices for increasing production and mitigating risk (GOI, 1985, p.3).

The NWDPA was administratively approved by the Government of India, vide Ministry of Agriculture, Department of Agriculture and Cooperation 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 was to contribute Rs.120 crores. The programme was followed through the successive phases and subsequently revised during 1990. The ninth plan emphasised the approach towards watershed development in no uncertain terms.

A holistic development plan of an interdependent system of resources confined to a well defined region and based on the major resource parameters can only be a solution for the rainfed areas. Water and land are the two basic resources which interact with the bio-system and thus a programme of proper management of this system should lead to optimum production along with least environmental damage. Watershed is defined as an area enclosed in a catchment boundary of a river basin. It is an eco-system or a bio-geo-physical unit in which the interdependence of renewable and non-renewable environment is closeted. Barrow (1987) describes watershed as a unit where physical and biological resources are linked by a complex of processes and any change in one of them can cause effects on the other. It is a "resource region" where there are close systematic interdependence and a proper biological balance can lead to optimum resource potential. Therefore, major objective of any watershed management programme is to design a sustainable resource use so as to provide optimum production potential for the agro-eco-system.

The management of a watershed involves utilization of land, surface water flow and vegetation so as to conserve and utilize these for a sustainable flow of benefits in view of

the aggregate welfare optimization. Broad objectives of any watershed programme can be summarized into three major components:

1. Preventing and retarding the process of degradation of renewable as well as non-renewable natural resources while optimizing the production potential.
2. repairing and implementing a holistic plan of conservation and use of resources by exploring as well as utilizing the potential of inter-dependent systems.
3. Establishing a symbiotic relationship between use of resources and regeneration of resources by establishing a perfect linkage.

Watershed can appear in different sizes and shapes. The ridge line marks the boundary and the direction of the run-off helps to plan the treatment. The treatments vary from the ridge to valley and the composition depends on the local conditions of each of the watershed. Thus a treatment complex for any watershed would depend upon five important constituents, namely, (i) Quantum and span of rainfall with water availability period; (ii) Level of degradation of the natural resources; (iii) Slope of land and type of soil including other parameters such as depth, pH, fertility, etc.; (iv) Type of vegetation in the arable and non-arable land; (v) Socio-economic factors such as level of commercialisation, industrial locations and types, urbanization, etc. The treatments in the watershed vary from ridge to valley and these will cover seven inter-dependent systems, namely, (i) Silvicultural; (ii) Silvi-pastoral; (iii) Silvi-horti-pastoral; (iv) Horti-pastoral; (v) Horti-agri-pastoral; (vi) Low density rainfed agricultural; and (vii) Protectively irrigated high density agricultural. These systems cover arable as well as non-arable lands and are accomplished with the help of various sub-components of the treatments.

Before the policy initiatives were taken towards the National Watershed Development Programme for Rainfed Agriculture, there were quite a few studies which attempted to analyse the impact of development in rainfed farming on the agricultural sector. The studies concentrating on the impact assessment on individual components have often cited the component of soil-conservation programme. Ram Mohan Rao *et al.*, (1987) and Lal Gupta *et al.*, (1970) have indicated substantial benefits of soil and water conservation through contour and graded bunding. Farm ponds have also indicated significant impact on yield as documented by Tejwani and Babu (1982) and Itnal and Narayan (1987). The benefit-cost ratio worked out as 1.33 with a high level of incremental income. Deep Joshi and David Seckler (1981) noted additional net income through the total package of rain water harvesting. These results point towards the importance of individual components but any area based programme like watershed development has to be analysed as a package (holistic) programme and not by individual components as the benefits are not separately discernible.

Impact assessment of watershed technology can best be accomplished by taking all the components together as watershed management is an area based programme. The study by Deep Joshi and David Seckler (1981) and Kanchan Chopra *et al.*, (1990) showed that in aggregate, treatment of any watershed exemplary results can be obtained if the programme is properly integrated. They studied Sukhomajri watershed and recorded that the incremental benefits are about Rs.2000 per hectare. The Sukhomajri experiment was fully supported by technical inputs from scientists of Central Soil and Water Conservation Research and Training Institute (CSWCRTI). The participation of the beneficiaries was also an important component in this. In a similar experiment supported by ICRISAT, for the watershed projects in Hyderabad, Solapur and Akola districts, Sarin and Ryan (1983) noted stabilization of cash flows in the economy, increase in productivity and incremental income.

They also recorded the additional employment generated from the programme. Walker *et al.* (1989), also reviewed the impact of ICRISAT watershed programme at different locations and noted yield difference as well as changes in crop.

Deshpande and Reddy (1990; 1991) reviewed the watershed programme of Maharashtra from two different perspectives. The first study (of 1990) focussed on a programme originated and operated totally by the Soil Conservation Department of Government of Maharashtra. The programme was named as Comprehensive Watershed Development Programme (COWDEP). They noted changes in crop pattern, intensity of cropping, proportion of waste lands brought under cultivation and yield per hectare in the treated areas as against the control areas. The programme also helped to cause an increase in the water table. The programme was more of technical nature with bunding as the central activity. In analysing the National Watershed Development Programme initiated during Sixth Plan period and followed through the Seventh Plan, Deshpande and Reddy (1991a, 1991b) concentrated on the holistic impact of the programme on all the components of watershed programme across the agro-climatic regions of the State. The impact parameters were analysed in the context of three different agro-climatic zones namely Scarcity Zone, Moderate Rainfall Zone and Assured Rainfall Zone. It was observed that the impact parameters in the three zones were quite different. In a similar study, Deshpande (1996) also analysed the issue of watershed management from the perspective of differential impact parameters across agro-climatic zones. It came out very clearly from the above studies that the impact parameters are a direct function of the agro-climatic characteristics of the region and that these parameters are location specific in nature.

Among the other location specific studies, the work by Katar Singh on Mittemari watershed in Karnataka is notable as a holistic work dealing with all the aspects of development of a watershed. Katar Singh observed net incremental benefit of Rs.9170 per hectare (Singh, 1994). Another important study on the holistic approach of watershed treatment is that of Laxmikanthamma (1997) based on her painstaking doctoral work at Mittemari observed IRR at 12.8 per cent and B-C ratio at 1:1.27. Among the important findings of the studies are: replicability of the programme, the most needed maintenance (sustenance) of the erected structures, participation of the entire community in the programmes, reconciliation of social *vis-a-vis* individual interests, realisation that the benefits are slow, the most needed horizontal integration of the official machinery, recovery of public investment from beneficiaries and the location specificity of the strategy.

The last group of studies include those which specifically brought out the constraints of the programme. An integrated inter-disciplinary approach for planning and administration is advocated by many (Deshpande and Reddy 1991a, b; GOI, 1991; Sarin and Ryan, 1983; Walker *et al.*, 1989; Katar Singh, 1989 and 1994; Laxmikanthamma, 1994 and 1997 and Deshpande, 1996). The hiatus between people's perceptions and official claims clearly emerge out of the studies namely Chandrakanth *et al.*, (1989) and Katar Singh (1988, 1994). The componentwise suitability, their acceptance at beneficiary level, the location specificity of the components had featured in almost every study though some times indirectly. The problem of impact on income distribution, employment generation and the financial viability analysis are dealt by Dangat (1986), Jaiswal and Purandare (1982), Tirath Gupta (1982), Deshpande and Reddy (1991 a, b), Deshpande and Rajasekaran (1995). The Indian Society of Agricultural Economics also addressed to the specific subject of watershed management in its Annual Conference in December, 1991. Among the issues discussed at this Conference the following issues assumed importance:

1. Watershed Management is a location specific strategy. This factor needs to be kept in view from planning to implementation stages.
2. Investment in watershed management programme should be taken as cost of preventing degradation rather than a cost for increasing output.
3. The benefits out of watershed based treatments should be examined also from the point of view of reverting/arresting the process of degradation apart from output stabilisation or yield increasing angle.
4. The initial investment in the watershed should come from public funds but the local people should be involved in planning and implementation in terms of contributions to the cost of labour.
5. Involvement of the local community in the watershed management is both crucial and necessary.

The above review indicates the most important issues involved in the watershed development approach. Among the various pointers emerging out of the analysis of the studies, four assume significance in the context of the present study. Firstly, the watershed impact analysis has to be closely location specific and the impact parameters across locations need not be the same. Secondly, the best method of quantifying the impact of watershed treatment is to identify the most important key variables, where the impact parameters are aggregated at one place. Thus the impact can best be assessed in terms of major indicators especially in the absence of the non-quantifiable benefits in the context of loss aversions of the natural resources. Thirdly, the very fact that not all the benefits and costs are easily discernible, one has to depend on the bold changes due to the watershed technology. This finally rules out any viability analysis in cost-benefit framework simply because there is nothing like a matching control. Moreover, the complex of tangible *vis-à-vis* non-tangible benefits, uncertain gestation period, the non-linearity in the flow of benefits and the difficulties in ascribing price to the level of degradation averted, make it difficult to fix the problem into usual project analysis framework. Lastly, the participation of the beneficiaries in the programme is the most crucial aspect. Higher participation can be induced only when the technology is simple, affordable, replicable and viable, in the view of the beneficiaries.

1.3 Approach Strategy and Components of NWDPR

Watershed development has been taken up under different programmes of Government of India. The Drought-Prone Area Programme (DPAP) and the Desert Development Programme (DDP) adopted the watershed approach in 1987. Even before this the NWDPR was approved by the central government with a three fold objectives namely:

- "1. Taking the watershed as a basis to conserve and upgrade crop lands and waste lands as a vital 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 alternative land use system" (GOI, 1986).

These objectives incorporated a vast canvass but the specificities remained inexplicit. Among the other important guidelines were the size of watershed, the unit cost of treatment, limit of the staff cost, priority areas and priority sections of cultivators. Our earlier analysis

of NWDPRAs under the 1986 guidelines indicated six most crucial factors. Firstly, an integrated holistic approach was suggested not only to develop natural resource base but also to sustain its productivity and quality of life. Secondly, each of the watersheds must begin with a complete plan of its development including the treatment of arable as well as non-arable lands. The involvement of the beneficiaries should be ensured from the planning stage itself. Thirdly, the participation of beneficiaries must be ensured right from the initial stage and through the implementation of the programme. Fourthly, the sharing of the cost of watershed and the norms suggested by the Government of India are quite complex and hence the entire cost of the watershed should either be borne by the Central or the State Government. But there must be a component of cost sharing by the group of beneficiaries which is essential for sustainability. Lastly, there must be a strong component of training for the selected farmers.

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 isohyets of 500 to 1150 mm, with less than 30 per cent of irrigated area be chosen for developmental works under NWDPRAs. The philosophy behind this restriction was perhaps to direct the concentration towards the lagging regions and avoid 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 (GOI, 1986, pp. 3-4) 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 Universities.
7. Priority be given to areas where farm tested technology is developed, necessary infrastructure is available, already earlier schemes are existing, local farmer's willingness and cooperation, where soil survey and soil conservation programmes are undertaken and where cost-benefit ratio indicates definite increase in yield or a significant reduction in yield fluctuations.

It can be easily seen that the criteria at serial numbers 1, 3, 4 and portions of 7 are operationally difficult things. The choice of watersheds, where soil survey and soil conservation programme are already existing, earlier ongoing schemes are there and where cost-benefit ratio indicates definite increase in yield or a significant reduction in yield fluctuations, makes the task of any evaluation of the NWDPRAs 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 philosophy behind this 'overall 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.

1.3.1 Approach and Components

The approach essentially involved devetailing 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. These aspects were translated into field components and possibly in the process the weights for the components were not taken care properly.

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 farmers 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 project guidelines prepared by the Central Government keeping in view the suggestions made by the Committee of the Secretaries and a working group of the Planning Commission during 1991-92 set forth a five-fold objective for NWDPRAs.

(i) Conservation, upgradation and utilisation of natural endowments like land, water, plant, animal and human resources in a harmonious and integrated manner. This will aim at perpetual availability of food, fodder, fuel, fibre, timber and biomass for rural and cottage industries to meet the growing demand of human and livestock population through diversified land use system.

(ii) Generation of massive employment during the project period and regular employment after the project completion for enhancing the employment opportunities in the backward rainfed areas to ensure livelihood security particularly for under-privileged sections of the rural population like small and marginal farmers, landless labourers, tribals, etc.

(iii) Improvement of production environment and restoration of ecological balance through scientific management of land and rain water. In the process *in situ* moisture conservation, introduction of scientific production system, network

of runoff management structures and devices for recharge of ground water will ensure enhanced availability of water for human and livestock drinking purposes, domestic consumption, life saving irrigation, and

(iv) Reduction of inequalities between irrigated and rainfed areas. Ultimately, stable production and processing of bio-mass would contribute towards better life in rural areas. This will reduce large scale migration from rural areas to the cities.

(v) In addition to food, fuel and fodder, the project would endeavour to enhance cash flow to the rainfed farmers and landless agricultural labourers through increased casual employment, marketable surplus of agricultural and dairy produce, growing of cash crops like vegetables, coriander, cumin, medicinal plants, etc., in suitable areas" (GOI, WARASA, 1992).

It is quite interesting to note that the above objectives seem to be targeting a very high order of development for rainfed agriculture and these can appropriately fit to any developmental programme but quite difficult to achieve even in a medium term perspective. It was argued that the objectives should have been more focussed than what they are (Deshpande, 1996). The approach and strategy are spelt out in five different components. Firstly, the integrated and holistic approach of the strategy is spelt out first time incorporating the maximum components. Secondly, the guidelines emphasised on projectisation of the programme to give a clear idea of achievable goals. Thirdly, people's participation in the implementation of the programme is taken seriously through '*Mitra Kisan*' and '*Gopal*'. This also helps to enhance the skills of the participants to understand and implement the strategy properly. Fourthly, the guidelines touched the aspects of organisational structure for implementation of the programme and indicate an integrated structure of implementing agency. An indicative structure of cost was also worked out for different components of the work, at aggregated level. Finally, the guidelines include the steps in monitoring of the project by an external agency.

1.4 NWDPR: Analysis of Design and Implementation

The approach and strategies indicated in the guidelines of NWDPR are more clear and transparent to implement as compared to the objectives. The approach and strategy is spelt out in five different categories. Firstly, the integrated and holistic approach of the strategy is spelt out indicating all its components. Secondly, the guidelines emphasized on projectization of the programme both as a bench mark as well as a blue-print of the works to be undertaken. This component is introduced first time in the guidelines of any watershed programme. Thirdly, adequate emphasis is given on the people's participation in the programme. It is intended to be achieved through the '*Mitra Kisan*', training for beneficiaries, institutional contacts and group activities. Fourthly, the organizational structure and the administrative details are discussed in the guidelines. These include the indicative cost structure for the management of the programmes. Finally, the guidelines also indicate the steps in monitoring of the project. We shall critically discuss below each of these five broad steps in the guidelines specifically from the view of their application at field level in Maharashtra.

Integrated and holistic watershed planning has been clearly incorporated under NWDPR. The treatments include arable as well as non-arable land and the network of natural drainage lines. Thus, three sub-sectors dominate the treatments. More specifically, the treatments include:

1. Basic Activities:

- a) Establishment of nursery – composite nursery
- b) Kisan nursery
- c) Survey and Projectization

2. Arable Land Treatments:

- a) Vegetative filter strips in place of diversion drains.
- b) Contour-vegetative hedges upto 4 per cent slope.
- c) Contour-vegetative hedges supported by trenches upto 8 per cent slope.
- d) Repairs of existing conservation measures.
- e) Gully control measures: Gabian structure, brush wood dam, loose boulder structure, vegetative systems, etc.
- g) Reclamation of ill-drained soils.
- h) Incentives for opening contour dead furrows.
- i) Contour cultivation.

3. Non-Arable Land Treatment:

- a) Filter strips in the place of diversion drains.
- b) Live fencing.
- c) Gully control measures with vegetative supports:
Gabian structure, Brush Wood Dam, Planting of shrubs, planting trees, drainage line treatment, Removal of Nalla congestion, Live check dam, Loose boulder check dam, Small dig-out ponds, Gully plugging - earth/stone. Earthen structure with vegetative support.
- d) Over-seeding of grass.
- e) Planting of trees and shrubs.
- f) Run-off Management with dug-out ponds.

4. Livestock Management:

- a) Castration of bulls.
- b) Other means of population control.
- c) Promotion of cultivated fodder production.
- d) Improvement of breeds.
- e) Training.

5. Agro-Forestry and Related Activities.**6. Training and Visit System:**

- a) Training of watershed activities.
- b) Demonstrations.
- c) Agro-forestry training.
- d) Organic farming
- e) Kitchen garden.
- f) Innovative schemes.

7. Construction of Chetana Kendras.**8. Other Activities.**

The list of treatments given is quite an exhaustive. Mainly three sub-components are operated under the farming system, namely, (i) Food sub-component; (ii) Fodder sub-component; and (iii) Fuel sub-component, of the overall sustainable farming system. The most important and interesting aspect of the guidelines is the flexibility of the components across districts and between watersheds. Each of the watersheds has its own composition of the components and this differs across the agro-climatic zones. However,

an important rider of this is that the flexibility is allowed within the technically suggested programmes. Another bottleneck faced while implementing the programme is not only the local level (lower than district level) flexibility of the technology and composition of the components but also the norms, related to the unit costs recommended and/or projectized, are non-flexible. Two often confronted cases are in the treatment of non-arable land with slope above 8 per cent and the brushwood dam or loose boulder structures in the resource-strained areas.

Another important step relates to projectization of the scheme. The earlier scheme of NWDPRAs did not involve any projectization and most of the decisions were centralized. The projectization incorporated in the NWDPRAs involved two objectives covering a survey to collect data on the structure and quantum of resources as well as to create a bench-mark survey for the purpose of the impact study. This involved three components, namely, (i) Resource Inventory; (ii) Production System; and (iii) Socio-economic Survey. A project report is thus prepared for each of the watersheds and for the district giving the bench-mark parameters and the proposed watershed programme. The components of bench-mark are done quite hurriedly and do not provide enough data. The reports rather concentrate more on the programme formulation. The bench-mark characteristics of the district are assigned very little space both in the watershed level report as well as district report (GOM, 1992). In fact, the report prepared at watershed level is superior compared to the one consolidated at the district. The watershed level report contains: (i) Land holding and land use; (ii) Vegetative resources; (iii) Socio-economic characteristics such as infrastructure, livestock, etc; (iv) Soil survey; (v) Physical characteristics and cost structure of the watershed; (vi) Incremental income and cost-benefit ratio; and (vii) Treatment maps. Though, the watershed level reports seem to be better organized and contain larger information, these have been completed in a very short time duration. Therefore, sometimes the presumptions at the time of the bench-mark have undergone change during implementation. The project guidelines both issued by the Central Government as well as the State Governments do not provide any mid-course corrections. A continuous projectization is needed especially for the purpose of the proposed treatments. The project reports prepared thus help in understanding the watershed level features but the reports at district level do not reach the expected level in Maharashtra.

A crucial factor introduced in the new guidelines of NWDPRAs is the participation of people in the programme. The second dimension is the horizontal integration of the various line departments participating in the planning as well as implementation of the programme. Thirdly, the vertical integration of the various bodies at village/watershed, taluka, district and State level. If all these three criteria are satisfied then the implementation faces few bottlenecks. The administrative structure recommended under the guidelines has five layers, namely, (i) Policy support at State level; (ii) Directions for the policy; (iii) Planning and implementation to be accomplished by a multi-disciplinary watershed development team for each watershed in consultation with the farmers; (iv) Apprenticeship of post-graduate Agricultural University students, one each in a micro-watershed; and (v) Monitoring and evaluation by an external agency. All these steps lead to a cohesive control and integrated implementation of a watershed project. In Maharashtra, the watershed level technical group is not constituted and the responsibility of projectization, etc., rests with the Sub-Divisional Soil Conservation Officer. Similarly, the horizontal coordination is expected to be obtained through the

district/taluka level committees constituted for that purpose. A technical cell constituting the watershed development team at the State level supports the technical needs of the process of implementation. Monitoring of the project is accomplished within the department and there are no external agencies involved in monitoring the progress. Absence of concurrent evaluation and monitoring does not allow any continuous projectization and thus can hamper the progress of the programme. The State Government has been following the formats of the quarterly and annual reports.

Fixation of unit cost for various components of the watershed is another important problem. The guidelines (GOI, WARASA, 1992, p. 49), recommend aggregate unit cost of the project not to exceed Rs. 3500 in plain areas (which includes Rs. 500 towards management) and Rs. 5000 for the undulating hilly areas. To qualify for hilly area the watershed should have more than 75 per cent of its area with higher than 8 per cent slope. The recommended unit cost is an aggregate average for the State and consequently the State Government is given the flexibility to allow increased unit cost in some areas and effect savings in other areas. The project is financed by the Government of India in the form of 75 per cent grants in aid and 25 per cent loan to the State Government. The project guidelines envisage some financial contribution from the beneficiaries.

1.5 Maharashtra Experience

It will not be out of place here if we incorporate the experience about the process of implementation seen from a closed angle. In Maharashtra, the NWDPR 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 isohyets of 500 to 1125 mm of normal annual rainfall. Overall, 380 watersheds were taken for development under NWDPR. The choice of 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 COWDEP. 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 Village Level Worker (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 NWDPR 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 multi-disciplinary background but the approach of administration is under a uni-disciplinary set up. Lastly, the participation of the relevant departments from other disciplines (e.g. hydrology, meteorology, 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 multi-disciplinary 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.

1.6 Present Study: Objectives and Design

This is a study which consolidates the results of the impact assessment exercises on watershed development under NWDPR conducted at various Agro-Economic Research Centres.¹ A two days workshop was conducted at the Gokhale Institute of Politics and Economics to prepare the complete guidelines of the project on the proposed impact study as well as to discuss the probable issues. All the Agro-Economic Research Centres (AERC) conducting the study were represented (except AERC, Waltair, Andhra Pradesh) at the workshop as well as a representative from the Ministry of Agriculture, Government of India, New Delhi also attended for both days. The following objectives were taken up for conducting the impact study in various States:

- (i) To examine the present status of the available technology and the extent of its adoption by the farmers.
- (ii) To identify the factors responsible for the changes in productivity and to ascertain the major impact parameters.
- (iii) To locate the constraints in the project implementation in terms of infrastructure, technology and other factors.
- (iv) To evaluate the impact of vegetative measures, soil and water conservation structures and other components of the programme.
- (v) To suggest strategies for removal of the constraints faced by NWDPR.

The workshop conducted at the Gokhale Institute of Politics and Economics also deliberated on the sample selection and the coverage of the study and suggested a common framework. The workshop participants were also supplied with a design and questionnaire. Two watersheds falling in two different Agro-Climatic Region of the State were to be selected for the purpose of analysis with 50 beneficiaries from each of the watershed and 25

¹ Besides this, we have also presented a system model for analysis of the impact of watershed programme in detail as a separate chapter.

non-beneficiaries to form a control group. The study was taken up in 10 States² forming four distinct groups as shown below:

- A. Western and Central Rainfed Zone
 - i. Gujarat
 - ii. Rajasthan
 - iii. Madhya Pradesh
 - iv. Maharashtra
- B. Southern Plateau and Hills Region
 - i. Andhra Pradesh
 - ii. Tamil Nadu
- C. Northern Alluvial Plains
 - i. Haryana
 - ii. Uttar Pradesh
- D. Hills Region with Assured Rainfall
 - i. Assam
 - ii. Himachal Pradesh
 - iii. West Bengal (Darjeeling District)

Apart from the analysis of primary level data it was also expected that the studies incorporate district level analysis of the secondary data but this was not attempted by most of the AERCs. Though the basic design was more or less common, there were differences in methodology employed for analysis. The present study intends to bring together the analysis of the data given under these studies in a consolidated form. The present research report is divided into eight chapters. The present chapter is of introductory in nature and is followed by a chapter (second chapter) giving a system model for analysis of the impact of watershed treatment. Four chapters bring together the findings of the studies under four different agro-climatic situations, namely, (i) Western and Central Rainfed zone; (ii) Southern Plateau and Hills Region; (iii) Northern Alluvial Plains; and (iv) Hill Region with Assured Rainfall. In the seventh chapter, we have analysed the impact of NWDPR in Maharashtra - the analysis depicts differential characteristics and hence dealt separately. The last chapter brings together the summary of the findings and policy implications of the study.

1.7 Limitations of the Study

This study suffers from the same limitations that can be perceived by any study bringing together research reporting by ten different researchers. Firstly, the data at all India level about the implementation was not available and that makes it difficult to analyse any macro level analysis of the programme. It is surprising that such data are not maintained even at central level. Most of the studies were completed by 1997 though these began by the end of 1994 except that of Maharashtra reported in chapter seven. The sporadic availability of State/district level data and the differential formats of the maintenance of such data across States led to its non-amenability of any common analysis across States. The concept of beneficiary used by some of the researchers among the ten studies is "the person who has got material benefits (in terms of subsidy, composite kit, weedicides, nursery establishment, or saplings)". This has been observed as a common practice in many researches even other than AERCs. Since watershed is an area programme and the benefits of a contour bund or

² In addition to these ten States, Rajasthan was also included here as the study was available on comparable basis.

afforestation upstream will certainly enhance the benefits of the cultivators down-stream (in terms of moisture enhancement) irrespective of the down stream cultivator being beneficiary of subsidy, minikit or any other benefit. Therefore, here in an area based programme every household cultivating/non-cultivating but being covered in the area of operation becomes the beneficiary. This has caused difficulty in comparing the results. Notwithstanding this, the analysis was taken up on the basis of the results available in the research reports. Another important limitation was the non-availability of the State level/district level data on NWDPR for quite a few States despite continuous persuasion. Had these data been available for at least the ten States under consideration present study would have been greatly benefited.

CHAPTER 2

IMPACT OF WATERSHED TECHNOLOGY: A SYSTEM APPROACH³**2.1 Introduction**

Impact analysis of an area based programme like watershed treatment is riddled with intrinsic difficulties. There are two major dimensions of the impact analysis, namely, time frame and the spread across sectors of the economy along with the inter-linkages. The impact signals are concentric but the across sector linkages result into a complex impact. The time dimension of the impact is quite an important dimension. The stability of the impact parameters depends on many aspects like treatment composition, bio-technological factors (soil texture, type of aquifer, level of degradation, slope, water-balance, climatic parameters and their influence during the project period), people's interaction with different technological components, markets, etc. In other words, we have directly and indirectly generated economic activities along with spill over effects over time and the intensity of the influence will vary over time. Keeping this in view, the approach of the impact analysis can be two ways. Firstly, it is the 'with project' parameter compared to the 'pre-project' situation gives the incremental benefits. But these increments in the parameters include the changes due to technology under the 'without project' scenario. Thus the benefits can be exaggerated. Secondly, the literature on project analysis suggests the comparison between the project parameters and the non-project control region. This method allows correction for the impact of technology in the absence of the project. It is more or less established that the project *vis-à-vis* non-project comparison is better alternative which also provides representative control.

A matching control in the case of any watershed impact study is a challenge in itself. The matching parameters must include slope; soil texture; depth; fertility; soil-water balance parameters; level of degradation; forest cover and composition; land holdings and distribution; water availability and drainage; people's participation; awareness; level of politicization and host of other parameters. In practice, this creates large number of problems in selection of control villages. Even then it is the method of comparison between beneficiaries and non-beneficiaries which yields comparable impact parameters.

2.2 World Bank Approach

The approach of the World Bank aided watershed projects over the four States focuses mainly on creating a pilot experiment in the selected States. The major objective of the World Bank aided project is to achieve the large scale verification of the already developed technological packages which are applicable under different environmental and social conditions (World Bank Staff Appraisal Report, Page 7). The project would

³ This chapter is based on the discussion note submitted to the World Bank team by the senior author and the work earlier reported in Deshpande and Rajasekaran (1995).

include those works of water utilization which are important for ecological reasons and aimed at innovative low cost approach. The approach involved multi-disciplinary horizontal co-operation between specialists of various disciplines and the farmers. In the process of implementation, the improvement in productivity, reduction of instability and resource conservation formed the basic guidelines (GOM, 1985, p.2). The guidelines for the selection of watershed also indicate certain important points clarifying the World Bank approach.

Guidelines for the selection of Watersheds:⁴

- (a) Total geographical area of about 25000 ha.
- (b) Being representative of a major agro-climatic region with more than 750mm of reasonably reliable annual rainfall.
- (c) Consisting of soil types for which farm-tested agronomic and land use development technology is available which would significantly raise potential yields and/or cropping intensities.
- (d) Facing resource conservation and management problems (denudation, erosion, drainage, etc.).
- (e) Being served by an effective agricultural extension service and a feeder road system of reasonable intensity.
- (f) Provision of ensured farmer access to inputs, markets and credit, and adequate production incentives in the form of favourable prices.
- (g) Proximity to administrative centres and potential use as a demonstration area.
- (h) People's willingness to cooperate and strengthen local organizations.
- (i) Located less than two hours travel from an agricultural research centre capable of providing technical back up, adaptive research, evaluation and training.
- (j) Investments required that match the finances available under the project.

The guidelines for selection of the project indicate three components in the major focus of the project, namely,

- (i) Choice of a large and resource constrained area with problems like denudation, erosion, drainage, etc. (a, b, c, d above);
- (ii) Served with the effective agricultural infrastructure like extension, credit, production incentives, markets, roads, etc. (e, f, g, and j above);
- (iii) Strong support component from the research centre of the State Agricultural University and involvement of people (g, h and i above).

From the above, we come to understand the World Bank approach very clearly. The approach involves four broad components. Firstly, it is the application of the technologies generated at the State Agricultural University Centres, to the farmers fields for better conservation and optimum use of resource so as to increase the economic gains keeping in view the sustainability. Secondly, ensuring a complete support of infrastructure to eliminate the plausible implementation constraint. Thirdly, to demonstrate an integrated organizational structure with strong horizontal inter-disciplinary cooperation and vertical administrative integration. Fourthly, to exhibit the replicability of the approach. The World Bank projects were taken up at four locations in the country. Apart from the concurrent monitoring and evaluation from the State

⁴ Compiled from Project Implementation Manual, Government of Maharashtra, 1985, p. 39.

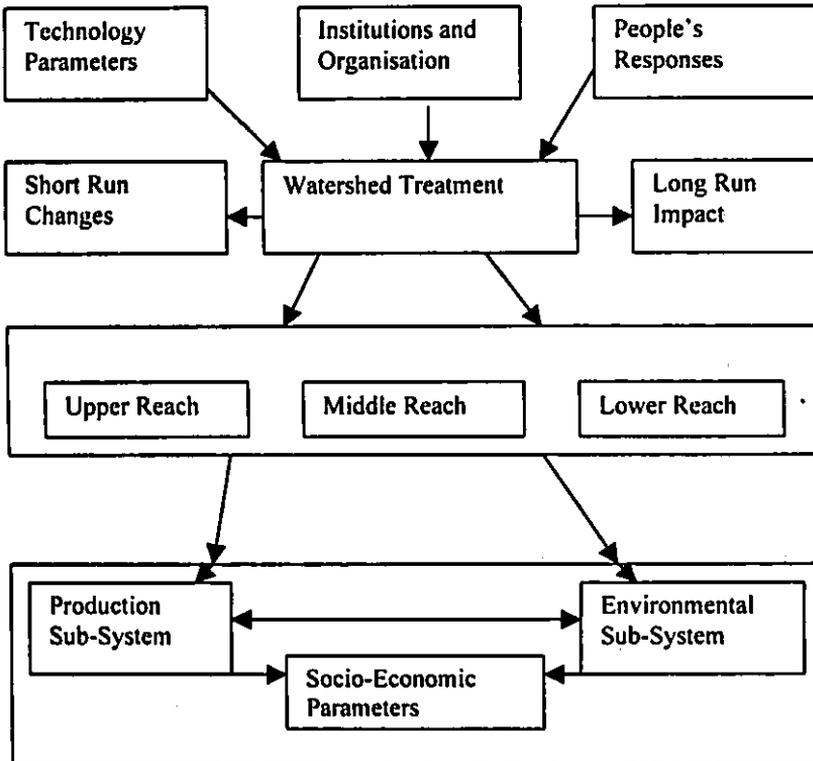
Agricultural Universities, the projects were also visited by the World Bank teams from time to time. Thus, there was a close monitoring both by the World Bank and the State Agricultural University.

2.3 System Approach

Management of the bio-geological resources on the basis of watershed involves quite complex processes of interactions. Therefore, the impact systems are layoral and intermixed than clearly additive. There are five basic constituents in the impact system analysis (see, Figure 2.1). Firstly, the existing or pre-project situation decides the direction and the quantum of the impact. The level of impact would depend on the level of degradation at the beginning of the project. If the degradation of the soil and water resources is severe, the time taken to revitalise the system is larger and thus fixing a pre-determined definite time span for realising the benefits is difficult. Sometimes, a certain part of the changes take place immediately whereas, the other portions take time. Therefore, the pre-project situation remains the important determining factor for the duration of the management. Secondly, the World Bank approach rightly insisted upon the location specific technologies. The watershed was chosen specifically in consultation with the State Agricultural University so that the technologies developed could be easily transferred to the project region. Thus, the treatment mix has to be unique for each of the watershed and even for the sub-watersheds to facilitate the impact. Therefore, only the intensity of the components may not signify the extent of the impact but this impact has to be viewed on the background of pre-project situation. Thirdly, the treatments have a close interaction with the crop pattern and crop combinations. This also decides the quantum and direction of the impact. The intensity of silvi-pastoral component leads to economic activities related with livestock economy, whereas the cash crop combination leads to a close market interaction for the cultivators and thereby a possible diversification towards the non-farm investment. Fourthly, the simplicity, affordability, adaptability, replicability and sustenance parameters of the components decide the long term impact of the watershed technology. It is quite possible that in short run the watershed technology may show some gains but the continuation of such gains would depend only on these crucial parameters and sustenance of the technology. In addition to this, the short run and the long run impacts of the technologies are also difficult to be segregated. Similar is the case with the direct and indirect impacts of the watershed management technologies. Lastly, the treatments on the watershed involves participation of the communities involved. The participation of the people in the programme is quite crucial, since it is an active area development programme. Further, the sustainability of the programme is the major criteria of success of the strategy and hence a complete involvement of the population is essential

Any approach for analysing the impact of the watershed project should be guided more by the terms of the implementation of the project. Working in the general domain of the watershed development projects, we worked out a system approach for the purpose of analysing the impact. The major components of the impact system can be: (i) Production Sub-system; (ii) Environmental Sub-system; (iii) Socio-economic Sub-system and (iv) Institutional Sub-system. Each of these sub-systems have their components and

Figure 2.1: Watershed Impact System Model



sub-components which have to be taken into consideration. Similarly, all the sub-systems should not be treated as independent but their linkages are internal and therefore, the study of the impact of these have to take care of the linkages. The World Bank approach involved mainly four major factors. Firstly, it was an integrated approach with all the required branches of knowledge and implementing agencies coming together to plan and implement the project. Secondly, the arable and non-arable lands to receive due importance in the overall planning and implementation. Thirdly, there was an involvement of a strong research component, with a support from the operational research team of the State Agricultural University. Finally, the choice of a largely denuded area, with the availability of infrastructure and offering a large scale verification of the technologies, suggests the necessity of the replicability of the approach. The revised guidelines of NWDPR also include similar components. The new guidelines insisted upon holistic approach, environmental parameters, watershed development teams, pre-project proposal and planning and people's participation.

2.4 Impact on Production Sub-System

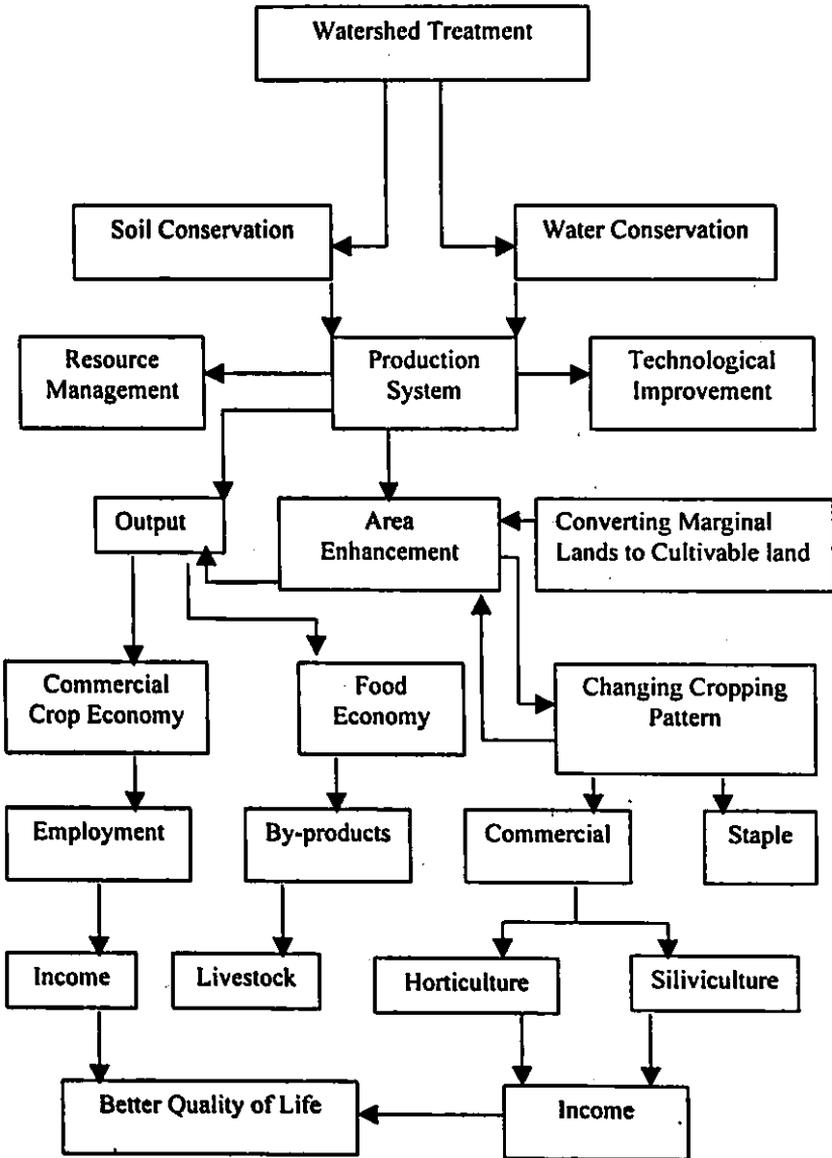
The impact on the production sub-system can be divided into three sub-groups. Firstly, the changes have taken place in the land use pattern due to the project activities. The land under cultivation increased as the marginal lands became productive and the quality of the marginal land changed. The change can be visible in both the ways, i.e., through an increase in the area brought under cultivation by bringing the marginal lands under plough and by changing the crop pattern on the marginal lands from low density-low value crops to horti-silvi-pastoral or regular crop systems. The difference can be noticeable in the lower reaches. Another change that can be visualised in the land use pattern is the intensity of land use. The cropping intensity undergoes changes due to moisture availability and short duration crops. But the more interesting change is the qualitative change in the land use pattern. The comparison between beneficiaries and non-beneficiaries indicate only marginal differences between the intensity of cropping. But the diversification of crops in the group of beneficiaries including the horti-silvi-agricultural systems indicate a sustainable pattern of land use. Therefore, though the double cropped area may not change significantly, there can be a strong qualitative change in the cropping pattern with an increase in the area share under crops like safflower, bajra, blackgram, soyabean and vegetables. Similarly, the new crops introduced during the project phase are horticultural crops as well as other commercial crops. The proportion of area under irrigation will also undergo a change from its pre-project position. This has a strong linkage with the enhancement of moisture availability and groundwater table. This has enabled the farmers to take more assured crops. The most important change that can occur as a result of the impact of any water conservation project is the increased area under horticultural crops and trees along with a diversification of the cropping pattern. In the process of this change, the allocation of area to the traditional crops and varieties declines whereas, it increases for commercial crops. In total, one can firmly say that the cropping system changes more towards achieving a sustainable land use system than before (see, Figure 2.2).

Secondly, the structure of the cost of cultivation also undergoes a change. The change in the cost of cultivation is directly related to the type of technology (programme), the change in the crop pattern and the structure of resources for cultivation. In the project area, the cost of cultivation per hectare in the group of beneficiaries and the cost of cultivation of the non-beneficiaries will be different on three counts viz. (i) variety; (ii) cash resources used; and (iii) labour use. While the human labour input may increase the density of material inputs the human labour inputs can even come down under the pressure of increased demand for human labour. In other words, though the expressed need for human labour may be quite high, the supply does not keep pace with it. Another reason for the changes in the structure of cost is usually the adoption of the new technology among the beneficiaries. The adoption rates in the technology of crop husbandry and the watershed technology components are interdependent. This is also one of the important component of the impact system.

Thirdly, the direct impact on the production and productivity of the crops are the most significant changes marking a step towards sustainability of the technology. Larger the differences, higher will be the probability of sustenance. The productivity increases

for traditional as also commercial crops. The increment in productivity comes both due to adoption of new technology as well as allocation efficiency. The increased span of

Figure 2.2 Production Sub-System in the Impact of Watershed Treatment



moisture availability allows ease in cultivation for the traditional crops and also to use better quality of resources. Cultivation also moves into a high risk taking zone. However, the major constraint usually faced by the cultivators in the project area in relation to the production sub-system relates to the resource availability and the increasing prices of the material inputs.

2.5 Impact on the Socio-Economic Sub-System

Overall socio-economic impact of this project on watershed management is a crucial step in the impact analysis. A large number of components are involved in the analysis of socio-economic impact. A simple Watershed Impact System Model on Socio-Economic Parameters (WISM-SEP) model is used to segregate the impact variables. Mainly income, assets, employment, consumption, health, education, female work participation rates and wages are the important impact variables considered here (see, Figure 2.3).

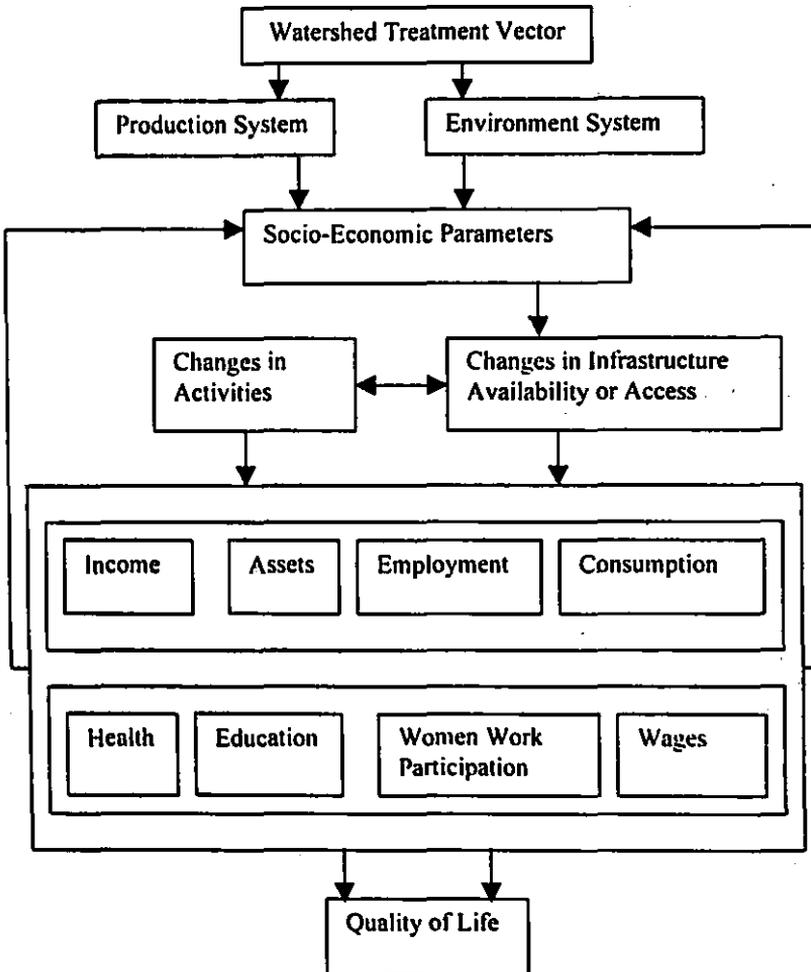
The changes in income of the beneficiaries can be quite substantial both in the case of agricultural income per hectare as well as gross income from agriculture. The changes in income take place both due to cost-efficiency and production efficiency. The adoption of new technology supported by the increased moisture availability make it possible to have larger incremental income. But incremental income here needs to be computed by comparing the income of beneficiaries with that of non-beneficiaries. Any comparison with the pre-project income gets marred by the price increase problem and the income stream should be deflated in order to obtain an income stream at constant prices. The most expected outcome of the increased income stream is the requirement of meeting the increased cost and allow the expected expenditure on plough back capital, consumption needs and improvement in quality of life. Another possibility of increased income comes from the additional employment generated. The small, marginal farmers and the agricultural labourers benefit from this.

Impact of the watershed project on the landless labourers and the women members of the household is an important component of changes in the socio-economic parameters. It is necessary that the women members of the household understand the concept of conservation very well. Their natural instinct of conservation helps to sustain the vegetative bunds with grass keylines and other watershed structure. Traditionally not many of them participate in the decision making process and most of those who participate in such process, become aware of the concepts. As far as the changes in the time disposal of women are concerned, this changes substantially in favour of income generating activities. The time allocated for cattle grazing and tending reduces, though there can be an increase in the number of cattle. Agricultural labour households also show substantial change in their incremental income and these changes must beat or at least match the forces of inflation.

Change in the asset position is another parameter in the impact analysis due to the watershed development project. We can foresee two comparative pictures, one is the beneficiaries present asset position with the position before the project, whereas the other relates to the comparison of beneficiaries with the non-beneficiaries. Interestingly, the project may not induce substantial change in the farm assets but the non-farm assets of the beneficiaries are expected to change significantly. The difference between

beneficiaries and non-beneficiaries can explain such change better than pre-post project situation. The change will be substantial among the farmers from lower reach area. Another feature in the change of assets is the increase in livestock holding. The livestock of the beneficiaries will increase substantially due to increased availability of fodder.

Figure 2.3: WISM-SEP Model



The consumption pattern of the beneficiaries, when compared with the non-beneficiaries may give a clear idea about the impact on the quality of life. The incremental income generated through the developmental programme is first used to

bring a change in the consumption pattern. After the adequate provision of consumption is ensured, the surplus is used to acquire durable assets or diverted for other avenues. The differences in the levels of consumption of beneficiaries as compared to non-beneficiaries can be high but may vary across regions. The level of consumption of agricultural labourers will also change substantially during the project phase. Thus, there can be an increased level of calorie consumption and this would certainly change the income distribution parameters. In an earlier study Deshpande and Reddy (1991b) noted such change in the income distribution parameters.

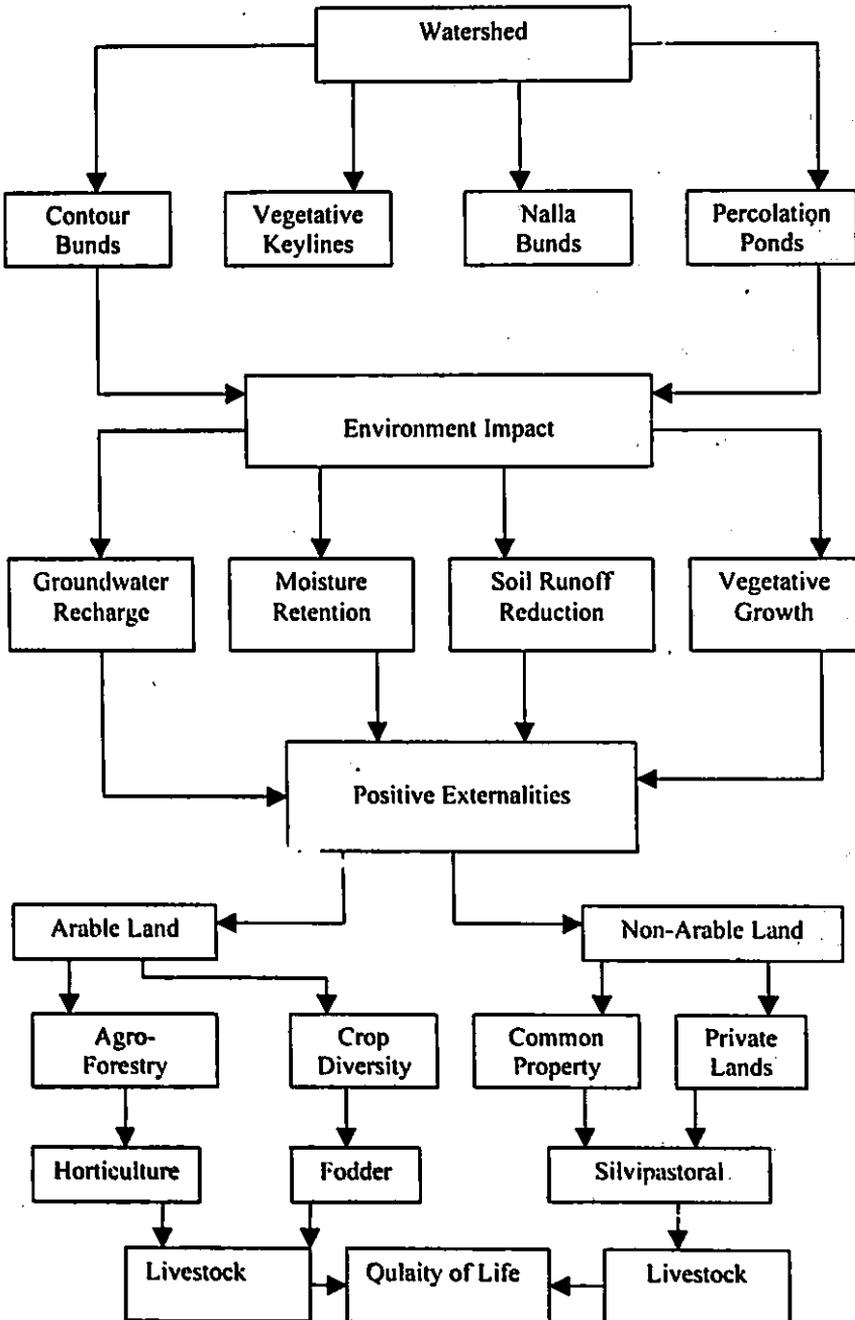
Income distribution in the project area can change due to several factors. There are different trends in the sources of income generation. The project can bring an overall positive change in the equity parameters. A comparison of Lorenz curves showed the decline in inequality among the group of beneficiaries (Deshpande and Reddy, 1991b, Deshpande and Rajasekaran, 1995). This has occurred due to the inverse relationship in the size of holding and productivity (income generation). Similarly, it is quite clear that the watershed treatment can open up new avenues of income generation for those who are at the lower rung of the ladder. In other words, access to new opportunities will improve the quality of life as well as influence the equity parameters positively.

2.6 Impact on Environmental Sub-System

Sustainable development of any agriculture based system would require minimisation of the negative externalities. In the process of development, over past several centuries and with the absence of the corrective measures, the quality of natural environment has degraded very fast. This has not only resulted in the higher use rates, low productivity and low pay-off but also helped in perpetuating the process. The process also has a cyclical reasoning. In a watershed treatment approach, the technological components are planned to halt the process of degradation and subvert the effects, so as to achieve as well as to improve the quality of the resources (see, Figure 2.4).

There can be six broad components which can be analysed under the environmental impact study. Firstly, the watershed treatments are different on arable and non-arable lands as well as across the slope. In the upper reach, the treatments include silvi-pastoral system and in the lower reach it is the soil-water conservation structures along with the new technology of cultivation. Therefore, reduction in the run-off becomes the first component of the environmental impact. It is certainly difficult to measure the reduction in run-off, as the available technology can only give clues about 4/10th of one hectare. Hence, deciding the reduction in run-off may be a scientifically tedious task for the whole watershed as such. This can however, be done by eliciting answers from the beneficiary group. Their perception of reduction in the run-off can be graded from moderate reduction to significant reduction in the process. Second important aspect of the process of degradation is the loss in the top soil. It is quite crucial to halt the process and sustain the soil texture significantly. A high proportion of beneficiaries have expressed that the soil loss has reduced after the treatments. The impact of the treatment results in moderate to significant reduction in soil loss which again can be graded on the basis of farmer's perceptions. Thirdly, the reduction in soil loss and run-off are complementary to each other and the two together enhance the fertility level. This aspect of improvement in soil characteristics can be easily told by the farmers. Fourthly, the reduction in the run-off also enhances the moisture availability. Increase in moisture

Figure 2.4: Environmental Sub-System: Positive Externalities in Watershed Development Programme



availability period can be felt in all the three reaches but more so in lower reach. The level of groundwater as well as the density of wells may show an increase. The increase in the groundwater availability can also be accompanied by the increased density of wells and as a result the draft-recharge ratio in the region undergone a change.

Fifthly, the density of horticultural crops will increase substantially in response to the programme of horticultural development in the middle and upper reaches of the watershed. The number of horticultural trees planted as well as varieties of trees may record an increase and the survival rate can also be quite high due to moisture availability span. The increased density of horticultural crops can help in optimum utilisation of resources and an increase in the income generated through this source. The silvicultural practices on the farmer's field will in turn help in enhancing the fuel availability and the fodder quantity. One of the important probable outcome needs to be recorded here about the increased stall feeding of the cattle. The number of livestock will increase substantially and also the grazing hours may undergo a similar change. Thus, there is a possibility of increased fodder as well as fuel availability. In order to economise on the fodder and fuel the local adjustment mechanisms may increase substantially. Lastly, the silvicultural plantations on the government lands have always been an important component of the project and also quite crucial from the point of view of the environmental impact. The survival rate of the trees on the government non-arable land is an indicator of the sustainability of treatments on the non-arable land. More than that these can help to prepare an index of sustainability of the treatments. The overall environmental impact of the watershed technology seems to be quite encouraging. It has helped in minimising the entrophies and optimising the positive externalities.

2.7 Institutional Structure and People's Participation

Watershed management concept is a holistic concept and therefore involves complex interactions of the bio-social systems. The World Bank Project formulation involved three basic considerations, namely, (i) verification of the technologies; (ii) project designing through micro-planning and (iii) replicability of the operational design. An approach with similar focus but with the existing operational structure was undertaken under NWDPPRA. These considerations, therefore, involved the project organization conducive to the integrated planning and implementation of the technology. Another important aspect of this includes participation by the community at large and institutionalisation of the entire process. The community participation as well as people's involvement can be judged from the reactions of the respondents. There are quite a few training programmes and meetings that take place under NWDPPRA's operational framework. Similarly, respondents' view about their role in the entire process also gives a clue about their participation. Large number of them have fairly good idea about the main components of the technology. Majority of the respondents reported to have derived the benefits out of the different components of the treatments.

Four important aspects of the community participation, namely, simplicity, affordability, viability and replicability indicate different dimensions of the concept of participation. The farmers' perceptions of these dimensions of participation show clearly their involvement with the project. Vetivar (Khus) bunds seem to be the most simple and clear treatment from the point of view of the farmer. Water conservation measures (farm

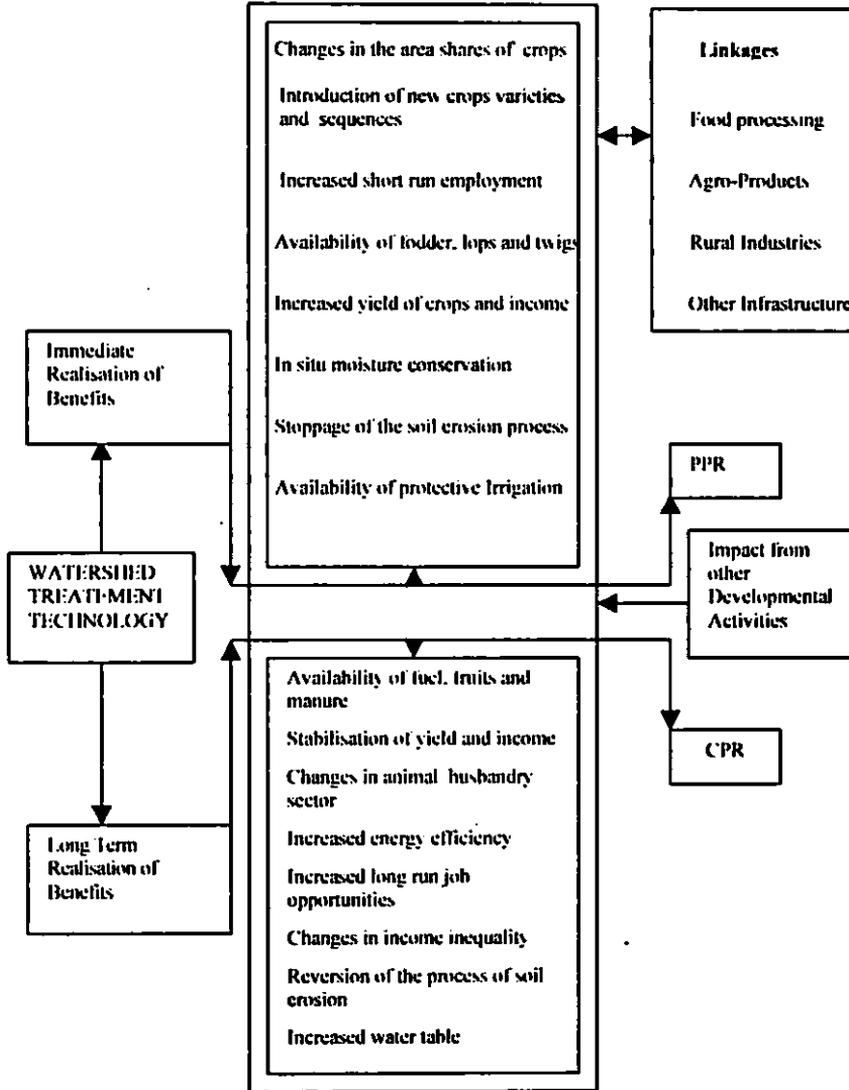
ponds, etc.) may not score high on this count. The affordability aspect of the treatments can indicate the farmers' readiness to take it up on their own initiatives.

The role of institutions is quite crucial in the process of implementation. The design of the project as well as the administrative organisation till recently, assigned only incidental role to the village level formal public institutions. The role of the informal institutions is also quite crucial but such institutions must function beginning with the planning stage of the project. Our analysis of the role of the institutions is from the angle of the respondents, because of the absence of any formal structure or tie-up between project and the public institutions. The participants of the programme seem to be taking active interest in the gram panchayat or co-operative society. Thus, one can visualise a strong linkage between these two institutions and the watershed programme. One important drawback of this, however, comes out of our analysis is the class response to the institutions. Largely, the farmers from higher size group of holding (proxy for wealth group) take keen interest in these aspects and, therefore, this kind of institutionalisation may have a difficulty in truncating the benefits in favour of the most needed.

The project organisational structure differs widely across States and programmes. But there is some broad structure which emerges across States. There are four levels of organisations which helped in effective integration of different disciplines in the project. A State Watershed Development Policy Committee organised in most of the States looks after the functioning of the project at State level and takes the policy decisions. The feedback from the implementation, is provided to the Committee. The State Watershed Development Cell (SWDC) created by availing the services of the officers from different line departments at the headquarters help in the functioning of the programme. But such cells are not common across States. The SWDC helps in vertically coordinating the work from the watershed to the State Policy Committee and between different line departments. The third and the fourth administrative structure comes at the district and lower level. The district level watershed committee organised in some States helped in planning the decisions and the project integration whereas, the project team had the involvement of the officers from forestry, horticulture and agriculture departments. The structure as such is ideal but not incorporated in many States. In a few States either the soil conservation department or the Directorate of Agriculture are posted with the responsibility of the watershed treatment. More often the internal co-ordination among the team members of watershed team and their proper integration with the system causes problems of implementation. Therefore, the organisational structure has to be well weaved and responsible for the programme.

In any watershed development programme four components of organisation are extremely crucial. First is the involvement of many disciplines and restricting their role to control imbalances in treatments. Many times absence of such controls overweighs the treatments in favour of soil conservation or crop husbandry. Secondly, it is the inter-disciplinarity of the entire approach that should be focal point of planning, implementation and monitoring. Thirdly, the planning and projectisation should involve not only the specialists of different disciplines but the plan should also be discussed with a select group of beneficiaries. Lastly, the whole planning exercise should be done independently by the experts in socio-economic planning who have little interaction and role in the process of implementation. Such independence from the implementation allows free thinking in the process of planning. Major impact parameters are indicated in Figure 2.5.

Figure 2.5: Impact of Watershed Treatment Programme



Most important part of the impact analysis is the process of institutionalisation of watershed approach at two levels. First at the administrative level and another at the watershed level. An integrated watershed management structure of Karnataka type helps in the process of institutionalisation. The parallel existence of such structures can enhance the effectiveness of the watershed approach. Horizontal integration across

departments and independence of the administration are two essential components. At the watershed level, we have experiences of watershed level committees and panchayats. Their non-institutional character and little scope to participate in the process of decision-making have together make these ineffective. With the 73rd constitutional amendment we have now opened up a possibility of watershed development to be managed at village panchayat. The process should include planning, implementation, monitoring and sustenance of the structures. The promise of the programme enhances with the village panchayats assuming decisive role.

CHAPTER 3

NWDPR: WESTERN AND CENTRAL RAINFED ZONE

3.1 Introduction

Watershed management strategy is the most crucial strategy for sustaining the growth of agriculture in the Western rainfed areas which include Rajasthan, Gujarat and Maharashtra. Situation is not very different in the unirrigated regions of Madhya Pradesh. The four States together account for the net cropped area of about 72 million hectares and about 8 million hectares of cultivable waste lands including current fallow. Scanty and uncertain rainfall is the basic feature of Rajasthan, Gujarat and large parts of Maharashtra. Only some parts of Madhya Pradesh has this feature but the water use efficiency in Madhya Pradesh is a matter of extreme concern. About 22 per cent of cropped area in Madhya Pradesh can claim to have assured irrigation and the land productivity is one of the lowest in the country. The strategy of watershed management in these four States have to be charted out keeping in view different kind of constraints faced by these States.

The programme of watershed/management under NWDPR began in all the four States during 1986-87. The initial strategic coverage of the programme is shown below in Table 3.1.

Table 3.1: Strategy of Watershed Management

State	Major Strategies
a. Gujarat	- Water and Moisture Conservation - Arresting top Soil-degradation - Up Land Vegetation
b. Rajasthan	- Water and Moisture Conservation - Up Land Vegetation - Creation of Small Water Bodies
c. Maharashtra	- Soil and Water Conservation - Creating Protective Irrigation - Up land Vegetation - Wasteland Horticultural Development
d. Madhya Pradesh	- Arresting Soil Degradation - Creating Protective Irrigation - Wasteland Horticultural Development - Forest Conservation

The strategies for watershed development through NWDPRA indicated above are indicative of the major bottlenecks of agricultural sector in the area. These are converted into programmes for watershed development in respective States.

It can be seen from the Table 3.2 that the initial thrust of the programme was not sufficient enough to deal with the magnitude of the problem in four States. However, subsequently the programme was upgraded both in terms of coverage of area and the details of the components. The eighth plan allocation for the programme for these four States was Rs.9732 lakhs, Rs.21517 lakhs, Rs.21138 lakhs and Rs.15905 lakhs for Gujarat, Madhya Pradesh, Maharashtra and Rajasthan respectively. But given the magnitude of area to be treated under watershed development approach in these States the allocations made are not in tune with the requirements.

Table 3.2: Allocation on NWDPRA: 1986-87 to 1988-89

State	No. of Watersheds	Arable Area Covered			Expenditure Incurred (in lakhs)		
		86-87	87-88	88-89	86-87	87-88	88-89
Gujarat	60	--	5141	5141	--	97.11	97.11
Madhya Pradesh	2	397	399	796	9.74	8.66	18.40
Maharashtra	379	--	11158	11158	--	304.52	304.52
Rajasthan	15	--	9254	9254	--	64.07	93.97

Source: Purohit, S D (1994), p. 13.

In this chapter we intend to bring together the findings of the four studies on Gujarat, Madhya Pradesh, Maharashtra and Rajasthan at one place to derive commonly emerging issues.

3.2 Watershed Treatment in Semi Arid Zone: Gujarat

Gujarat State is characterised by its scanty and uncertain rainfall. The average annual rainfall in the State ranges from 350 mm in Kutch to 1890 mm in Valsad and Dang districts. Rainfall is inadequate erratic and unevenly distributed introducing fluctuations in the agricultural income stream. About 27 per cent of the gross cropped area of the State is irrigated and most of the area under irrigation is irrigated by wells and tubewells. The density of groundwater extraction sites is increasing at a fast rate and consequently groundwater availability is depleting rapidly. Despite the availability of irrigation to about 27 per cent of area the cropping intensity in the State is about 113 percent indicating usage of irrigation in kharif season. According to one estimate (Shah and Patel, 1996), about 158.50 lakh hectares of area in the State requires soil and water conservation treatments. The NWDPRA intends to cover about 4 lakh hectares during the eighth plan. All the soil and moisture conservation measures in Gujarat were implemented by the Department of Agriculture as a part of their activities. The Gujarat

State Land Development Corporation (GSLDC) came into existence in 1978 and after this year GSLDC undertook the implementation of land/soil upgradation and development programme in the State. Various soil and water conservation programmes, including NWDPRAs are now undertaken on watershed principle.

During the Seventh Plan, the Government of India launched the NWDPRAs and GSLDC implemented this programme for 60 watersheds spread over 13 districts covering an effective arable area of about 81 thousand hectares. The revised NWDPRAs which came into being during 1990-91 proposed to cover 168 selected blocks spread over 19 districts and an area of about 3.4 lakh hectares. Of these 3.4 lakh hectares, 81 per cent is arable area and the rest requires treatment as non-arable land. Among the 168 watersheds chosen for the purpose of treatment the size of the watersheds range between 208 hectares to 8434 hectares. The highest approved cost of treatments per hectare ranges between Rs.3161 per hectare in Junagadh district to Rs.2454 for Dang district.

The Gujarat State Land Development Corporation which manages the implementation of NWDPRAs is governed by a Board of Directors appointed by the State government. A Managing Director and an Additional Director of Soil Conservation serve as the nodal authorities and they are deputed to GSLDC from the Department of Agriculture. A multi-disciplinary team consisting of senior officers of all the concerned departments is constituted and placed at the disposal of GSLDC and this team coordinates the activities of NWDPRAs. It is clear that Gujarat State has developed a complete framework of an interdisciplinary team. Working of a watershed based programme is more effective with such team.

For the purpose of the impact analysis the AERC, Vallabh Vidya Nagar selected two watersheds from two blocks namely Danta Block from Banaskantha district and Kapadvanj Block from Kheda district. The micro-watershed of Danta falls in a non-tribal area whereas, the Kapadvanj block is a pre-dominantly tribal inhabited block. The block receives average annual precipitation of about 532 mm and it is highly fluctuating. Open dug-wells are the major source of irrigation and at the time of survey there were 300 such wells in the watershed. Kapadvanj block receives average annual precipitation of about 795 mm per year and this is also characterised by large fluctuations. Kapadvanj block also has open wells as the main source of irrigation and there were about 100 dug wells operating within the watershed area. Each of these watersheds cover four villages. The item-wise physical and financial achievements of Danta watershed have been better as compared to Kapadvanj watershed whereas, the estimated total cost of Danta project is much lower as compared to Kapadvanj. Both the watersheds fall on the main roads and hence easily accessible. The achievements in terms of the per cent expenditure incurred on Danta watershed is 101.5 per cent of the total targeted expenditure whereas, in Kapadvanj block the per cent of expenditure incurred to the targeted expenditure is only 26.1 per cent during the same period.

The economic impact of the NWDPRAs in Gujarat was analysed by Shah and Patel (1996) and covers all the major aspects of the impact analysis. In Danta block 94.3 per cent of the net cultivated area of the beneficiary households was found to be irrigated whereas about 79.3 per cent net cropped area of non-beneficiaries comes under irrigation. Consequently, the irrigation intensity was 14 points higher for beneficiaries. The cropping intensity of beneficiaries worked out to be 173.9 per cent whereas, the same for non-beneficiaries was 165.7 per cent. In Kapadvanj block however, the beneficiaries have 61.8 per cent area under irrigation and the non-beneficiaries have 41.2 per cent area coverage under irrigation. This has also a reflection on their cropping intensity. But surprisingly the cropping intensity of the beneficiaries is lower than that of the non-beneficiaries.

The soil and moisture conservation treatments under NWDPR have helped in improving the groundwater table as well as availability of water. From the total wells of the beneficiaries, more than 51 per cent wells recorded an increase in water table by more than 4 feet in Danta block. The rise in water table was above 4 feet in the case of 31.4 per cent of beneficiaries in Kapadvanj block. The research team remarked that the rise in the water table is noticeable but not commendable compared to the expectations. The cropping pattern of both Danta and Kapadvanj blocks is turning in favour of commercial crops. The cost structure of agricultural operations also underwent change in favour of cash inputs. The watershed treatment has induced more consumption of fertilizers, HYV seeds, FYM and increased area under irrigation.

Yield improvement has been quite substantial in Kapadvanj block as compared to Danta block but the advantage of yield improvement in Kapadvanj is absorbed more by the incremental cost of cultivation incurred by the Kapadvanj farmers. Yield per hectare obtained by the beneficiaries of Danta block were higher by 63 per cent for groundnut, 26 per cent for castor, 24 per cent for bajra and 20 per cent for mustard crops (Table 3.3). In Kapadvanj block, the yield per hectare of beneficiaries were higher by 60 per cent for castor, 56 per cent for cumin, 41 per cent for paddy, 22 per cent for bajra and 19 per cent

Table 3.3: Incremental Yield due to Watershed Treatment

Crop	(Kgs/ha)	
	Danta Block	Kapadvanj Block
Wheat	+ 254	+ 99
Paddy	--	+ 712
Bajra	+ 447	+ 310
Maize	- 556	+ 149
Castor Seed	+ 280	+ 668
Groundnut	+ 452	-
Cumin & Fennel	-	+ 520
Mustard & Rapeseed	+ 288	-
Cotton	--	+ 207
Gross Incremental Income	Rs.1130/ha	Rs.4102/ha
.Net Incremental Income	Rs.1455/ha	Rs.1541/ha

Notes: Incremental yield per hectare is the difference between yield per hectare of beneficiaries and non-beneficiaries

Source: Shah and Patel, (1996).

for cotton crops. The net farm income per hectare of GCA for beneficiaries in Danta block worked out to Rs.4527/ha. and that for the non-beneficiaries was Rs.3876/ha. In the case of Kapadvanj, the net farm income of beneficiary households was Rs.7687/ha and that of the non-beneficiary was Rs.6139/ha.

Besides enabling beneficiaries in enhancing yield and net income the NWDPR has also helped in enhancing the employment opportunities by bringing in additional area under cultivation (crop intensity effect). In Danta block the additional employment created was 39 mandays and 4 bullock labour days per hectare of net cultivated area, whereas, in Kapadvanj block, the additional employment created was 11 man days and 4 bullock labour days per hectare of net cropped area. On the technology adoption front of watershed development

technology the adoption of bunding activity was quite high in both the blocks. The adoption of new technology has increased reasonably of the vegetative bunding but the development of pasture was not taken significantly. The relevance, adequacy and adoption of the level of activities under NWDPR was high to moderate level. About 60 to 80 per cent of the aggregate beneficiaries expressed satisfaction towards the content and effectiveness of NWDPR.

Works on the non-arable land planting of shrubs, grasses, afforestation and vegetative contour hedges were taken up. These works were reported to have had little impact because of the low density. The drainage line treatment works in both Danta and Kapadvanj region were also not of significant magnitude to have any discernible impact on the watershed region. As regards the participation by the beneficiaries both the blocks have shown encouraging results. But still it was felt by the researchers that there is an ample scope to encourage fuller participation of the beneficiaries.

Among the on farm constraints noted by the beneficiaries, five constraints assume greater importance. Firstly, the infrastructure provided for credit, demonstration and extension network, the Chetana Kendras and access to suitable horticultural crops has not been adequate. These supply bottlenecks and information asymmetry have created uneven impact of the programme. Secondly, the programme has given indicative unit costs for almost every component. Some of these are extremely insufficient to implement the intended work done. Like the cost of vegetative hedges is fixed at Rs.420 per hectare of the treated area. This was felt extremely inadequate by the research team, hence, local level flexibility was argued in this context. Thirdly, the procedures fixed for sanctioning the components of the programme was quite elaborate and this causes time lapses. Such time lapses culminate into further delay in implementation and half hearted work in the programme. Fourthly, the multi-dimensional integrated approach of NWDPR does not seem to be functioning as a co-ordinated multi-disciplinary programme due to lack of horizontal coordination. Lastly, the research team reported that even though the programme guidelines are well prepared but these are not effectively implemented. The external evaluation and monitoring of the project is not taken up so also there are no elaborate plans prepared for the development of watersheds. This goes a long way in the effective implementation of the programme and the absence of such monitoring can create unnecessary expenditure.

3.3 Watershed Treatment in an Assured Rainfall Region: Madhya Pradesh

Madhya Pradesh receives assured rainfall in most of the parts of the State. The State is characterised by its low level of irrigation and slow adoption of technology. In an across State perspective the growth rates of the agricultural sector of Madhya Pradesh are quite low and need to be enhanced further. The productivity per hectare of the crops in Madhya Pradesh is also below the all India average productivity for majority of the crops. Keeping in view the agro-climatic diversity the Agro-Economic Research Centre at Jabalpur chose two districts falling in two different agro-climatic situations in the State. Raipur district falling in the sub-region namely "Chattisgarh plains including Balaghat region" and Khargon district falling under "Nimar plains" were selected for the purpose of the study. Whereas, Raipur district receives average annual precipitation of 1375 mm, Khargon district receives average annual rainfall of 747 mm. Raipur has a predominance of Khanhar, Dorsa, Matasi and Bhata soils but Khargon has stony, loamy, grey and black cotton soils. The cropping

pattern of Raipur is dominated by crops like paddy, wheat, fruit crops and oilseeds whereas, that of Khargon region has jowar, wheat, maize, tur and oil seeds as dominating crops. The AERC research team selected Silyari Nala watershed from Raipur district and Chanderi Nala watershed from Khargon district. The analysis carried out by the research team was separate for the two watersheds as the agro-climatic conditions differed widely.

The Silyari Nala watershed falls in the assured rainfall region of the State with average annual rainfall exceeding 1000 mm. It is not a big watershed and had only 1138 holdings. The Financial achievements, as reflected from the per cent of expenditure to the targeted expenditure, is about 29 per cent and that for the preliminary activity was only 22.7 per cent. A larger achievement (in terms of expenditure) could be noted in land development with 34.24 per cent of total expenditure. The work under livestock management programme was also commented as most unsatisfactory (Athavale, 1995). The Chanderi Nala watershed in Khargon district is also relatively small and has only 911 cultivator households. The estimated expenditure for five year period for all the activities was only 22.09 per cent of the targeted expenditure. Similar results were seen for preliminary activities and land development. Only drainage line treatment and water conservation measures have better achievements compared to the other components.

The concept of beneficiary in AERC, Jabalpur study is quite different. The research team preferred to call a 'beneficiary' if only the household has received benefit under various components of NWDPR, namely, Sapling distribution, Nadev construction, crop demonstration, weedicide kit or composite kit. Hence the benefits accrued to the household also get defined as benefits from these activities. Such concept of beneficiary is not conducive to any impact analysis of a watershed development programme as the very concept of watershed is an area based concept.

The cropping pattern of Silyari Nala watershed is dominated by paddy and out of this only about 30 per cent is irrigated and remaining is rainfed area. The per cent of irrigated area on beneficiary farms was 23.76 per cent whereas, the same on non-beneficiary farms 37.80 per cent. Paddy was irrigated to the extent of 24 per cent on the beneficiary farms and about 37 per cent on the non-beneficiary farms possibly due to higher moisture availability. The cropping pattern of beneficiaries and non-beneficiaries is more or less the same but the cropping system of the area falling outside the watershed region is quite different. The cost of cultivation of non-beneficiaries is slightly higher than that of the beneficiaries for paddy, wheat, gram and teora. It is not surprising that the yield per hectare of beneficiaries in some groups of size of holding is slightly higher than that of the non-beneficiaries and in some other groups less than that of non-beneficiaries due to the definition of beneficiaries taken up in the study (Table 3.4). The adoption of improved farming practices among beneficiaries was much higher. Input supply and credit facilities have some bottlenecks created. As far as the participation of the beneficiaries in the programme is concerned, only 26 per cent showed some awareness of the programme in terms of their participation in planning and/or implementation process but 60 per cent of beneficiaries have only mentioned that some meetings did take place in the villages.

Chanderi Nala watershed experience is not different from that of Silyari Nala. This watershed is relatively lower in size. The entire cultivated area of non-beneficiaries falls inside the watershed area but about 1.5 per cent of the area of beneficiaries falls outside the watershed boundary. This is an interesting factor emerging out of the misplaced concepts of beneficiaries and non-beneficiaries. Irrigated area on beneficiary farms was 75.63 per cent as against 23.89 per cent of the same on non-beneficiary farms. This must have posed a

problem of attributing the benefits accrued to beneficiaries of watershed programme. The cropping pattern is dominated by jowar, wheat, maize, pulses and groundnut and 81 per cent of the irrigation is used by the beneficiaries for irrigating cereal crops. The cost of cultivation of beneficiaries is higher than that of the non-beneficiaries for wheat, jowar, groundnut and cotton, though the difference is not very high. The differences in yield per hectare are of quite significant in nature.

The adoption of new technology is at a higher level in Chanderi Nala watershed as compared to Syliyari Nala watershed. More number of beneficiaries as well as non-beneficiaries are adopters of new farming practices in Chanderi Nala watershed. The input supply and credit bottlenecks are felt by all the farmers. As regards participation in planning and implementation of NWDPR only 20 per cent of the beneficiaries felt that they were involved in the process, whereas, the remaining 80 per cent felt left out. About 60 per cent of the beneficiaries stated no awareness of any meetings regarding watershed to have taken place in their village.

Table 3.4: Yield per Hectare of Principal Crops of Beneficiaries and Non-Beneficiaries in Madhya Pradesh NWDPR

Crops	Syliyari Nala		Crops	Chanderi Nala	
	B	NB		B	NB
Paddy HYV	2969	2911	Jowar HYV	1414	864
Local	2021	2365	Local	751	845
Wheat	1068	1116	Groundnut HYV	622	661
Gram	623	678	Local	560	605
Teora	518	429	Maize	1000	-
			Wheat	1624	1227
			Cotton	1261	920

Note: Incremental yield is not computed because of the problem of definition of beneficiaries; B – Beneficiary; NB – Non-Beneficiary.

Source: Athavale, (1995).

On the whole, the analysis of NWDPR as reflected from Madhya Pradesh study does not hold great promise. Some of the components like preliminary activities, nursery, Chetana Kendras, Nadev tanks and farm ponds showed better performance and were welcome by the beneficiaries but the maintenance of the created structures and the participation was not to the level of expectations of the research team. Hence these factors need to be looked into.

3.4 Watershed Treatment in Semi-Arid Commercial Setting: Maharashtra

Maharashtra is a State with the dubious distinction of having lowest area under irrigation and largest span of drought-prone area. The initial efforts towards dry land farming began in Maharashtra as early as in 1930s and the work on soil conservation has also received good returns over years. Government of Maharashtra implemented the watershed development programme beginning with 1982 under Comprehensive Watershed Development

Programme (COWDEP). This programme showed quite encouraging results (Deshpande and Reddy, 1990, 1991) and served as platform to begin the programme of NWDPR. Government of Maharashtra chose to put the same watersheds under NWDPR and hence the transition was not difficult. Only the nomenclature of the erstwhile Soil Conservation Department was changed to form a new department of the Directorate of Soil Conservation and Watershed Management with the same functionaries manning the department. Thus nomenclature did change keeping the basic philosophy and approach unaltered.

The impact study of NWDPR was focussed on two watersheds falling in two distinct agro-climatic regions (Deshpande and Rajasekaran, 1995). The first watershed was selected from Scarcity Zone of Maharashtra with average annual rainfall less than 700 mm. It falls in the core drought prone area of Maharashtra and the second watershed was a part of the transition zone (assured rainfall belt). The logic behind the choice of the watersheds from two distinct agro-climatic regions was to test the hypothesis of differential impact of watershed based technology across agro-climatic regions. The first selected watershed in the Scarcity Zone was from Ahmednagar district covering a village namely Bugewadi village. This was called as Bugewadi watershed. The second selected watershed is located in Satara district on the eastern hill slopes of Sahyadri ranges. This covers the villages namely Nune and Gaudi and hence called as Nune-Gaudi watershed.

The NWDPR in Maharashtra included a component of preparation of an outline plan for each watershed in every district. These plans accompanied with short notes gave a large amount of information about the region prior to the treatment. But these were prepared without any training. Bugewadi watershed receives scanty and uncertain rainfall of only about 450 to 600 mm, with shallow soils and low fertility. The irrigated area of beneficiaries is 17.66 per cent as against 4.7 per cent of that of the non-beneficiaries. The irrigation intensity and cropping intensity was also higher among beneficiaries. The cropping pattern is dominated by jowar, wheat, pulses and oilseeds. The cropping pattern of the beneficiaries has changed in favour of non-food commercial crops. The change in yield of crops is also significant on beneficiary farms. Cost of cultivation of beneficiaries is higher than that of non-beneficiaries and the new inputs like fertilizers, pesticides and new farming practices form a major component of the cost. But such escalation in the cost has not brought down the net returns. The adoption of improved farming practices is quite prevalent among beneficiaries and the adoption of improved land development practices as well as vegetation development among the beneficiaries was also encouraging. Adequacy, usefulness and relevance of the programme were investigated. The beneficiaries were asked about each of the component and it was noted that between 30 to 60 per cent of the beneficiaries expressed satisfaction about the component. As regards sustainability of the programme is concerned, about 40 to 86 per cent beneficiaries across different size classes expressed the probable sustenance of different components.

People's participation in the watershed programme was checked by their participation in planning process, training programmes, visits of officials, discussions with them and village meetings organised. The participation of beneficiaries ranged between 30 to 70 per cent but was never total. Complete participation was not even expected from the programme. The environmental impact of the programme on increase in moisture retention, vegetative bunds, contour cultivation and the water table increase was satisfactory.

Watershed treatment in Transition Zone need to concentrate on nine components, namely, (i) proper drainage system; (ii) water harvesting structures; (iii) contour cultivation and strong bunds across contours; (iv) brushwood dams; (v) gully control; (vi) diversion

drains; (vii) planting of pastures, trees and shrubs; (viii) livestock activities; and (ix) other forest based activities. These activities are specific to the Transition Zone. Nune-Gaudi watershed falls on the eastern slopes of Sahyadri ranges. The rainfall is in the neighbourhood of 800 to 1000 mm. The cropping pattern of Nune-Gaudi is dominated by paddy, wheat, jowar, grass and oilseed. Onion and sugarcane are taken as cash crops. The cropping intensity on beneficiary farms is 130 per cent as against 126 per cent on the non-beneficiary farms. Hardly 17 per cent of the net cultivated area of the beneficiary farms comes under irrigation. The changes in cropping pattern indicated a shift towards commercial high value crops. Cultivators with larger size of holding have more flexibility for such changes.

In the Transition Zone, the change in area allocation was more obvious than any perceptible change in yield levels. In fact, for a few crops the yield per hectare of beneficiaries was lower than that of the non-beneficiaries (Table 3.5). This seems to be mainly due to a shift towards new crops. The structure of input use of beneficiaries has changed more in favour of cash paid inputs than in terms of owned inputs (own bullock labour, family labour, FYM etc). The adoption of the improved farming practices is more prevalent here as compared to the Scarcity Zone. The relevance, adequacy and sustainability of the technology under NWDPR in the Transition Zone is better than the same in the Scarcity Zone. Similarly, the participation of beneficiaries in various components of the programme is above 60 per cent level except for the training component. Analysis of the environmental impact of the programme confirmed increase in moisture availability, decreased run-off, effectiveness of vegetative bunds and enhancement of water availability period.

Table 3.5: Incremental Yield per Hectare under NWDPR in Maharashtra

Crops	(Kgs/ha)	
	Scarcity Zone (Bagewadi)	Transition Zone (Nune-Goudi)
1. Paddy	-	-588
2. Wheat	+367	-
3. Local Jowar	-	+14
4. HYV Jowar	-	-130
5. Jowar	+63	-
6. Bajra	+226	-
7. Green Gram	-	+354
8. Black gram	-	+62
9. Tur	+243	-
10. Kulith	-225	-
11. Sunflower	+301	-
12. Safflower	+133	-
13. Groundnut	+395	-10
14. Onion	-	+270

Source: Deshpande and Rajasekaran (1995).

The micro level constraints enlisted in the Maharashtra study include four important aspects. Firstly, it was strongly felt that there should be local level flexibility in managing and maintaining the watershed level programme to some extent so that quick decisions can

be taken by the implementing authorities. Secondly, the availability of inputs such as proper seeds, fertilizers and pesticides was expressed in both the watersheds but no such efforts were undertaken. Thirdly, the availability of extension services and credit services were felt inadequate. The extension machinery was not properly equipped to meet the requirements. This has resulted in slow adoption of new technology. Lastly, absence of any external monitoring has relaxed the programme and the implementing officers also do not realise these constraints due to absence of feedback. Lack of flexibility and the arduous route of sanctioning any change takes its toll in getting satisfactory results.

3.5 Watershed Treatment in Arid Zone: Rajasthan

Although Rajasthan State falls in the Arid Zone it can be divided into two broad regions, namely eastern and western regions according to specific climatic characters. The rainfall in different agro-climatic regions of Rajasthan ranges between less than 400 mm to above 800 mm. The proportion of irrigated area is 23 per cent and a large part of this is available only in the north. The Agro-Economic Research Centre, Sardar Patel University at Vallabh Vidya Nagar had also conducted an evaluation study of National Watershed Development Programme in Rajasthan (Purohit, 1994). The study conducted was only two years after the guidelines of NWDPR were revised in the light of the experience of the programme during the first phase of implementation and hence the impact parameters are not boldly discernible. The team of researchers selected two watersheds for indepth study, namely, (i) Madhogarh-Rampura Watershed in Ajmer district; and (ii) Nogama Watershed in Banswara District.

Madhogarh-Rampura watershed falls in an extremely Arid Zone with average annual precipitation of 345 mm. About 90 per cent of the total rainfall occurs only during 13 weeks between June and September, leaving the larger part of the year under complete arid conditions. NWDPR started during 1987-88 in the region. The watershed area has an average size of holding of 3.2 hectares for beneficiaries as against 1.9 hectares for non-beneficiaries. The beneficiary group had only 3.5 per cent of area under irrigation, whereas the non-beneficiary could claim such benefit only for 1.3 per cent of their cultivated area. The treatment of the watershed could increase the proportion of irrigated area among beneficiaries to 9 per cent which in itself is a commendable achievement. With the availability of irrigation, the cropping intensity of the beneficiary group increased marginally. The cropping pattern is dominated by bajra, jowar, oil seeds and pulses. Cotton is taken as the only commercial crop. Per hectare productivity differences between the beneficiaries and non-beneficiaries have not always been positive. In other words, the beneficiaries have not consistently claimed higher yield levels across crops than that of the non-beneficiaries. In fact, in the case of jowar, groundnut and cotton, the non-beneficiaries have higher yield levels. The cash inputs are higher in the case of beneficiaries as compared to non-beneficiaries. The impact of the NWDPR on the poverty alleviation is also not discernible because of the complexities in the farm business calculus.

Nogama national watershed is another watershed chosen for the impact analysis by AERC team. This watershed comes under Banswara district and has an average annual rainfall of 750 mm. Though the precipitation is little higher the variability is also high. This watershed does not have sufficient irrigation. Thus irrigated area under the watershed is only about 6 per cent. The cropping pattern includes paddy in addition to the crops like maize, black gram, gram, tur and cotton. Yields of the crops are not comparable with those of non-beneficiaries as the research team did not include non-beneficiaries in their scheme. This

was done because surrounding area either had good irrigation facilities or were covered under different watershed programmes. But it was recorded by the research team that yields improved about 30 to 70 per cent across farms as compared to the earlier years. Consequently, the gross value of production increased by about 27 per cent after adjusting the increase towards cost of cultivation. The research team for Rajasthan did not consider the impact on environmental factors.

Among the operational constraints pointed out by the research team four constraints are quite important. Firstly, the staff strength of NWDPRAs and the horizontal coordination across departments was the main lacuna. The staff was inadequate and lacked support from the concerned departments. Secondly, the unit cost recommended for the aggregate NWDPRAs works was found to be inadequate and hence it required further enhancement. Thirdly, the beneficiary involvement was quite low and this is exactly expected under any programme which has a long gestation period in the arid environment. In the arid environment the food security level is always in a delicate balance with employment and this will get affected if people work on a project with longer gestation period. Lastly, the engineering components of the work should be properly tuned to the local conditions. This also needs to keep in view the type of soil, climate, wind velocity and dust storms which are frequent in the State.

3.6 Conclusions

The impact of NWDPRAs across the four States has been varying and has been beneficial for the agricultural sector. Among the major impact parameters noted: change in cropping pattern, land use, enhanced productivity, increasing cost of cultivation and increased net income from agricultural activity, are some of the important parameters for the agricultural economy. The programme has the required income stabilisation effect but it was not amenable for analysis as the data pertained to only one point of time. As regards the environmental impact parameters not all the studies concentrated on this crucial aspect but some references could be located in each of the studies. There is enough evidence of increased moisture availability, increase in area under irrigation and increase in the height of water table. There were only a few references about the reduction in run-off and soil losses. The afforestation in the ridge area was also not a focus of the studies but there are indirect evidences confirming this. Participation of the beneficiaries at various stages in the programme was analysed by the research teams. There is a mixed kind of evidence regarding this and the results are quite encouraging.

Among the programme constraints at field level it was pointed out that the programme was necessary, relevant and adequate but has certain implementation level bottlenecks. Firstly, the location specificity of watershed treatment must be kept in mind and enough flexibility be given to the local team leaders in the process of implementation. Secondly, the implementing agencies except in Gujarat are not multi-disciplinary in nature and therefore the process of implementation suffers from lack of coordination across departments. It is essential that different States should agree to a common structure for the purpose of implementation. Thirdly, the flexibility in decision making at watershed level was emphasised by the officials working at watershed level. The procedural routines, many times delay the implementation process and cause delay. Fourthly, the capital formation in the agricultural sector is slowing down and it is essential that the provision of timely credit should be made which can enhance growth of

the sector in rainfed areas. Lastly, the input delivery system, availability of quality and quantum of inputs become necessary. The adoption of technology is not proper mainly due to this factor. Similarly, the component of extension services needs to be strengthened under NWDPR.

CHAPTER 4

NWDPR: SOUTHERN PLATEAU AND HILLS REGION

4.1 Introduction

The Southern Plateau and Hills region cover major parts of the States of Andhra Pradesh, Karnataka and Tamil Nadu. These three States experience large variations in rainfall across their districts and have agro-climatic characteristics of varying nature. There are vast patches of rainfed areas in these three States and cropping pattern is paddy dominant in most of the parts. The treatments under watershed management approach have to be more or less similar across these States but should have different composition of the treatments across agro-climatic zones within the States. Major agro-climatic sub-regions of the States are shown in Table 4.1. The components incorporated under NWDPR include the treatments suitable for all these agro-climatic regions. However, only a proper combination of these treatments, which need to be worked out and implemented through the programme can help in effective implementation. Apart from planning at the level of broad agro-climatic region, the treatments should also be planned at watershed level keeping local characteristics in mind as given in the guidelines (WARASA, 1992).

Table 4.1 Agro-Climatic Sub-Regions of the States under Southern Plateau and Hills Region

Sl. No.	State	Sub-region	Major Treatments
1.	Andhra Pradesh	i. North Coastal Andhra	- Drainage Treatments
		ii. South Coastal Andhra	- Soil Conservation
		iii. Nellore	- Soil-moisture Conservation
		iv. Rayalaseema	- Soil-moisture Conservation
		v. South Telangana	- Water Conservation
		vi. North Telangana	- Vegetative Treatments
2.	Karnataka	i. Northern Dry Region	- Soil-Moisture Conservation
		ii. Central Region	- Protective Irrigation
		iii. Southern Region	- Soil-water Conservation
		iv. Hills and Coastal Region	- Drainage Treatments
3.	Tamil Nadu	i. North Region	- Arable Land Treatment
		ii. Central Region	- Soil-moisture Conservation
		iii. Middle East Coastal Region	- Drainage and Gully Control
		iv. Delta	- Drainage and Gully Control
		v. South East Coastal Region	- Soil-water Conservation
		vi. South Region	- Water Conservation
		vii. Hills Region	- Non-arable Area Treatment

Source: Reports of Agro-climatic Regional Planning Teams, Agro-climatic Regional Planning Unit, Ahmedabad.

There are only two reports analysing the impact of NWDPRRA on the agricultural sector: one from AERC, Waltair, Andhra Pradesh and another from AERC, Chennai, Tamil Nadu. No study was initiated for Karnataka or Kerala. The total financial outlay on NWDPRRA for these four States is Rs.27,603 lakhs which is about 21 per cent of the total allocation to the programme during 8th plan. The highest allocation during the eighth plan period is for Karnataka (Rs.11837 lakhs), followed by Andhra Pradesh (Rs.9161 lakhs), Tamil Nadu (Rs.4151 lakhs) and Kerala (Rs.2454 lakhs). The allocations are probably based on the programme of land treatments given by each State. Due to the paucity of data we could not correlate the achievements or plan targets of the programme with the expenditure or financial allocations. The data supplied by a few States do not match with the totals as well as to those given in different documents published by the State Governments. This is mainly due to the variation in time period considered by various publications.

4.2 Impact of NWDPRRA in Andhra Pradesh

Andhra Pradesh is one of the better performing States in the agricultural sector. The State has a large coastal region with severe drainage problems as well as vast areas falling under rainfed conditions. On one side of the State there are water scarce areas whereas, on the other side there are severe water management problems. As per the instructions from GOI the State Government undertook a programme of treating 1,97,150 hectares of area falling under 94 watersheds to be treated during the eighth plan. The work on the programme thus began during 1991 whereas, the survey of impact assessment by AERC was undertaken during 1993-94 with 1992-93 and 1993-94 as reference years. This gave barely three years after the beginning of the implementation of the programme. There are six different official machineries which oversee the NWDPRRA programme in the State. These include: (i) State Watershed Development Policy Committee; (ii) State Watershed Development Implementation Committee; (iii) State Watershed Development Team; (iv) District Level Coordination Committee; (v) Sub-Divisional Level Coordination Committee; and (vi) Multi-Disciplinary Watershed Development Team. The report of the AERC, Waltair records that "As per the information given at the State Headquarters, the State Watershed Policy Committee held only one meeting during the last five years. The Watershed Development Implementation Committee met two times during the period 1992 to 1995. The Watershed Development Team was reported to have held their meeting only once during the plan period. The District Level Co-ordination Committee, Sub-Divisional Coordination Committee and Multi-Disciplinary Watershed Development Team have reported to have held one meeting each in a year to review and monitor the implementation of Watershed Development Programmes" (AERC, 1996, Waltair, p.14).

It is intriguing to note that even with the formation of committees for various levels of coordination, they do not meet often and this defeats the very purpose of formation of such committees.

Even with the infrequent meetings of the policy bodies, the NWDPRRA in Andhra Pradesh seem to have achieved good progress in terms of expenditure incurred. The State has incurred about Rs.3788 lakhs or 75 per cent of the total amount released (Rs. 5064.227 lakhs) as expenditure. Against the 75 per cent expenditure incurred the area treated (94495 ha. between 1991-92 to 1994-95) was only 37.27 per cent of the targeted area during the same period.

AERC research team chose two watersheds falling in two distinct agro-climatic regions. One watershed namely Narvagedda in Visakhapatnam district falls under North Coastal Andhra Pradesh. Embo watershed falls in Kumool district falling in the scarce rainfall zone under Rayalseema region. The research team defined beneficiaries as those farm households which have received benefit from among any of the ongoing schemes under NWDPRRA, namely, (i) Contour-Vegetative Hedges on bunds; (ii) Contour-Vegetative hedges; (iii) Gully Control Works; (iv) Dry-land horticulture; (v) Crop-demonstration; and (vi) Fodder Development (animal husbandry). These beneficiaries were asked about their performance and it was compared with that of the non-beneficiaries to ascertain the impact parameters. The non-beneficiaries residing or owning land under the treated watershed were not excluded.

Naravagedda watershed comes under Visakhapatnam district with normal annual rainfall of 995.5 mm. The main characteristic of the rainfall is a long dry-spell with cyclonic heavy down pour at least once a year. The management of water during such down pour causes extensive damage to crops. The watershed has 2058 hectares under irrigation out of the total 2925 hectares of net cropped area. A large part of the watershed is irrigated by tanks (1366 hectares out of 2925 hectares). The cropping pattern of the watershed area is dominated by paddy, bajra, ragi, horse gram (other pulses), groundnut and vegetables.

The watershed level achievements in terms of expenditure incurred in Naravagedda watershed is about 74 per cent but there is a large variation across component activities. Expenditure on drainage line treatment (one of the most important activities in this watershed) is 240 per cent of the allocated amount whereas, that on the preliminary activities is only 31.19 per cent of the target. Physical achievements under vegetative filter strips, contour vegetative hedges and repairs of the existing structures are 66, 71 and 130 per cent of the planned activities. Gully Control measures have covered only 68 per cent of the target area from the beginning of the activity. The achievements varied across the sub-watersheds and activities. The variation of achievement across activities was in the range of 20 to 80 per cent and thus points out to the planning bottlenecks.

The impact of NWDPRRA at beneficiary level is more easily discernible. The size of holding of the beneficiary is slightly higher than that of the non-beneficiaries. Due to the definition of the beneficiary followed by the study team it is not surprising that the beneficiaries have about 40 per cent of their average size of holding outside the watershed area. Cropping pattern of the beneficiaries is dominated by paddy, bajra, ragi, pulses and groundnut. About 24 per cent of the area of beneficiaries receives irrigation as against two per cent area of the non-beneficiaries coming under irrigation.

Beneficiaries have larger area under plantation crops like cashew and casurina when compared with the non-beneficiaries. Cost of cultivation of beneficiaries per hectare for groundnut, bajra and ragi is higher than that incurred by the non-beneficiaries. But in the case of unirrigated paddy non-beneficiaries incurred higher cost. The major impact of the watershed treatment can be seen in yield level improvements. The yield improvement as can be seen from the Table 4.2 is in the range of 25 per cent to twice of that of the non-beneficiaries in Naravagedda watershed.

Embo watershed comes under Bethamcherla Mandal of Kumool district and a drought-prone region of Western Andhra Pradesh. The average annual precipitation recorded in the watershed region is 596 mm, of which more than half is received during July to September. The total area of the watershed is 2920 hectares of which 2160 hectares comprise of arable lands and 76 hectares come under non-arable lands. The project work began during 1991-92 and the area treated under watershed management technology is 1368

hectares of arable land and 523 hectares of non-arable land. This constitutes a coverage of 70 per cent of arable land and about 72 per cent of non-arable land already covered under the treatment. The financial achievements as reflected from the proportion of expenditure incurred to the targeted expenditure, show picture a which is almost similar to the one reflected from the area treatment. The expenditure was under preliminary activity which was only about 21 per cent of the targeted amount for that period, but the expenditure under agricultural development, non-agricultural activities drainage line treatment and livestock management is 64, 64, 75 and 21 per cent respectively.

Table 4.2: Yield per Hectare of Beneficiaries and Non-Beneficiaries

Crops	Naravagedda Watershed		Incremental Yield	Crops	Emboy Watershed		Incremental Yield
	B	NB			B	NB	
	(Kgs/ha)						
Groundnut	771	618	+153	Groundnut +	646	759	-113
Bajra	1231	644	+587	Redgram			
Paddy	3039	1259	+1780	Korra	818	578	+240
Ragi (Kharif)	790	363	+427	Jowar	557	302	+255
Ragi (Rabi)	395	840	-445	Groundnut	684	733	-49
				Cotton	1236	272	+964

Notes: B - beneficiaries; NB - non beneficiaries; Incremental yield refers to difference between the yield rate of B and NB.

Source: Rao, T.V.S. (1996).

At the household level impact was analysed by canvassing a structured schedule to the beneficiaries who received benefits under khus grass, mango sapling distribution, groundnut seeds and pesticide kits, live check dams and loose boulder structure and stylo grass seeds. The average size of holding of beneficiaries is 3.45 hectares as against 3.07 hectares of the non-beneficiaries. Hardly 4 per cent of the area of the beneficiaries is irrigated and hence the crop pattern is dominated by rainfed-low density crops. Large number of crops are grown by both the beneficiaries and non-beneficiaries. Major crops among these include groundnut, korra, redgram, jowar, cotton and other horticultural crops. The per hectare cost of cultivation of the non-beneficiaries is higher in the case of groundnut, korra and cotton. But in the case of jowar and a few other crops the beneficiaries have higher cost of cultivation per hectare. The adoption of new technology by the beneficiaries is quite commendable as compared to the non-beneficiaries. Yield differential are perceptible for korra, jowar and cotton but it is not so in the case of major crops like groundnut.

The environmental impact, adequacy, relevance, sustainability and suitability of the programme from the beneficiary point of view have not been investigated into. Similarly, the research report does not include any findings on people's perception of the programme. Among the constraints highlighted by the research team the most important are the provision of vehicles to the implementing agency, timely availability of funds, lack of training and planning of the project at grass root level. Khus grass was found unsuitable but being strongly propagated by the authorities. The time duration required for the review of the programme is at least 6 years and therefore as the gestation period was not completed the

benefits have not been fully realised. Apart from this the required monitoring by an independent agency mentioned in the guidelines of NWDPRAs has not been undertaken.

4.3 Impact of NWDPRAs in Tamil Nadu

Tamil Nadu is one of the agriculturally well developed States. The State has recorded high long-run growth rates compared with all India average rates of growth during the last five decades. It has about 48 per cent of its area under irrigation and it is one of the major producers of paddy in the country. During the 8th plan period the allocation on NWDPRAs for the State was Rs.4147.45 lakhs of which, an amount of Rs.2317.31 lakhs has been already utilised during the years 1991-92 to 1994-95 bringing the per cent achievement to 56 per cent. The physical achievements however, do not commensurate with the financial achievement. The total programme of the State includes treatment of 84 blocks spread over 15 districts.

The research team of agro-economic research centre of Madras University carried out the work of impact assessment. The watersheds falling in two distinct agro-climatic zones were selected. One watershed from Salem district and other from Coimbatore district were taken for the purpose of survey. Elachipalyam watershed in Salem district has an area of about 1000 hectares of which, 949 hectares come as arable land. The proportion of irrigation in the watershed area is 11 per cent as against about 30 per cent irrigated area in the district. The total expenditure incurred was Rs. 36.016 lakhs up to 1994-95 and the remaining balance of Rs. 13.40 lakhs is expected to be spent in the next two years. Like any other State the proportion of expenditure on preliminary activities is the lowest when compared with other activities.

Another watershed chosen for the study is from Coimbatore district namely Perumanallur watershed. Coimbatore is a drought prone district but has about 37.3 per cent of area under irrigation. The total allocated amount for Perumanallur watershed is Rs.49.22 lakhs of which, only Rs.21.82 lakh was spent up to 1994-95 and the remaining 56 per cent of expenditure is being planned for during the remaining three years (by the end of 1997). The basic activities and non-arable land activities have larger share of allocation and expenditure incurred.

In Perumanallur watershed area the average size of holding was 1.07 hectares of both beneficiaries and non-beneficiaries. The water table is going down at a very high rate and the average depth of wells is 350 to 500 feet. Thus enhancing the water table is one of the important concerns of the programme. Cropping pattern of beneficiaries as well as non-beneficiaries includes the same crops and crop combinations but the relative importance of crops have changed between the two groups. Groundnut, cholam; groundnut + greengram; cholam + cowpea are the crop combinations grown. Beneficiaries allocated larger share of area to crop combinations non-beneficiaries gave higher preference for sole crop like cholam. The net income per hectare for groundnut was Rs.5309 for the beneficiaries as against Rs.2337 for the non-beneficiaries. The net income of beneficiaries out of the other crops was also higher by the increment of 20 to 60 per cent of that of the non-beneficiaries. Farmers have received subsidies under the programme for vetiver grass, dairy, sheep and goat rearing, vermiculture and seedlings. Out of the 50 beneficiaries, 22 have claimed to have participated in the process of planning for watershed. Similarly 35 farmers (out of the 50 selected) had attended the training programme for cultural practices, bunding activity, soil and water conservation methods.

The other watershed, namely, Elachipalayam watershed comes under Salem district and is about the same size as that of Perumanallur watershed. The size of holding of the beneficiary is 1.14 hectares and for the non-beneficiaries it was 1.08 hectares. The beneficiaries had about 28 per cent area under irrigation whereas, the non-beneficiaries have about 33 per cent irrigated area. The cropping pattern of beneficiaries as well as non-beneficiaries is almost same except some variation in the relative importance of the crops. The non-beneficiary groups having higher proportion of area under irrigation, naturally favoured higher water requiring crops.

It can be seen from the Table 4.3 that the net income of beneficiaries is higher even in the presence of higher irrigation facilities for the non-beneficiaries.

Table 4. 3: Net Income of Beneficiaries and Non-beneficiaries

Crop/Crop mix	(Rs/ha)			
	Perumanallur Watershed		Elachipalayam Watershed	
	B	NB	B	NB
Groundnut	5309	2337	5562	2258
Redgram	877	528	384	106
Cholam	5278	2808	1482	1176
Paddy	-	-	8831	9986
Cotton	-	-	20,068	22,506
Groundnut mixed crop	3786	3116	-	-
Cholam mixed crop	5319	1292	-	-
Greengram	225	129	-	-

Notes: B - Beneficiary; NB - Non-beneficiary.

Source: Arputharaj, (1996).

The report does not explicitly mention any constraints of the project prevailing in Tamil Nadu. It has also not incorporated important factors of impact analysis namely the environmental impact, people's participation, relevance, adequacy and sustainability of the technology. The study team also chose not to analyse the implementation bottlenecks of the programme. But what comes out clearly as a shortcoming is the limited attention given to preliminary activities and to the overall planning of activities at State level.

4. 4 Conclusions

The treatments under NWDPR in the Southern States will have three broad features. Firstly, it is essential to provide yield stability in the vast patches of the Southern Plateau by properly managing the received precipitation. Thus moisture conservation becomes the first priority in the drought-prone areas of south. Secondly, the degraded patches on the South Plateau are spread over the hill slopes as well as on the plains. Soil conservation, gully checks and non-arable land treatments receive second most priority treatments in these regions and lastly, the coastal areas of south have large degraded patches and drainage problems. Therefore, drainage corrections and treatment of coastal eroded lands in the coastal areas have these as top priorities.

The two studies reviewed here of Andhra Pradesh and Tamil Nadu point towards the localised requirements in the treatment of watershed. It also showed clearly that a holistic plan is essential for the purpose of effective implementation of the programme. Though, Tamil Nadu study points to the most required people's participation the impact on net income of the beneficiaries is not perceptible enough to encourage them to participate enthusiastically. Both the States showed noticeably low expenditure on the basic activities which involve survey, projectisation, training, research and innovative support etc. These activities were either not pursued as planned or have been over-estimated while preparing the budget. In other words, the overall projectisation at State level needs to be reviewed especially in these two States.

CHAPTER 5

NWDPR: NORTHERN GANGETIC PLAINS

5.1 Introduction

The vast area of Northern India consists of the most fertile Gangetic plains. This Zone covers parts of Uttar Pradesh, Punjab and Haryana. Agro-climatically this area comes under two agro-climatic Zones, namely, Upper Gangetic Plains and Trans-Gangetic Plains. Problems of drainage, usher lands, flood control and proper water management are the major concerns of the region. Therefore, the watershed management strategy in this region should deal with drainage line treatments, water run-off management, gully/ravine checks and afforestation. These components will be among the leading components of the strategy whereas, the holistic approach needs to be concentrated upon. Similarly, problems related to over irrigation and impact of deforestation in the region also need to receive due attention in the watershed planning.

The allocation under NWDPR, to the States of Haryana, Punjab and Uttar Pradesh during the 8th Plan period was about Rs.10,225 lakhs apart from the funds released by the Government of India (GOI) during the first two years of implementation (1990-92). Table 5.1 shows the allocation of NWDPR for the three States.

Table 5.1: Allocation for NWDPR during Eighth Plan

State	(Rs. in lakhs)		
	Funds Released by GOI (1990-92)	Eighth Plan Allocation (1992-97)	Total for the period (1990-97)
Haryana	324	1560	1884
Punjab	138	615	753
Uttar Pradesh	1701	8050	9751
Total	2163	10225	12388

Source: Shah and Patel (1996).

As mentioned earlier the allocations seem to have been arrived at by taking unit cost of treatment of arable and non-arable land. Due efforts to understand the logic of this allocation were constrained by two factors, namely, the availability of the data and the method of arrival of the unit cost.

The impact analysis of NWDPR was taken up in two States, namely, Haryana and Uttar Pradesh by the AERC, Delhi and AERC, Allahabad respectively. The analysis of the impact of NWDPR was attempted in selected two districts falling in two different agro-climatic regions of the State. The study of NWDPR of Haryana as well as Uttar Pradesh selected such watersheds falling under two different agro-climatic zones, but while reporting their results the research team of Uttar Pradesh chose to combine the two watersheds

together thereby defeating the basic purpose of the choice of two distinct agro-climatic watersheds. Haryana report contains the analysis separately for the two watersheds. The concept of beneficiary in Haryana report refers to those who received at least one of the benefits from among the schemes under NWDPR, namely, fruit plant saplings, crop demonstration, compost pit, field visits etc. The remaining cultivators are taken as non-beneficiaries.

5.2 NWDPR: Impact of the Programme in Haryana

During the eighth plan period, NWDPR was started in Haryana in five blocks of which, 3 were in Ambala district and 2 falling in Bhiwani district. One watershed spread over a cluster of villages in each of the blocks was selected for the purpose of analysis. No work was reported on the project during the first year of the implementation. The progress report of NWDPR in Haryana up to March 1994 showed that only 37 per cent of the allocated funds were spent. The bulk of this expenditure was on soil and water conservation. In Haryana also only 17 per cent of the allocation on basic activity could be spent and as the basic activities are concentrated during the first phase of the project, the remaining expenditure may not be incurred. The research team reported that the pace of development has been unsatisfactory due to the unrealistic targets.

The implementation process of NWDPR in Haryana goes through five important institutions. Firstly, there is a policy body at State level, namely, Watershed Development Policy Committee which supports the policy framework and involves Ministers and Secretaries of concerned departments. The Watershed Development Implementation Committee, Chaired by the Secretary, Department of Agriculture provides overall directions for the implementation of the project in the State. Third layer consists of the district level Watershed Development Coordination Committee responsible for Coordination of the work on NWDPR at district level. The Committee is headed by the Deputy Commissioner. This is supported by a Watershed Development Team headed by Divisional Soil Conservation Officer and involves a multi-disciplinary team drawn from various departments like forestry, agriculture, animal husbandry, etc. This is followed by the project level implementation group. It is not clear from the report as to how many times these teams/groups met and discussed the problems or their influence on suitably tailoring the programme for the needs of the State.

As mentioned earlier, the research team investigating into the impact of NWDPR selected two watersheds falling in two different agro-climatic zones. Saral watershed comes under the semi-arid tracts of Haryana and has severe environmental problems such as scanty and variable rainfall, receding water table, top soil loss, deteriorating soil fertility etc. The watershed development plan for this watershed was required more to focus on the soil and water conservation. At watershed level, the achievements expressed in terms of the percentage of total expenditure to the sanctioned outlay on different activities, ranged between 26 to 36 per cent. No work on livestock development was initiated till March 1995. The average size of holding among the participants (as the report uses participant as the concept in the place of beneficiaries) was 3.99 hectares as against 2.62 hectares of non-participants. Proportion of cultivated area irrigated by the participants was 41 per cent as against 43 per cent of the non-participants. A large part of this is irrigated by own tube wells and some portion comes under canal irrigation. More than half of the participants and non-participants have their own source of irrigation. The cropping intensity of the participant

farmers comes to 147 per cent as against 166 per cent of the non-participants. The cropping pattern of both the groups is more or less the same. Bajra and gram are the dominant crops of the participants as against bajra and guar of the other group. Yield per hectare of the participants and non-participants is given in Table 5.2 below.

Table 5.2: Yield per Hectare of Participants and Non-participants in Haryana NWDPR (Kgs/ ha)

Crops	Saral Watershed		Jattan Majri Watershed	
	Participants	Non-Participants	Participants	Non-Participants
Wheat (Irrigated)	3129	2690	1565	1777
Mustard (Irrigated)	1237	1245	-	-
Mustard (Unirrigated)	405	494	-	-
Gram (Unirrigated)	570	533	517	395
Maize	-	-	1093	1223

Source: Sharma, R. K. (1996).

The yield per hectare of participants are not necessarily higher than that of the non-participants except in a few cases but this may be more because the non-participants' fields are also located in the same area as those of the participants and receive indirect benefits of watershed treatment.

Dryland horticultural activity is taken up as an important activity in the Saral Watershed. A plan of planting of 38 thousand fruit trees was included as a target but only about 19 thousand saplings could be distributed during the first five years. The saplings distributed include beri, guava, lemon, grapes, shahtoot, anar and amala. Most of these are sturdy plants and except grapes and lemon the other plants do not need extensive attention. Only about 36 per cent of the participants reported to have planted saplings. The survival rate is reported as 76 per cent. Agro-forestry is another important activity taken up in the Saral Watershed. A new plant, namely, Jojoba was introduced which is an inhabitant of the desert areas of Mexico. Its seed contains high value oil (45-55 per cent) which can be used as machine oil. Among the other plants distributed under the programme include shisham, jandi, kikar, safeda and neem. Average survival rate was 91 per cent. The fodder cultivation and demonstration and diffusion of dryland technology were also the major components.

Jattan Majri Watershed is located in Pinjore block of Ambala district. It is located in the lower Shivalik hill tracts. The watershed has a sub-humid climate with an average annual rainfall of 1120 mm. The variability of the rainfall is also high. Due to the topography much of the rain water from the catchment area goes out as run-off. The groundwater availability is fairly good and water table ranges between 10 mtrs bgl to 25 mtrs bgl across seasons and area. Total arable land of 860 hectares is irrigated by *Kuhls*. The average size of holding of the participants and non-participants is exactly the same. The cropping pattern of the participants differs slightly. The major difference arises in terms of two crops, namely, paddy and maize. The participants have about 24 per cent of area under

paddy of which, 18.9 per cent receives irrigation whereas, the non-participants do not grow paddy and instead of paddy, they preferred irrigated maize.

The total project expenditure during the first two years was Rs.20.14 lakh of this Rs.13.55 lakh were spent on soil and water conservation measures, Rs.4.31 lakh on basic activity and Rs. 2.15 lakh on production system. The conservation measures on arable land include 128 gully controls and 267 hectares of contour and vegetative hedges. The non-arable land treatment included 678 check dams, 44 dug out sunken ponds and Rs.1.10 lakh spent on drainage lines and gully control. A Barani Chetana Kendra was set up for the purpose of meetings and training net work was started.

The overall impact of NWDPRAs as reflected from the study seems to be satisfactory. But leaving the soil and water conservation measures, and infrastructure development, the progress on other components has not been very satisfactory. The general impression gathered by the research team is that the non-arable land treatments are not satisfactory. The plan for dry land horticulture has been implemented without keeping in mind the input and output market constraints. The crop demonstrations are so large in number that these do not facilitate proper supervision. It was strongly opined by the research team that the task of formulation of the project did not receive significant attention. Although soil and topography survey was taken up in the area, no socio-economic survey was taken up. This kept the beneficiaries out of the process of planning.

5.3 NWDPRAs: Impact of the Programme in Uttar Pradesh

The programme under NWDPRAs for Uttar Pradesh envisaged a coverage of more than two lakh hectares with an expenditure of more than 70 crores. The programme was drawn for 186 watersheds in 34 districts of the State. Out of the 18 activity groups undertaken for the project only 4 activity groups like composite nurseries, agro-forestry, bank stabilization and contact farmer training showed good progress. The financial performance of NWDPRAs in Uttar Pradesh does not seem to be quite encouraging. Among the macro-policy level constraints the proportions of unspent (unutilised) funds during the first four years of implementation comes under bold relief. We have shown the proportion of unutilised funds in Table 5.3.

Table 5.3: Proportion of Unutilised Funds in Total Allotment of NWDPRAs in Uttar Pradesh

Year	Proportion of Unutilised Funds (as per cent to funds actually made available)
1990-91	44.70
1991-92	76.14
1992-93	54.09
1993-94	53.53

Source: Shyam, Radhey (1995).

The tardy utilization of funds was more on account of failure of the process of planning. There seem to be some gap in the horizontal coordination of the programme. The constraints come out more clearly in the micro-level exercise.

The research team of AERC, Allahabad chose two watersheds, namely, Baghai Nala in Jhansi district and Panja Row in Saharanpur district for the purpose of study. The Baghai Nala watershed is spread over 3080 hectares of which, 3383.20 hectares is arable land and the remaining is non-arable land. There were only 1901 cultivating households in this watershed. The area under irrigation in the watershed area was only 12.3 per cent. The review of physical progress of the project indicates that except a few items like nursery, training, plant distribution, bank stabilisation, loose boulder structures and contour bunds could not be completed as per stipulated plans. This was traced to the ambiguity and impracticability of the policy measures and also due to people's apathy. In addition to this the sustenance of the structures was hampered by the negligence on the part of beneficiaries and the stray cattles grazed and damaged the structures. Against the total cost of the project of Rs.73.29 lakhs, only Rs.13.02 lakhs could be spent in the first four years which is only about 17.3 per cent of the envisaged expenditure that shows the tardy progress of the works.

The case of Panja Row watershed situated in Saharanpur district is better but not different than the Baghai Nala Watershed. This watershed is spread over 2120 hectares of which 1538 hectares fall under arable lands. Even though the irrigated area in the watershed is 10.8 per cent, the cropping intensity is 163 per cent. The cultivating households in the watershed are only 1437. A review of the progress of the physical works on the project revealed 82 per cent coverage during the first four years in terms of area. Among the components of the watershed treatment nursery, agro-forestry, dry-land horticulture, vegetative filter strips, bank stabilisation, loose boulder structures, small dug out ponds, vegetative check dams and run-off management showed good progress. It is quite interesting that in order to obtain such satisfactory progress the expenditure incurred was only 37.67 per cent of the sanctioned amount. This again points out to the gaps in the process of planning.

The research team preferred to combine the micro level analysis of the two watersheds. Hence separate results of the two watersheds could not be located. The size of holding of the beneficiaries was 1.59 hectares as against 1.40 hectares of the non-beneficiaries. Majority of the beneficiaries and non-beneficiaries had only 'average' quality of soil. The beneficiaries had 23 per cent more area under irrigation when compared with the non-beneficiaries. Even with this higher level of irrigation the beneficiaries could not achieve higher intensity of cultivation. This is because of the differences in their cropping pattern. The beneficiaries as well as non-beneficiaries have a cereal dominant cropping pattern but there are differences in composition of the crops. Beneficiaries devoted larger share to paddy, gram and peas while the non-beneficiaries preferred jowar, maize, wheat, gram and groundnut. The adoption level of new technology is higher in the case of beneficiaries as compared to their peer group. The participation in the project has made the vital difference but this adoption was more confined to the use of improved seeds and fertilizers. The impact on crop yield has been perceptible in the case of beneficiaries. The per hectare yield of paddy, wheat and maize in the case of beneficiaries was 15, 14 and 11 quintals as against 10, 11 and 7 quintals of yield of non-beneficiaries respectively for the same crops. The net return of the beneficiaries for all crops together was Rs.3262 per hectare as against Rs.2082 hectares of the non-beneficiaries. The research team did not address to the issues relating to environmental impact or the adequacy, relevance and sustainability of the programme.

The overall implementation of the schemes lacks proper execution as the components are quite specific in nature. Allocation of funds has not been keeping in pace with the requirements. Emphasis on conserving water through vegetative bunds without proper

earthwork did not serve the purpose. The scheme is implemented by the soil conservation department and the inter-departmental horizontal co-operation is lacking. Kits and tools were distributed among the beneficiaries. But this was an overlapping activity duplicating with similar other programmes. Due to lack of inter-departmental co-operation the success of the programme was limited. Above all the research team recorded strongly about lack of participation of beneficiaries.

5.4 Conclusions

Watershed development activities in the Northern Gangetic Plains should focus more on drainage treatments in the moderate assured rainfall areas and to water conservation in the low rainfall regions. The programme under NWDPR in the northern States does not have the coverage comparable to the Southern plateau. Flood control measures, gully ravine control, arresting run-off and water harvesting should have been the priority areas. It was felt by both the research teams that the projects were not properly formulated, a priori planned and thus there exists a gap between targets and achievements. Some times even when the physical targets are reached the financial allocation are not even half spent and vice-versa. This clearly showed lack of proper projectisation and a base line survey. This is amply commented by both the study teams. The implementing authorities could not bring together various line departments in a perfect horizontal integration. Similarly, the participation of the beneficiaries in the programme is far from satisfactory. The much acclaimed '*Mitra Kisan*' and '*Gopal*' did not yield the desired results. The programme did not yield similar results in the Northern region as in the Central Plains and Semi-Arid Zones.

CHAPTER 6

NWDPRA: HILLS REGION AND ASSURED RAINFALL ZONE

6.1 Introduction

The soil and water management problems of hilly regions are diagonally different than those in the river basins and plains. There are five specific characteristics to be kept in mind while planning for the treatment of watersheds in hill regions. Firstly, these regions receive moderate to heavy rainfall, gushing floods and therefore drainage line treatment with cement-boulder based nalla bunds and waterways assume importance. Secondly, the slopes are generally steep and the land is undulating with naturally formed drainage systems. Strong water currents cause gullies and ravines and consequent degradation of the top soil. Such gullies and ravines need strong (cement-mortar based) gully/ravine checks. Thirdly, the ridge portion of most of the watersheds in hilly regions with high slopes have highly degraded soils and the soil depth is also not enough to sustain good vegetative cover. Therefore, the ridge portion needs the silvi-pastoral treatment but as the hill regions are also habituated by tribals dependent on forest products it is necessary to carefully plan such treatments. Fourthly, a large proportion of the hilly tracts of the country has terraced lands and small size of holding with moderate to heavy rainfall. Under the steep slope conditions a persistent heavy rainfall not only causes severe damage to the crops in that particular season but also severely despoils the field conditions due to hill slides or avalanches. In such cases the waterways need to serve two purposes, namely, to allow the flow of gush floods during heavy rainfall season and to allow the water conservation according to the requirement of the crop. Lastly, the vegetative treatments in hilly regions should merge with the existing bio-diversity and local varieties of trees shrubs and grasses. This will not only sustain the diversity but may sustain the economic dependence of the tribals of the forest products.

6.2 Impact of NWDPRA in Himachal Pradesh

Himachal Pradesh is not a homogenous agro-climatic region. It has four distinct zones namely, sub-tropical zone, sub-temperate zone, temperate zone and cold-dry zone. Thus each of these zones in the context of watershed treatment need different and specific treatments under watershed approach. The cropping pattern includes seasonal as well as horticultural crops. Forestry and logging is also among the important economic activities and the dependence on forest products is receding slowly. Over the years there has been an increase in the tree felling and deforestation in the region largely for wood required in packaging industry. This has caused the top soil erosion and thus a vast amount of waste lands. Land use and water resources of this area have specific problems. Disturbed pastures and meadows, eroded soils and associated land slides, silted reservoirs, low productivity and thus low income characterises the region. The agro-climatic regional planning exercise in the region pointed out to the problems related to eroded slopes, deforested areas, water harvesting structures and argued for an essential boost up in agricultural productivity. Land and water management thus becomes the most important planning strategy for the region.

The impact study of NWDPR in Himachal Pradesh was carried out on the basis of the data obtained from two distinct watersheds falling in two agro-climatic zones namely, sub-tropical zone and sub-temperate zone. The achievements both in physical and financial terms have not been very impressive due to the short duration between the time of implementation and the time of evaluation. The research team selected Talara watershed falling in Kangra district in the sub-tropical zone. The total geographical area of the watershed is about 598 hectares which has undulating slopes ranging from 2 to 15 per cent. The arable and non-arable land is almost equal with average size of holding of 1.09 hectares. The strategy for development of watershed here involved: (i) sustainable farming system; (ii) village or community owned system for water storages and irrigation facilities; (iii) people's participation, and (iv) moisture conservation.

Another watershed was selected from the district of Solan falling in the sub-temperate zone. Sher-Chirag watershed covers an area of about 583 hectares of which almost half of the area is non-arable with undulating hilly terrain situated between 1000-1800 meters above sea level. Interestingly, in Himachal Pradesh there are certain targets to be achieved under benefit-cost ratio and cropping intensity apart from those under conservation measures, pasture-fodder development and other watershed treatments. The beneficiaries were selected from among the cultivators falling in the watershed and the non-beneficiaries from outside the watershed.

Land use pattern of beneficiary and non-beneficiaries is more or less the same but the non-beneficiaries have increased cropping intensity to compensate the smaller size of land. "The cropping intensity of beneficiaries in the sub-tropical zone was 182 per cent as against 189 per cent of the non-beneficiaries. The difference is substantial in the sub-temperate zone where non-beneficiaries have obtained cropping intensity to the level of 191 per cent as against 164 per cent of that of beneficiaries. Maize and paddy are the two important crops of the sub-tropical zone but the sub-temperate zone has vegetables dominating the cropping pattern. Maize, paddy and wheat are also taken as minor crops but the crop pattern is not cereal dominant.

Table 6.1: Crop-wise Net Returns of Beneficiaries and Non-beneficiaries in Himachal Pradesh

Crops	(Rs/ha)			
	Sub-Tropical Zone		Sub-Temperate Zone	
	Beneficiaries	Non-Beneficiaries	Beneficiaries	Non-Beneficiaries
Tomato	-	-	42363	14833
Capsicum	-	-	4079	1411
French Beans	-	-	3189	2133
Peas	-	-	2886	2831
Barley	423	182	161	276
Maize	465	158	433	411
Wheat	691	506	518	391
Paddy	707	468	-	-
Mango	3767	3595	-	-
Plum	-	-	6716	7489

Source: Vaidya *et al.*, (1995).

As can be seen from the productivity (net) per hectare in terms of net returns reported in Table 6.1 above, the beneficiaries have higher net returns per hectare than the non-beneficiaries. The differences are more pronounced in the sub-temperate region than those in the sub-tropical region. While analysing the causes of productivity differentials the research team of AERC, Shimla, noted the differences in land quality, type of soil, slope of land and improved farming practices as the major contributing factors. However, there was no uniform pattern observed in availing the benefits of watershed management technology across size classes of land holding in the sub-tropical and sub-temperate zones. Non-availability of seed material was reported by about 40 per cent of beneficiaries in sub-tropical zone and by about 50 per cent of beneficiaries in the sub-temperate zone. Similar level of constraints were noted in the availability of fertilizers, herbicides and pesticides.

As regards the relevance, adequacy and sustainability of the technology is concerned, most of the beneficiaries felt that the technology was relevant but not adequate enough. They have also recorded differential opinion about the sustainability across the components of the technology. Nalla training and water conservation structures were classified as less sustainable as compared to the other components of watershed technology. Analysis of people's participation showed totally different results in the sub-temperate region and sub-tropical region. The involvement of beneficiaries in the meetings as well as the influence of '*Mitra Kisan*' was quite limited in the sub-temperate region, but not so in sub-tropical zone. Only 10 to 14 per cent of the farmers in the two zones were involved in the meetings at planning stage but the training programmes were well attended by the beneficiaries of the sub-tropical region. In this zone about 84 per cent of the farmers were aware of '*Mitra Kisan*' but in sub-temperate zone only 24 per cent were aware of '*Mitra-Kisan*'. Thus participation seem to be quite limited in Himachal Pradesh.

Among the major constraints faced by the farmers in Himachal Pradesh regarding NWDPR participation at planning stage is the most important factor. The beneficiaries expressed inadequacy of the bunds constructed and therefore there is a severe problem which causes water over-run and soil run-off. Another constraint faced by the farmers was the input delivery system which caused slow adoption of technology. All the farmers of the sub-tropical region and 82 per cent farmers of the sub-temperate region have to depend on private traders and that too after covering the undulating terrain of more than 13 kms. The supply bottlenecks were felt in the supply of fertilizers. This was also coupled and compounded by the non-availability of extension services. Credit shortage and thus lack of investment in the farming activities was felt as one of the constraining parameters.

6.3 Impact of NWDPR in West Bengal

West Bengal is one of the moderate to assured rainfall regions of the country. It is characterised by hill regions of the North and plains of the South. Agro-Economic Research Centre at Shantiniketan investigated into the impact of NWDPR and selected the districts of Birbhum and Darjeeling for the purpose of this study. As the regions selected were from the hilly tracts of the State, we have incorporated the impact study of NWDPR in West Bengal in this chapter dealing with hill regions. The State has different agro-climatic regions, namely, (i) Barind Plains; (ii) Central Alluvial Plains; (iii) Alluvial Coastal Saline Plains; and (iv) Rarh Plains. The region has enough water resources coexisting with the persistent problems of floods during rainy season and non-

availability of water during other seasons. Substantial investment in channel system, use of lift irrigation, water storages in terms of small tanks and wells along with conjunctive use of water, are among the recommended strategies under agro-climatic regional planning. The achievements in terms of expenditure incurred during first five years of the programme are given below in Table 6.2. It is very clear that over the years the total uptake of funds has not been more than 40 per cent in any one of the years. This points to the possibility of either weak planning or tardy implementation or both. The picture across districts in West Bengal is more or less the reflection of the State level achievements. Jalpaiguri, Dakshin and Uttar Dinapur, Hoogly, North 24 parganas and Birbhum are the districts where more than 40 per cent of the allocated expenditure is incurred. In all the other districts this is lower than 40 per cent. It is notable that in the districts of Malda and Murshidabad the per cent of expenditure to allocation is only about one per cent. The research team concluded that "the magnitude of expenditure on assigned purposes under this scheme in this State had certainly been neglected and which have certainly been one of the most important constraints for hindering economic uplift of the watersheds" (Sen, Sinha and Sarkar, 1995, p.30).

Table 6.2: Yearwise Funds Released and Expenditure Incurred in West Bengal under NWDPR

Year	Amount Released (Rs.in lakhs)	Expenditure Incurred (Rs.in lakhs)	Expenditure as per cent to the Total Amount Released
1990-91	68.49	18.41	26.88
1991-92	23.24	0.82	3.53
1992-93	163.30	51.37	31.46
1993-94	256.96	59.06	22.98
1994-95	348.94	NA	NA
Total of Five Years	860.93	137.75	15.99

Source: Sen, Sinha and Sarkar, (1995).

In West Bengal there are six organisational layers at State, district, block and watershed levels. At State level there is a State Watershed Development Committee. This Committee is expected to monitor and oversee the implementation of the programme in the State as a whole. The District Coordination Committee and Watershed Development Teams work at the lower level. No mention was made about the functioning of such Committees. The research team selected two districts namely, Birbhum and Darjeeling for the purpose of field work. In Birbhum district, they selected Rajnagar block. Naxalbari block was selected from Darjeeling district. The average size of holding in Rajnagar block watershed was 1.62 acres, whereas, the same in Naxalbari was 1.74 acres. It was noted that the beneficiaries had some area even outside the watershed. The size of holding of non-beneficiaries in Rajnagar and Naxalbari blocks was slightly higher than the beneficiaries. The proportion of irrigated area of beneficiaries in Rajnagar was 25.4 per cent and the same for non-beneficiaries was 27.5 per cent. Similarly, in Naxalbari the beneficiaries have a slight edge over the non-beneficiaries in terms of proportion of irrigated area.

As regards the cropping pattern, both the blocks have kharif paddy as a dominant crop. Apart from this, vegetables and jute are cash crops of Naxalbari whereas, potato, wheat, mustard and vegetables are the cash crops of Rajnagar. Beneficiaries in Rajnagar block were found to be quick enough to adopt the new paddy HYV varieties. But in Naxalbari only 21 per cent of the beneficiaries have accepted HYV paddy as against 35 per cent in the case of non-beneficiaries.

Table 6.3: Productivity per Acre of Beneficiaries and Non-Beneficiaries in West Bengal NWDPR

Crops	(Quintals/acre)			
	Rajnagar		Naxalbari	
	Beneficiaries	Non-Beneficiaries	Beneficiaries	Non-Beneficiaries
Paddy (Local)	2.69	2.69	2.60	2.70
Paddy (HYV)	2.75	2.82	2.65	2.80
Potato	119.10	119.93	48.19	47.37
Wheat	10.00	11.91	12.19	12.12
Mustard	4.03	4.50	4.55	4.50
Jute	-	-	4.63	4.85

Source: Sen, Sinha and Sarkar (1995).

The productivity differences are almost negligible between the beneficiaries and the non-beneficiaries (Table 6.3). In fact, in many cases the non-beneficiaries have slightly higher yield per acre than that of the beneficiaries. The research team of AERC, Shantiniketan remarked that "The link between the authorities on the one hand and the beneficiaries on the other is not unfortunately being maintained at all" (p.51). This seems to be the main reason behind laxity in adoption of technology and therefore of lower productivity of the beneficiaries. The adoption level of the new technology of beneficiaries is slightly higher than that of the non-beneficiaries in Rajnagar block but in Naxalbari the non-beneficiaries have an edge over the beneficiaries. Among the factors responsible for low productivity the research team noted, unsuitable land situation, lack of information about technology, financial limitation, lack of timely irrigation, high cost of inputs and untimely supply of them, as the major constraints causing low productivity.

As regards the impact of NWDPR, it was noted that in the State of West Bengal the impact of the programme was not significant enough and brought out many shortcomings. The distribution of benefits among the selected beneficiaries was restricted to only four items, namely, horticultural seedlings, goat, poultry birds, and afforestation. Most of the goats supplied under this project died even before generating income. Lack of proper training was noted as the cause for such disaster. This programme suffered mainly due to lack of active participation by the intended beneficiaries. The most significant point noted by the research team is that both the beneficiary and the non-beneficiary households neither saw the impact of this programme nor remembered the conditions before the start of the project due to insignificant development work under this scheme. The machinery devised to implement this programme was not adequately involved particularly in utilisation of the released funds.

There was an overall lack of integration between agencies involved in the process of implementation. Even after five years of the implementation the results were not discernible due to lack of people's participation.

6.4 Impact of NWDPR in Assam

The State of Assam is known for its hilly region, forest cover, high proportion of tribal population, inaccessible villages, poor quality of communication net work, undependable weather and above all underdeveloped agricultural sector. Any developmental programme planned for Assam must keep in view of these bold features of the economy and watershed management is no exception. The agricultural sector here involves a large dependence on the forest and livestock economy. The slopes are steep and the strong gushing streams cause considerable environmental damage during rainy season. NWDPR was launched since 1990-91 in the State with a target of covering 60,200 hectares under the eighth plan. The envisaged investment in terms of project cost was estimated as Rs.28.43 crores. Altogether 110 watersheds were taken up for development in the State spread over 23 districts of the State. These districts come under six broad agro-climatic zones of the State, namely, (i) North Bank Plain Zone; (ii) Upper Brahmaputra Valley Zone; (iii) Central Brahmaputra Valley Zone; (iv) Lower Brahmaputra Valley Zone; (v) Barak Valley Zone; and (vi) Hills Zone. In order to implement the programme, the State Government constituted committees at three levels. The State level committee consists of Secretaries and Directors of the line departments involved in the process of implementation. This was formulated to oversee the effective implementation of the programme in the State. The Director of Agriculture acts as a Member Secretary and the Agricultural Production Commissioner is an ex-officio Chairman of this Committee. Another district level Committee under the Chairmanship of Deputy Commissioner of the district was constituted for looking after the administrative problems. Besides these, for each project, a project level inter-disciplinary committee of the involved line department officers was established to effectively bring in the inter-disciplinary nature of the process of implementation.

The research team, investigating into the impact of NWDPR, selected two watershed projects falling in two distinct agro-climatic regions. Kakodonga watershed project from Titabar block was selected from the upper Brahmaputra valley whereas, Lakhinizar watershed falling in Mayang block of Central Brahmaputra valley was selected for the purpose of indepth inquiry.

There are six perennial streams in the Kakodonga watershed project and those streams originate in Naga hills in Nagaland. The indiscriminate felling of trees for shifting cultivation, Oil and Natural Gas Commission's (ONGC) oil exploration activities and the other urban residential encroachments obtained through heavy earth cutting, bulldozer use etc., have all left the upper reaches in severely denuded condition. The entire hill comes under heavy rainfall zone. More than 40 per cent land of the watershed has a slope of more than 2 per cent and another 40 per cent of land has 2 to 3 per cent slope, the rest are plains. Paddy, oilseeds, pulses, potato, wheat and some horticultural crops are mainly grown in the watershed area. Cropping intensity in the watershed region is 124 per cent. The total cost of the project as sanctioned by the Government is Rs.1.01 crores. But the released amount (Rs. 11 lakhs) itself is only about 10 per cent

of the total allocation. The expenditure incurred is about Rs.10 lakhs which comes to about 90 per cent of the released amount.

Lakhinizara watershed is situated in Central Brahmaputra Valley. It does not have major stream and is characterised by hot and wet summer followed by dry and cool winter. The average annual rainfall is about 2259 mm. More than 35 per cent of the land of the watershed has about 8 per cent slope and about 12 per cent of the land has the slopes between 1 to 3 per cent. Almost 52 per cent of the land has slope less than 1 per cent. The cropping pattern of the watershed region is paddy dominant and jute, sesamum accompany as secondary crops. The work on Lakhinizara watershed was initiated in 1990-91 and the expenditure incurred during first four years of implementation was about 60 per cent of the amount released. The total sanctioned amount for the project is Rs.27.70 lakhs of which about Rs.5 lakhs has been released and only about Rs.3 lakhs is spent on the works during the first 4 years of implementation during the eighth plan period. This clearly shows lack of planning in the programme.

The field survey was conducted in these two watershed regions and the concept of 'beneficiary' used by the research team incorporates those cultivators who were benefitted from any one of the schemes sponsored by NWDPR (eg., compost pit, HYV seeds, fertilizers, horticultural seedlings, livestock etc). Thus the non-beneficiaries were those who did not receive any such benefits and this does not preclude them from having land inside the watershed area. Some may be belonging to the adjacent village. Thus the incremental impact parameters cannot be strictly applied to the works under NWDPR.

The average size of holding of Kakodonga watershed is 2.22 hectares whereas, the same in Lakhinizara watershed is 1.51 hectares only. The lands of beneficiaries in Kakodonga watershed did not have any irrigation facilities whereas, Lakhinizara watershed beneficiaries had 7.31 per cent of their land under irrigation. The cropping intensity of the group of beneficiaries of the Kakodonga watershed project is worked out as 124 per cent whereas, in Lakhinizara watershed it was only 110 per cent. It seems that irrigation availability in Lakhinizara has not brought about any marked change in the cropping intensity.

The productivity per hectare across crops between beneficiaries and non-beneficiaries cannot be taken for the analysis of the impact of watershed since the non-beneficiaries (except a few of them) have their lands under watershed but have been called as non-beneficiaries as they have not received the direct benefits under the schemes such as compost pit, HYV seeds/ fertiliser distribution, seedlings of horticultural crops, livestock, special forestry programmes etc. But it can be seen from the Table 6.4 that those who have participated in the implementation of the programme have in general could obtain higher yields than those who were on the fringe of implementation. The differences in cost of cultivation, application of modern inputs as well as the total adoption of watershed technology also indicated a similar pattern.

People's participation in the entire process of watershed management approach is an essential component of NWDPR. The observation of the research team indicated that no one from the grass root level was allowed to express their opinion in the watershed planning. However, at the implementation level the cultivators from Lakhinizara watershed showed keen interest in the process as compared to the cultivators from Kakodonga watershed. The '*Mitra Kisans*' and '*Gopals*' selected from Lakhinizara project were imparted 3 days training and their rapport with the cultivators and officials was well appreciated. This has motivated the farmers in Lakhinizara watershed area. In

contrast, the sample farmers from Kakodonga were not as much involved with the process of implementation. The 'Mitra Kisans' and 'Gopals' were also reported to be non-effective in communicating to their peers. Probably this can be attributed to the fact that the officials involved in Kakodonga project did not take their task seriously as reported by the research team. The visits of these officials to the watershed area were rare and the implementation of a few components defective.

Table 6.4: Productivity of Crops in Kakodonga and Lakhinizar Watershed in Assam (Kgs/ha)

Crop	Kakodonga		Crop	Lakhinizar	
	Beneficiaries	Non-Beneficiaries		Beneficiaries	Non-Beneficiaries
Ahu HYV	3329	3331	Ahu.Irri. (HYV)	3530	3738
Ahu Local	2594	2894	Ahu. Un.Irri.	3231	1765
Sali HYV	3227	3240	Sali (HYV) Irri.	4631	5531
Sali Local	3017	2708	Sali (HYV) Un.Irri.	4167	3334
Mustard	840	827	Mustard	835	-
Potato	5833	4615	Boro HYV Paddy	3684	4170
Vegetables			Vegetables (Rs/ha)	20415	21000
(Rs/ ha)	17462	15566	Sali Local Irri.	2887	4848
Horticultural			Sali Local Un.irri.	2814	3081
Crops (Rs/ha)	8094	6752			

Notes: Irri – irrigated; Un.Irri. – Unirrigated; HYV – High Yielding Varieties.

Source: Saikia and Borah (1995).

The overall impact of NWDPR in Assam seems to be mixed and a lot needs to be done for a forceful administration of the programme. The research team noted quite a few constraints which include: (i) poor administrative set up and project management; (ii) lack of co-ordination with other departments; (iii) inadequacy of project funds under the most needed component; (iv) lack of technical support and training of the field staff; and (v) faulty planning of the components. All these constraints along with those not listed here point to the lack of proper planning and co-ordination. The research team also indicated steps to overcome such constraints. It was felt that a proper bench mark planning will help to sort out the major problems in the process of implementation. The neglect of mechanical completion of the training component at various levels also causes differential adoption of technology. Support from local level organisations like NGOs is essential in obtaining and enhancing participation of beneficiaries in the programme. Production cum demonstration plots for various activities find a prominent place among the suggestions made for the improvement of the impact of NWDPR.

6.5 Conclusions

Impact of the treatments under the watershed development approach in the hill areas is quite different than that on the plains. The interaction with the hill region environment

seeks top priority in planning for watershed management here. Increase in crop production, cropping intensity, optimum use of farm inputs are also of relevance as these are in the case of plains. But soil degradation, protecting land slides, deforestation, gully/ravine formations, however, need immediate attention. Out of the available reports, it comes out very clearly that the planning exercises of NWDPRAs were extremely mechanical and concentrated more on agriculture as the major activity. This also gets reflected in the expenditure incurred on projectisation. Thus proper local level planning is the most significant aspect of NWDPRAs treatment in hill areas.

Elaborate administrative mechanism is suggested in the guidelines of NWDPRAs and the State governments have also taken steps to constitute such committees at various levels to oversee the implementation of the programme. However, in practice these committees hardly meet and monitor the progress of the work. Some of the studies are explicit about this. Even assuming that such committees meet periodically, then that should have been reflected in the implementation of the programme. There is no such evidence of effecting any changes in the mid-course of the process of implementation.

Participation of the beneficiaries in the implementation of NWDPRAs is as crucial in hill areas as on the plains. This is more so in the environmental context. Hill area population derives its livelihood from agriculture as well as forest products. Protection of hills, arresting land slides, prohibiting gullies or ravine formations to stop snap floods deal with their very existence. Their interaction with their environment is closely associated with their survival and hence their involvement in planning, implementation and monitoring the programme becomes most crucial. The absence of participation through these steps has caused skewed impact of the programme.

CHAPTER 7

WATERSHED APPROACH IN FRAGILE RESOURCE REGION⁵**7.1 Introduction**

The watershed approach to the soil and water conservation is essentially aimed under two broad circumstances: firstly, the regions that have entered into a domain of extreme stress on natural resources due to over-exploitation of water and land resources, need immediate steps to conserve these resources and sustain the livelihood system including the ecology of the region. Secondly, the regions that have reached an optima of resource use efficiency and the enhanced probability of such region getting into marginal negative externalities has become very high. In either cases, it becomes necessary to conserve the resources and obtain the dual goal of achieving optimal resource use efficiency as well as conservation of the natural resources. At the same time, it is essential to keep the ecology of watershed undisturbed and restore its plans.

The Deccan Plateau has a large steppe of drought-prone areas where the rainfall has been quite erratic and low in quantum. In such cases, the degradation of the forest lands and the soil is a natural outcome of the process over the years. Unfortunately, this has entered into a vicious circle. The over-dependence on land leading to over-exploitation of the natural resources thereby reducing the productivity and thus resulting into a fall back again on the natural resources. This vicious circle has brought the natural resources equilibria at an extremely low level and thereby threatens the very livelihood system especially in the instances of severe stress.

7.2 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 indicates a situation 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 situation chosen are agro-climatically different and also differ in terms of treatments. Table 7.1 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 7.1 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. Consequently, irrigation

⁵ This chapter is based on the study conducted for evaluation of NWDPR in Maharashtra. This provides a detailed account of differential impact of watershed programme across three agro-climatic zones and hence presented separately.

Table 7. 1: Basic Characteristics of Selected Watershed in Maharashtra

Characteristics	Wadegaon WS Solapur District	Krishnapurwadi 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 mode-rately fluctuating
c. Water Availability	Low	Moderate	Moderate
d. Terrain	Flat	Hilly	Undulating
e. Soils	Ustrothents, Ustropepts	Pollusterts, 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. ii. Nala Training. iii. Nala Bunding. iv. Graded and Contour Bunding. v. Dry Farming Practices.	i. Nala Bunding and Training. ii. Contour and Graded Bunding. iii. Afforestation and Pasture Development. iv. Land Development and Horticulture. v. Dry Farming Practices.	i. Contour and Graded Bunding. ii. Reclamation of ill drained soils. iii. Diversion Drains. iv. Nala Training. v. 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.

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 a 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 analyze the hypothesis relating regional peculiarities in the impact and implementation of watershed technology.

7.3 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 as well as across climatic zones. It can be observed from Table 7.2 that average size of holding of beneficiary farmers is higher than that of non-beneficiary farmers except in the case of moderate rainfall zone. The proportion of area under

Table 7.2: Land Utilisation of Beneficiaries and Non-Beneficiaries in Maharashtra

Parameters (Units)	Beneficiary Group Zones			Non-Beneficiary Group Zones		
	AZ	MZ	SZ	AZ	MZ	SZ
1. No. of Farmers (Nos.)	45	45	45	15	15	15
2. Average Farm Size (ha.)	3.78	3.82	4.25	1.80	4.46	2.93
3. % Area Irrigated	31.78	14.30	13.60	21.12	20.46	25.45
4. % of Fallow and Uncultivated Land	12.54	12.60	-	10.08	6.96	1.14
5. % of Cultivable Waste to Total Area Owned	-	-	-	-	-	-
6. Crop Intensity (%)	116	131		117	122	130

Notes: AZ - Assured Rainfall Zone; MZ - Moderate Rainfall Zone; SZ - Scarcity Zone.

Source: Deshpande and Reddy, (1991a).

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 lead to an increase immediately in irrigation facilities, especially in scarcity and moderate rainfall zones. On the contrary, short run impact may suggest an improvement in moisture availability. This point gets confirmed when the cropping intensity of both the groups is observed. The differences in the cropping intensity 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 unirrigated lands alone then the watershed region has 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 intensity with low irrigation level. The argument of intensive cultivation in the watershed region 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.

Table 7.3: Cropping Pattern of Beneficiaries and Non-Beneficiaries in Maharashtra
(Per cent of Gross Cropped Area)

Crop	Beneficiary Group			Non-Beneficiary Group		
	Zones			Zones		
	AZ	MZ	SZ	AZ	MZ	SZ
Bajra	30.40	22.98	45.49	39.00	18.50	14.22
Jowar	24.48	-	16.42	33.24	-	52.91
Wheat	9.15	2.93	0.42	7.73	5.23	3.29
Rice	-	2.26	-	-	1.34	-
Cotton	15.62	15.83	0.19	9.14	27.35	3.69
Sunflower	-	-	3.38	-	-	1.66
Pulses	11.61	37.58*	13.12	-	32.98*	7.29
Hulge	-	-	9.39	8.08	-	0.30
Sugarcane	3.22	-	11.31	-	0.54	0.74
Vegetables	1.24	-	-	-	-	-
Oilseeds	1.86	-	0.93	0.70	13.00	2.55
Others	2.42	15.69	9.35	2.11	1.07	3.35

Notes: AZ - Assured Rainfall Zone; MZ - Moderate Rainfall Zone; SZ - Scarcity Zone.

* - includes a good number of pulses (tur, moong, matki, gram).

Source: As in Table 7.2.

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. These results are not reported here. The non-beneficiary farms also reveal a similar pattern in the case of irrigation, though the relationship between farm size and crop intensity seems 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 the differences in cropping pattern of the group of beneficiaries as against that of non-beneficiaries.

The basic difference 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 7.3). Even sugarcane can be seen in all the size classes of beneficiary households, whereas 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 commercialisation in watershed region but it is confined only to some size classes. Across the zones, scarcity zone shows larger diversification than the other two zones. Surprisingly the level of commercialisation is also similar across zones.

7.4 Productivity, Cost of Production and Income Inequality

The most important aspect of the impact for sustenance of the watershed technology 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 largely depends on its impact on yield rates and production. But, 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 groups of beneficiaries and non-beneficiaries.

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 among the non-beneficiaries better than those of the beneficiary group (Table 7.4). However, across zones the differences reveal that the yield rates in the watershed region are not

Table 7.4: Yield Rates per Hectare of Principal Crops in Maharashtra

Crop's Name	(Quintals/ha)					
	Beneficiary Group			Non-Beneficiary Group		
	Zones			Zones		
	AZ	MZ	SZ	AZ	MZ	SZ
Jowar	5.78	10.98	2.88	14.59	11.57	5.14
Bajra	5.92	-	3.29	11.44	-	4.22
Wheat	17.57	29.11	7.78	19.10	17.18	5.06
Paddy	-	8.27	-	-	15.00	-
Gram	-	8.40	-	-	8.13	-
Tur	4.27	-	2.00	5.21	-	5.19
Udid	-	4.89	-	-	3.93	-
Moong	-	4.31	-	-	4.18	-
Cotton	9.77	7.59	-	11.92	6.56	-
Safflower	-	4.53	-	-	4.05	-
Sunflower	-	-	5.58	-	-	2.22
Groundnut	-	3.91	-	-	-	-
Sugarcane	74.28	-	40.0	-	-	75.00

Notes: AZ - Assured Rainfall Zone; MZ - Moderate Rainfall Zone; SZ - Scarcity Zone.

Source: As in Table 7.2.

necessarily higher than those prevailing in the non-watershed region. This indicates that watershed technology takes longer time to adjust with the input structure and other

factors. Non-beneficiaries had better resource intensity as compared to the beneficiaries and hence the differences may be more in the net income than the gross value of the product. 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 farmers of the non-beneficiary group than the beneficiary group. The explanations for this may be visible from the analysis of input use pattern.

The farm level input use pattern across size classes for both the group is presented in Table 7.5. Though the crop-wise input data would have helped us in deriving better relationships between input use and yield rates, we are presenting here only the aggregate

Table 7.5: Input Intensity per Hectare in the Beneficiary and Non-Beneficiary Groups in Maharashtra.

Inputs (Units)	Beneficiary Group Zones			Non-Beneficiary Group Zones		
	AZ	MZ	SZ	AZ	MZ	SZ
Seeds: Q (Kgs)	45.53	24.79	64.83	11.25	9.58	65.76
V (Rs.)	228.00	137.00	66.00	144.00	172.00	75.00
FYM: Q (Qntl)	5.00	4.04	1.56	6.11	5.47	3.42
V (Rs.)	230.00	157.00	81.00	284.00	236.00	208.00
Fertilizers: Q (Qntl)	1.47	1.31	0.37	1.79	1.47	0.33
V (Rs.)	315.00	316.00	40.00	387.00	328.00	64.00
Pesticides: Q (MI)	1.10	0.56	0.02	0.30	0.57	0.52
V (Rs.)	93.00	107.00	1.40	60.00	100.00	6.00
Irrigation: Nos.	3.48	0.67	1.07	2.85	0.34	1.70
V (Rs.)	85.83	26.00	37.00	66.00	50.00	55.00
Family Labour: (MD)	52.64	62.07	32.95	77.37	43.90	45.14
Hired Labour: (MD)	25.77	33.80	21.93	37.39	26.68	45.70
Wages (Rs.)	279.00	176.00	275.00	363.00	224.00	496.00
Bullock Labour						
Own (PD)	18.04	19.16	6.80	22.63	16.09	5.17
Hired (PD)	3.21	5.84	8.43	11.59	3.70	6.68
Wages (Rs.)	79.00	140.00	244.00	293.00	95.00	273.00

Notes: Q - Quantity; V-Value; MD- Man days;PD- Pair days; FYM - Farm Yard Manure. Only in the Assured Rainfall Zone there was some evidence of machine labour.

AZ - Assured Rainfall Zone; MZ - Moderate Rainfall Zone; SZ - Scarcity Zone.

Source: As in Table 7.2.

data in order to have a broad idea regarding the input use pattern and also to avoid the complicated presentation of data for each crop. In addition to this, we are looking into input allocation rather than the input-output relationship as such. The input use pattern between these two groups indicates 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 the non-beneficiary group. It was observed that the variations in input

use across size classes within the beneficiary group are higher than that of non-beneficiary group. Further, there is a large difference in the levels of input use on the large farms across the regions. 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 across the zones. It may be worth mentioning here that the beneficiary group showed in aggregate a typical inverse relationship between farm size and productivity (Deshpande and Reddy, 1991a) and 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. 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 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 7.6) brings out clearly that the incremental gross returns in the assured rainfall zone is higher than that of the other zones whereas, in the non-programme area the moderate rainfall zone is better placed due to higher yield advantages. The average gross returns of the programme area are comparable with those of the non-programme area probably due to a little differences in crop systems, input structure and level of degradation.

Table 7.6: Gross and Net Income per Hectare of Beneficiaries and Non-Beneficiaries (Rs/ha)

Item	Beneficiary Group			Non-Beneficiary Group		
	Zones			Zones		
	AZ	MZ	SZ	AZ	MZ	SZ
Gross Income	3312	3078	895	3115	3180	1641
Paid Out Cost	1324	1059	744	1660	1205	1177
Imputed Cost	1014	783	610	1323	782	701
Farm Business Income	1988	2019	151	1455	1975	464
Net Income	974	1236	-459	132	1193	-231

Notes: AZ - Assured Rainfall Zone; MZ - Moderate Rainfall Zone; SZ - Scarcity Zone.
Source: As in Table 7.2.

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 across the zones. However, these are more than compensated by the incremental gross income which is reflected in the farm business income. Our earlier analysis across size of holding indicated an inverse relationship between the size-productivity in all the zones (Deshpande and Reddy, 1991a). This indicates that the higher cost of cultivation on the smaller groups has reversed the negative relationship between farm size and gross

returns.⁶ 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 cropping pattern of the beneficiary group which is more tuned to the stability of income flow rather than higher level of income. In addition to this, we may hypothesise that small farmers try to maximise 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 gap 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 showed higher level of inequality in the non-project area as compared to the watershed region (see, Deshpande and Reddy 1991a; Deshpande and Rajasekaran, 1995). 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?

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 7.7). Not many of the test results reveal that the differences observed earlier between beneficiary and non-beneficiary farmers are statistically significant. This may lead us to a quick

Table 7.7: Difference of Means Test for Various Indicators: 'Z' Value

Item	'Z' Value		
	AZ	MZ	SZ
Value of fertilizers used (Rs.)	0.77	0.68	0.66
Value of farm yard manure (Rs.)	1.36	1.33	1.08
Family labour used (Mandays)	1.84***	0.24	0.52
Hired labour used (Mandays)	1.59	1.76***	1.49
Owned bullock labour used(pair days)	0.75	1.39	1.54
Hired bullock labour used (pair days)	2.03**	0.51	1.61
Value of material input used (Rs)	0.01	0.07	0.88
Gross Value of Output (Rs.)	0.74	0.42	0.96
Net Value of Output (Rs.)	2.03*	2.43*	0.81

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

2. *, ** and *** - level of significant at 10, 5 and 1 per cent respectively.

3. AZ - Assured Rainfall Zone; MZ -Moderate Rainfall Zone; SZ - Scarcity Zone.

Source: As in Table 7.2.

* The size group-wise analysis is based on Deshpande and Reddy (1991a).

conclusion 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. But such hurried interpretation is neither desired nor warranted as the evaluation methodology for any watershed programme has to be holistic and under the frame of WISM model. This may be mainly due to two reasons: first reason 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 treatments may initially impact to set right the environmental degradation and bring back the production process properly in clear framework. The incremental benefits begin only after that.

7.5 Food, Fodder, Fuel, Water and Quality of Life

Apart from these direct benefits, there are other positive environmental externalities in terms of benefits like increased levels of consumption, water table, availability of fodder, run-off arrest, reduction in loss of top soil. Our analysis of the consumption pattern indicates that there are no dramatic differences in per capita consumption per year between these two groups. However, it was observed that there are certain subtle differences in consumption pattern across zones. But what interested us more was 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 (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.

As regards the changes in availability of moisture, increased water table, reduced run-off and loss of top soil, these are difficult to capture in measurement. Most of these can be observed by taking continuous measurement over time and for such things experiments have to be established covering the area of the watershed. We however relied more on the farmers' perception of these changes. It was noted that moisture availability increased in terms of days in the scarcity zone (SZ) whereas water table increase was noted in the assured rainfall zone (AZ) and moderate rainfall zone (MZ). The run-off and loss of top soil was reduced significantly in the AZ and MZ as compared to SZ. These changes were observed by the farmers.

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. This would result in higher fodder availability. For this purpose, data regarding number of hours the cattle are grazed on open lands during different seasons of the year are analysed here. The data indicate that the availability of fodder is more in the programme areas (see Table 7.8).

It can be observed from the table that there are no consistent differences in the number of hours cattle are grazed on the open lands between beneficiaries and non-beneficiary groups. 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 expenditure incurred on the sample households on fodder and fuelwood. The data indicated 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 project 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.

Table 7.8: Zone-wise Number of Hours of Cattle Grazing and Purchase of Fodder and Fuel

Farm Zones	Number of hours of cattle grazing per day						Purchase of fodder/fuel per household (in Rs.)			
	Beneficiaries			Non-beneficiaries			Beneficiaries		Non-Benefic.	
	SM	WR	RY	SM	WR	RY	Fod-der*	Fuel [§]	Fod-der*	Fuel [§]
AZ	2.55	2.84	2.70	3.54	3.92	3.42	150	24	29	21
MZ	3.24	3.57	3.12	3.55	3.83	3.42	166	32	177	19
SZ	5.42	5.44	3.90	4.01	4.18	3.10	88	41	158	145

Notes: 1) SM - Summer; WR - Winter; RY - Rainy.

2) * - Purchase of Fodder is given in per cattle unit per year basis.

3) § - Purchase of fuel is given on per week basis.

4) AZ - Assured Rainfall Zone; MZ - Moderate Rainfall Zone; SZ - Scarcity Zone.

Source: As in Table 7.2

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 (or quantum) 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 7.9 these reactions.

It can be noted from the table that wages, employment, run-off, water table 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 differences across zones are concerned, it is observed that relatively more number of farmers from AZ (67 per cent) have felt that their yield rates have gone up when compared to their counterparts. Yield improvement reported in scarcity zone

Table 7.9: Distribution of Farmers According to the Changes Noticed by Them

(Per cent to total respondents*)

Zones	Percentage of Farmers Reporting Improvement in					
	Level and Stability of Yield Rates	Reduced Run-off	Availability of Fodder	Availability of Fruits and Vegetables	Employment and Wages	Increased Water Table
AZ	67	69	18	11	73	58
MZ	58	76	20	13	67	62
SZ	47	64	22	2	100	49

Notes: 1. * - Respondents are 45 in each zone.

2. AZ - Assured Rainfall Zone; MZ - Moderate Rainfall Zone; SZ - Scarcity Zone.

Source: As in Table 7.2

was only 47 per cent. It can be deduced though hurriedly that watershed benefits are accruing more in the AZ and MZ resulting in the increase of inequalities across zones. But, this has to be read with the stability effect that the watershed treatment has in the scarcity zone. The reduction in the attitude towards risk comes out very clearly in the scarcity zone. 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. Not many farmers felt that the availability of fruits and vegetables has improved after the implementation of watershed. On the other hand, most of the farmers noticed the improvement in employment and wages though the level of employment is lower in the watershed areas as compared to non-watershed area. The increased water table and reduced run-off were in two important components reported by the beneficiaries.

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 that they received.

7.6 Conclusions

The impact of NWDPPRA across the zones 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. Whereas, the results can be ascertained quickly in AZ and MZ. 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 any agro-climatic 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 across zones was hampered by the unusual presence of some irrigation 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. 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 were 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 across agro-climatic zones. More interestingly the farmers found the technology of *in situ* moisture conservation as yield improving and stabilising, water table enhancing, run-off arresting and net income increasing. Assessing the impact needs the control of agro-climatic zones as also the project and non-project region.

CHAPTER 8

SUMMARY AND CONCLUSIONS

8.1 Introduction

After a significant boost up given by the technological change in mid-sixties accompanied by the achievement of food security, now the agricultural sector is confronted with new challenges. These major challenges identified by now, fall in five distinct groups. The macro-economic participation of the agricultural sector in keeping the growth rate of the economy on a pre-determined growth path comes as the first priority. Over the last decade this expectation is fulfilled by the sector but much of the credit should go to the favourable climatic conditions during this period. It has been proved beyond doubt that the aggregate growth of the economy is quite sensitive to the growth rate in agricultural sector (Rangarajan, 1982). Hence sustenance of the performance of agricultural sector becomes a pre-requisite of the targeted growth of the economy. Secondly, the regions bypassed by the technological change were handicapped on account of the weak natural resource structure as well as the character of the technology, low profile of irrigation development, improper water harvesting, largely degraded soils and bio-resources, pre-dominance of low value crops and the commercial character of agriculture in the neighbouring regions. All these characteristics together bring the handicapped position of these regions under a bold profile. It is therefore necessary to provide necessary developmental infrastructure to these regions. Thirdly, the capital formation in the agricultural sector has slowed down in the late eighties and early nineties. Various hypotheses have been put forward and tested concerning the tardy growth of capital formation in Indian agriculture (Misra and Chand, 1995). However, it is quite clear that the basic capital influx has already taken place in the well endowed regions and now the value added from agricultural sector of these regions flows to urban areas in terms of consumption of goods and services originating from urban areas thereby slowing down the pace of capital formation in agricultural sector. At the same time, the bypassed regions have little to look ahead in increasing the pace of capital formation apart from the factual dearth of the availability of capital. Fourthly, the availability of appropriate technology for rainfed agriculture and its adoption due to gestation period of the results is another bottleneck. Lastly, the contents of the new economic policy posed multitude of challenges in front of the rainfed agricultural sector in terms of its participation in the process of growth. Questions regarding the probable contribution to the domestic and world market from these regions, are not easily answerable.

The first phase of developmental efforts in the technology of rainfed agriculture were directed more towards experiment on soil conservation conducted at some research stations meant for that purpose. The impact of these efforts was quite encouraging but the magnitude of the task involved as well as the thin spread of these experiments indicated need for more concentrated efforts. One of the important externalities of these efforts as well as the much publicised green revolution was that the rainfed crops remained as a bypassed sector in the process of development. The next phase was characterised by its emphasis on the development of suitable crop varieties as well as cultivation practices. Results of the trials conducted at experimental stations were quite encouraging but failed to replicate the demonstrated yield gap on farmer's field. As a result, the adoption rates of these practices as well as crop varieties were quite low. One of the prominent factors in deciding the low

response was the location specificity of the technology and the nexus of risk aversion with adoption of technology. All this led to a unique solution of an integrated planning approach to the development of rainfed agriculture (GOI, 1986a, Jodha, 1979). Any holistic planning approach for agriculture will involve the area in the form of a resource region where the central resources will be soil and water around which the planning exercise will be undertaken. These works were taken independently under various institutional arrangements and across a large number of regions in the country. Such multiplicity of the experiments was not very conducive for evolving a common framework, however, the mosaic of experiments across the country offers a great deal of diverse situations essential for management.

At the time of the mid-term review of the Seventh Five Year Plan it was felt that a programme of development of the rainfed agriculture can be taken up in the country. Similarly a review of dry land farming practices was taken up by a group of experts during 1986 (GOI, 1986a). The mid-term review of Seventh Five Year Plan recommended a massive watershed development programme covering a large number of districts across various States in the country. Thus, for the first time, the National Watershed Development Programme covering 99 districts in 16 States of the country was taken up for the implementation. The National Watershed Development Programme for Rainfed Agriculture (NWDPR) came into force with the Government Order No.6-13/85-CAV dated 3rd July 1986 for the years 1986-87 to 1989-90 at the total cost of Rs.239 crores. The earlier ongoing programmes connected with watershed activity were merged with this programme. The objectives of NWDPR set in the 1986 guidelines (GOI, 1986b) were:

1. Taking the watershed as a basis to conserve and upgrade croplands and wastelands 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 alternative land use system."

It is very clear from the above objectives that the NWDPR initially concentrated on growth and balance of eco-system. Subsequently, with three years experience of the implementation of the programme of watershed, a committee was appointed to review the guidelines prepared during 1986. These were revised thoroughly during 1990 and published under a title WARASA (Watershed Areas Rainfed Agricultural Systems Approach). The project guidelines prepared in the light of the recommendations of the Committee of Secretaries and the working group of Planning Commission set forth a five fold objectives. This involved firstly, the conservation of natural resources along with augmentation of the availability of food, fodder, fuel, timber and bio-mass. Secondly, the programme was directed to create an influence on employment in the sector by making available additional work opportunities to the weaker sections, landless labourers and tribals. Thirdly, the new programme envisages an overall improvement in adoption of technology, environmental conservation, income opportunities and resource availability. Fourthly, the programme was aimed at creating avenues for income in such a way that these will create conditions for reduction of income inequality. Lastly, the design of the programme was such that it will create awareness among the beneficiaries and shall ensure their participation through the stages of its implementation (GOI, WARASA, 1992).

Major improvements in the new programme were directed on four major aspects. Firstly, the new programme recommended a holistic and integrated approach including not only the development of natural resource base but also to sustain the productivity as well as improvement in quality of life. Secondly, planning of watershed was given prime importance. A complete development plan of the watershed was to be prepared covering all the treatments on arable and non-arable lands, unit costs of the treatment, socio-economic characteristics of the watershed and the expected benefits. Therefore, projectisation became an important aspect of NWDPR. Thirdly, the project rightly emphasised the crucial aspect of people's participation. It was recommended that the involvement of the beneficiaries should be ensured from the planning stage and continued through the stage of implementation. This was envisaged to be achieved through the institutions of '*Mitra Kisan*' and '*Gopal*' (contact farmers and contact dairy farmers) as well as watershed level committees. Training of the farmers was introduced as an important component. Lastly, the funding arrangements were changed and the Central Government undertook to extend 100 per cent finance to the State governments for the project of which, 75 per cent was in terms of grants and 25 per cent as a loan component. Continuous monitoring and concurrent evaluation were introduced as major components.

The programme began in most of the States almost simultaneously. Though the guidelines prepared under the title WARASA were quite elaborate and had given the specific implementation stages through different booklets, the process of implementation followed in each of the State varied significantly. If such flexibility was employed to the advantage of the implementation process, then it was certainly desirable. But many times this happened more due to inertia towards change. It is essential to emphasise here that each of the State has to be treated under differential strategy under the programme. Such flexibility was allowed under the guidelines in terms of preparation of elaborate plans.

8.2 Objectives and Methodology

As we have seen above, the National Watershed Development Programme for Rainfed Agriculture focused mainly on four major aspects. Conservation of land and water resources by adopting soil and water conservation measures became the first priority aspect of the programme. Secondly, the programme envisages augmentation of food availability, fodder production, fuelwood supply, fruits by inducing a proper land use system. Such changes in the farming system are expected to bring in additional income and create gainful employment. This is the third important aspect. Lastly, it is first time that a developmental programme planned from above sought to enlist participation of the beneficiaries through perpetual institutions created to encourage this. Keeping in view the focus and objectives of the programme the Ministry of Agriculture, Government of India initiated a series of studies to evaluate the assessment of the impact of NWDPR in various States with the following specific objectives:

- (i) To examine the present status of the available technology and the extent of its adoption by farmers.
- (ii) To identify the factors responsible for productivity changes and to ascertain major impact parameters.
- (iii) To locate the constraints in the process of implementation of the project and to ascertain them in terms of infrastructure, technology and other factors.
- (iv) To evaluate the impact of vegetative measures soil and water conservation structures and other components of the programme.

(v) To suggest strategies for removal of the constraints faced by NWDPRRA.

Methodology for the analysis of an area development programme has to be different as compared to the method of analysis of any other programme. Here the flow of direct benefits in terms of supply of inputs, machinery, tools etc., do not represent the core of the impact. The actual impact has a wider significance and spread in the area of operation of the programme. Therefore, even those who have not been directly supplied inputs etc., will stand to gain in terms of moisture availability, soil capability, vegetative symbiotic nutrition, nitrogen fixation, green manure etc. Therefore, in an area development programme the entire area needs to be incorporated in the spread of benefits.

The usual tools of project analysis are not only inadequate but possibly misleading in the case of an evaluation of a watershed project. Any watershed development programme has a strong component of location specificity and therefore, the cost and benefit flows (a large part of it has to be imputed) are governed more by the local conditions. These flows cannot be assumed as linear and are susceptible to the various factors like climatic changes and local parameters. This makes generalisations in terms of cash flows very difficult as the time profile of the cost and benefits depends on the level of degradation, geo-climatic conditions and interface of these with the response of the beneficiaries. Some of the benefits in terms of positive externalities such as rejuvenation of soil, availability of pasture, increased recharge to groundwater, higher moisture availability period etc., are not easily amenable to pricing. Thus, their inclusion in the stream of benefits even in a micro-catchment area of a few hectares is difficult and therefore it becomes a formidable task. Moreover, any treatment of watershed has inter-dependent systems of components generating concentric impact signals. Tapping such signals at any one place on the periphery is difficult as well as erroneous.

Any important analysis, therefore, should be attempted under a structured Watershed Impact System Model. The organisational and institutional structures along with the technological parameters decide the composition of the treatment of a watershed. The changes in a treated watershed are both of short run and long run nature. It is also difficult to define a boundary of such changes as well as time span of each of these changes, as these would depend on the factors such as the present level of degradation, slope, soil type, precipitation, bio-geological resources and people's interaction. Therefore, the best method to tap the impact signals would be to identify the changes in the important parameters in terms of pre-project and post-treatment situations as well as compare the project situation with the area that falls out of the project. The perception of beneficiaries about the impact is another method of assessment.

This study attempted to consolidate the results obtained by various studies undertaken for analysis of the impact of NWDPRRA in the country and especially conducted by the Agro-Economic Research Centres. A two-day workshop was conducted at the Gokhale Institute of Politics and Economics, Pune, to discuss the study proposals and methodology. Ten Agro-Economic Research Centres (AERCs) participated in the workshop where the methodology of the impact study was discussed and the proposal, questionnaire were finalised. The participating AERCs covered in all 10 States are: (i) Gujarat (ii) Madhya Pradesh and (iii) Maharashtra from Western and Central Rainfed Zone; (iv) Andhra Pradesh and (v) Tamil Nadu from Southern Plateau and Hills Region; (vi) Haryana and (vii) Uttar Pradesh from Northern Alluvial Plains; (viii) Assam, (ix) Himachal Pradesh and (x) West Bengal (Darjeeling district) from Hill Regions. This gave an excellent contrast across the

country and thus offered variety of experiences of the impact. Apart from these we also had the benefit of a study conducted on Rajasthan by AERC, Vallabh Vidya Nagar.

The common framework involved selection of two watersheds falling in two distinct Agro-Climatic Zones in the State. The logic behind selecting the watersheds falling in two distinct Agro-Climatic Zones is to test the hypothesis that even with different combinations of treatments across Agro-Climatic Zones the impact parameters move in the same direction and that the magnitude of the treatments varies with the Agro-Climatic Zones along with the incremental changes.

As mentioned earlier ten Agro-Economic Research Centres participated in the impact study and chose the watersheds as detailed in Table 8.1. It can be seen from the

Table 8.1: List of Watersheds Selected for Study by different States

State	Districts	Selected Watersheds	Agro-climatic Zones
1. Andhra Pradesh	Visakhapatnam Kurnool	Narvagedda Emboy	North Coastal Andhra Pradesh Scarcity Zone, Rayalaseema
2. Assam	Shillongoni Jorhat	Lakhinizar Kakodonga	Central Brahmaputra Valley Upper Brahmaputra Valley
3. Gujarat	Kheda Banaskantha	Kapadvan Danta	Scarcity Zone Scarcity Zone
4. Haryana	Bhiwani Ambala	Saara Watershed Jattan Majri Watershed	Semi Arid Zone Hill Region
5. Himachal Pradesh	Kangra Solan	Talara Sher Chirag	Sub-tropical zone Sub-temperate Zone
6. Madhya Pradesh	Khargaon Raipur	Chanderi Nala Silvarinala	Nimar Plateau Chattisgarh Plains
7. Maharashtra	Ahmednagar Satara	Bugewadi Nune-Goudi	Scarcity Zone Transition Zone
8. Tamil Nadu	Salem Coimbatore	Elachipalyam Perumanallur	North Western Zone Western Zone
9. Uttar Pradesh	Jhansi Saharanpur	Bhagai Nala Panja Row	Trans-Gangetic Plains
10. West Bengal	Birbhum Darjeeling	Rajnagar Naxalbari	Sub-Humid Hills Northern Hill Region

Source: AERC, Various Evaluation Reports on NWDPRA.

table that the reports prepared on impact studies offered a multitude of experiences. However, due to differences in the approach it was difficult to get together a common line of analysis throughout. Among the major difficulties confronted, five problems

prominently inhibited the analysis. Firstly, despite our best efforts and repeated reminders, we could not get the secondary level data on all the concerned States regarding financial and physical achievements in the States across various activities. This would have helped in constructing a picture of strong and weak spots across the States to tally with the ground level experience. Some of the data available were supplied to us as late as the end of 1997 but these were not in the useable form. Secondly, it was incorporated in the design that a portion of the study (at least one chapter) will concentrate on the analysis of secondary data. However, such chapter was not attempted by most of the studies thereby ruling out any secondary data analysis across the States. Thirdly, the concept of beneficiary used by the studies is not the same. During the phase of evaluation of various rural development programmes the concept of beneficiary was construed as "those who receive some component (seed, fertilisers, equipment, direct subsidy etc) from the programme". This was fine with some of the direct intervention programme of which the spread effects are of peripheral importance. But in an area development programme where the spread effect dominates the focus of the programme such conception may be misleading. Some of the studies have taken beneficiaries as those who have received direct benefits under one or the other component (seedlings, earthen bunds, social forestry, vegetative bunds etc). This was not so much incorrect as these farmers participated in the programme. But while comparing the non-beneficiaries (non-project or control) group with that of beneficiaries, adequate care was taken to choose this group from the area of non-influence of watershed treatment. Fourthly, the choice of two watersheds from two different agro-climatic regions was taken up to contrast the results, however, this was not attempted by quite a few studies. In fact, the study of Uttar Pradesh chose to combine regions possibly because they found no significant differences to be reported. Lastly, the questionnaire of the study prepared at the Gokhale Institute of Politics and Economics, Pune had a special section on the beneficiary responses towards usefulness, adequacy, relevance and sustainability of the programme. Similarly, beneficiary participation at various stages was also an important component of the intended study. However, not much could be obtained about these from majority of the studies.

8.3 Summary of Findings

For the purpose of our analysis, we grouped the available studies into four groups of States based on agro-climatic conditions. The first group included Gujarat, Madhya Pradesh, Maharashtra as the States representing Western and Central rainfed regions of the country. Incidentally another study which was readily available on Rajasthan was included in this group. The second group included two States, namely, Andhra Pradesh and Tamil Nadu covering the major portion of Southern Plateau and Hills region. A notable exclusion here was Karnataka because the study undertaken by Agricultural Development and Rural Transformation Unit of Institute for Social and Economic Change, Bangalore was not completed by middle of 1998 and also it did not have similar framework as that of the other studies. Hence, Karnataka could not be included in our analysis. The third group included the States falling under Northern Alluvial Plains. Two studies were available for Haryana and Uttar Pradesh under this group. The last group consisted of the studies covering Hill Regions with Assured Rainfall. Here we had three completed studies on Himachal Pradesh, Assam and West Bengal. The last State

was included here mainly due to the coverage of Darjeeling and Birbhum districts of the State. The hypotheses that run throughout the analysis attempt to bring forth the situations specific impact parameters of the region.

8. 3. 1 Western Plateau and Central Rainfed Regions

As indicated earlier, we have taken four States for analysis here, namely, Gujarat, Maharashtra, Madhya Pradesh and Rajasthan. The major thrust of NWDPR is particularly in this region is expected to influence four parameters. Firstly, the programme has to instil the most required stability in crop yields to deal with the vagaries of monsoon for the scarcity prone area. Thus, moisture conservation becomes first priority here. Secondly, the low yield characteristic of the region also inhibits its contribution to the aggregate output. Thus, yield enhancement comes as the next priority. Thirdly, the environmental damage to the soil structure and deforestation are the concerns of this region and hence that assumes importance in the process of planning. Lastly, water conservation and sustaining the crop system is the priority for the programme and this needs to be achieved through active participation of beneficiaries.

In Gujarat State, NWDPR is operated by the Gujarat State Land Development Corporation. This is a body mostly manned by the administrators from the Department of Agriculture but provides a unique framework of inter-disciplinary administration. The expenditure on primary activities which include survey, planning etc., happens to be much below the target. But the results obtained by the treatment are quite satisfactory in both the Agro-Climatic Zones. Yield per hectare of the beneficiaries showed an improvement and the change is in favour of area shifts to commercial crops. It is recorded that the employment as well as yield per hectare have increased substantially after the treatment of watershed mainly due to the change in the crop pattern and cultivation practices. Both the watersheds have shown encouraging results as far as participation of the beneficiaries is concerned.

Among the important constraints brought out by the research team, the inadequacy of funds, fixation of farm unit cost across regions, procedural delays, lack of horizontal coordination and monitoring/feedback were felt acutely.

The experience of Rajasthan is intriguing from three distinct view points. Firstly, the State has a dubious distinction of having vast spans of rainfed area. Secondly, due to the low level and high variability of rainfall, water conservation becomes an important activity of the region. Thirdly, the process of desertification is alarmingly increasing along with fast rate of deforestation and soil degradation. In order to meet these issues of prime importance, the programme of NWDPR was tuned to the requirements of the State. But the results were not necessarily encouraging both due to the short time lag between the process of implementation and the field survey, and the difficult task set ahead of them. NWDPR has helped the on-farm activities by inducing an increase in the yield level and creating additional employment. The programme is implemented by the line departments and no separate agency was created for the purpose of implementation. This has had a telling effect on the process of implementation. The lack of horizontal coordination, paucity of funds, absence of a complete master plan were the constraints highlighted by the research team. Most important among the observations of the research team is the lack of people's participation in the programme. It is not unexpected from a region with a stress on the resources and where the basic survival takes a natural precedence over other factors.

Madhya Pradesh comes under a distinct category of States with totally different agro-climatic conditions. Research team of AERC, Jabalpur selected two districts of which one from Chattisgarh region and the other from Nimar plains. The concept of beneficiary followed by the research team incorporated only those who have received one or the other direct benefits (mini-kit, sapling, Nafed construction etc). This has created a situation where the 'non-beneficiaries' were also located inside the watershed region and hence the difference between the two groups was not perceptible. Thus, the differences between the two groups, especially those related to land activities and the other not related to such activities could not be totally attributed to the programme. The participation of beneficiaries in the programme implementation was not satisfactory. Only between 20 to 30 per cent of the beneficiaries felt that they need to participate in the programme. The sustenance of the structures erected during the process of implementation of the watershed development programme may not be guaranteed and thus efforts are needed to sensitise the intended beneficiaries.

The experience of NWDPR in Maharashtra is more encouraging. Watershed development activities began in the State with the Comprehensive Watershed Development Programme (COWDEP) and then continued during the two phases of NWDPR. The study team selected two regions, namely, Scarcity Zone and Transition Zone for the purpose of the evaluation of NWDPR. The incremental yield per hectare, employment and income generated due to the programme showed promising results. The programme is implemented in the State through a Directorate of Watershed Development specially constituted for the purpose after renaming the erstwhile soil-conservation department. Naturally, the emphasis of the programme was more on the soil conservation. There were about 30 to 60 per cent beneficiaries who felt that the programme was relevant and useful and even larger proportion of them felt that it is sustainable. The participation of the beneficiaries was between 30 to 70 per cent but never total. Environmental impact of the programme confirmed increase in moisture availability, decreased run-off and effectiveness of vegetative bunds. Four important constraints emerged from the analysis of the programme. Firstly, the local level flexibility in operating the programme was the most essential component. Many times delay in the bureaucratic procedures caused severe bottlenecks. Secondly, the input delivery system created problems in efficiency of production and adoption. Thirdly, the extension service needs and the training requirements are not attended adequately. Lastly, absence of any external monitoring relaxed the programme substantially.

8.3.2 Southern Plateau and Hills Region

This Agro-climatic Zone covers the major parts of the three southern States, namely, Tamil Nadu, Andhra Pradesh and Karnataka excluding the coastal regions. A large portion of this Agro-Climatic Zone falls in the rain shadow region apart from the vast patches of degraded lands. A variety of agro-climatic characteristics can be seen under the broad homogeneity of the region. Therefore, the main focus of the treatments of watersheds and the mix of such treatments differ across the agro-climatic regions.

Andhra Pradesh has a multi-tier system for administration and monitoring of NWDPR consisting of six committees. These include (i) State Watershed Development Policy Committee; (ii) State Watershed Development Implementation Committee; (iii) State Watershed Development Team; (iv) District Level Coordination Committee; (v) Sub-divisional level Coordination Committee and (vi) Multi-disciplinary Watershed Development Team. It is recorded by the research team of AERC, Waltair, that these

committees did not meet periodically and hence defeated the whole purpose of constituting them. Despite this, the expenditure on various components of NWDPR is more than 75 per cent of the amount released. AERC Research Team selected two watersheds falling in two distinct agro-climatic zones but while identifying beneficiaries they took those beneficiaries who have got direct benefits under NWDPR like (i) contour/vegetative bunds on the beneficiaries field; (ii) contour-vegetative hedges; (iii) gully control works; (iv) dry-land horticultural plants; (v) fodder demonstration and (vi) livestock activity. This automatically formed another group of 'non-beneficiaries' and many of them had their fields within the watershed boundaries. Out of the two selected watersheds, one has about 47 per cent of area under irrigation and still works on NWDPR are carried out there. Yield improvement on the beneficiary fields has been substantial as compared to the non-beneficiaries. But for ragi, groundnut and red-gram the non-beneficiaries have an edge over the beneficiaries. The expenditure incurred on preliminary activities (only 21 per cent of the released amount) shows that this vital component might have been neglected in the process of implementation. Among the constraints highlighted by the research team, the timely availability of funds, provision of vehicles to the project staff and importance of training and planning of the project find prominent place. Khus grass was found to be non-suitable for the region.

Impact of NWDPR in Tamil Nadu offers a good case to check the influence of the programme in a high growth agricultural environment. Out of the released funds up to 1994-95, more than 56 per cent have already been spent, but the research team observed that physical achievements do not commensurate with the financial achievement. The expenditure on primary activities fell short of the total expenditure expected on that. This indicates either a faulty planning of these activities or bottlenecks of implementation. The impact on net income and employment generated due to NWDPR has been quite effective in both the watersheds. The group of beneficiaries have higher net income per hectare as well as they employ more wage labourers when compared with the non-beneficiaries. But the participation rate of the beneficiaries in the various meetings and training programmes shows less than 50 per cent participation. Some of the important components of the analysis, namely, the impact on environmental factors, sustainability, desirability, adequacy of the programme, and the constraints of the programme at macro as well as micro level did not attract attention of the research team.

8.3.3 Northern Gangetic Plains

The technological change of the mid-sixties, during initial phases, made its impact felt in the Northern Gangetic Plains. Especially the area coming under Trans-Gangetic Plains was strongly influenced by this change. However, there were bypassed regions and pockets which needed specific attention due to their dependence on rainfall alone during the second phase. The studies on impact analysis were carried out in Haryana (from Trans-Gangetic Plains) and Uttar Pradesh (from the middle and Upper Gangetic Plains). Being largely the plains and having substantial area under irrigation, the region needed a strategy that deals with water conservation and halting the process of soil degradation.

In Haryana, the NWDPR was started in five blocks of which three were in Ambala and two falling in Bhiwani district. The total expenditure for the period 1990-1997 was Rs.1884 lakhs for the State. However, the financial achievement in terms of the per cent of expenditure to the total allocation was reported as 'not satisfactory'. Upto 1994, only 37 per cent of the allocated funds were utilised. It was pointed out that only 17 per cent of the

allocated funds on basic activities could be spent. This points to the possibility of lapses in planning of the programme. There is an elaborate State machinery which helps in administration of the programme with five important committees monitoring the progress. The effectiveness of monitoring the programme is however, not clear from the report. The research team chose two groups, namely, 'participants' and 'non-participants', where the 'participants' are those who have received some or the other direct benefits under the scheme such as sapling of fruit plants, crop demonstration, compost pit, field visit etc. The remaining cultivators were taken as 'non-participants' even though a good number of the non-participants have their lands falling under watershed. Being an irrigated tract, about 41 per cent of the net sown area of the participants receives irrigation as against 43 per cent in the case of non-participants. This in a way goes against the basic purpose of the project which is defined mainly for 'rainfed areas'. The differences between the group of participants and non-participants are not remarkable due to the share of irrigated area and the cropping intensity. Dry land horticultural activity picked up substantially in the region.

Among the constraints identified by the research team prominent are three. Firstly, the research team felt that the span of activities included under NWDPRRA is not properly covered like the crop demonstration, soil testing and survey, non-arable land treatment etc. The team also recorded marginal participation in terms of planning and implementation.

The impact assessment of NWDPRRA in Uttar Pradesh was carried out by AERC, Allahabad. Their sample of watersheds was drawn from Jhansi and Saharanpur districts from the Upper Gangetic Region. The research team chose to report the results together even though they selected the watersheds from two agro-climatic regions. The expenditure on the project has been quite tardy and the proportion of unutilised funds over the years is more than 50 per cent of allocation. At watershed level the research team reported the proportion of expenditure incurred only as 17 and 38 per cent of the total allocation. The review of the physical progress in the watershed indicated that nursery, training, plant distribution, bank stabilisation etc., could not be completed in time. The tardy progress was traced to the ambiguity and impracticability of the policy measures and also people's apathy towards the programme.

The comparison of the performance on the field of the beneficiaries and the non-beneficiaries showed that the beneficiaries have obtained a slight edge over the non-beneficiaries in terms of yield per hectare, as well as net income per hectare. It is interesting to note that the beneficiaries had higher proportion of area under irrigation when compared with the non-beneficiaries. Hence, it is not simple to attribute the differential performance between the two groups to the treatments under NWDPRRA.

Among the various constraints pointed out by the research team the process of planning assumes utmost importance. It comes out very clearly from the report that proper efforts were not taken to design the programme which has resulted in the low proportion of expenditure on the activities. It was surprising to note that some times the physical targets are reached but the financial allocation is not even reached up to 50 per cent. The implementation authorities could not bring together horizontal integration despite having five committees monitoring the programme. The institutions created through '*Gopal*' and '*Mitra Kisan*' also could not influence participation of the cultivators. Both the study teams did not attempt any analysis of the impact on environmental parameters.

8.3.4 Hills Region and Assured Rainfall Zone

Treatment of watershed in hill areas and also in Assured Rainfall Zone is quite different when compared with plains and scarcity zone. The emphasis of the treatments here has to be more on managing the flow of water on the slopes so as to reduce degradation, loss of top soil and prevent land slides. Prevention of gully and ravine formation also takes priority here. Under the steep hills any heavy downpour can cause a severe damage to crops as well as it can result into heavy landslides. In such situation the waterways should be managed in such a way that the damage is minimised. We had three studies falling in this broad category of agro-climatic classification. Himachal Pradesh and Assam clearly fall in the hill region. We have also included West Bengal in the same category as the AERC research team chose hilly tract of Darjeeling for the purpose of the study.

The study on impact of NWDPR in Himachal Pradesh incorporates two watersheds, one falling in the sub-tropical zone and another in the sub-temperate zone. Both the zones have distinct characteristics and hence the results bring out interesting comparisons. Even though financial achievements could not keep pace with the demand of the programme, the physical achievements were recorded at satisfactory level. Significant productivity gains were recorded in both the watersheds as well as a slight preference towards commercial crops among the group of 'beneficiaries'. As regards the relevance, adequacy and sustainability of the programme is concerned, most of the respondents felt that the watershed treatments are relevant but not adequate. They recorded differential opinion about the sustainability across the various components of the technology. Analysis of people's participation showed totally different results in the two agro-climatic regions. Similarly, the influence of '*Mitra-Kisan*' or '*Gopal*' was felt quite limited. Only 10 to 14 per cent of the beneficiaries have participated in the meetings at planning stage in the Temperate Zone but the participation was slightly higher than this in the Sub-tropical Zone.

Among the major constraints faced under the programme three are quite important. Firstly, the input delivery system in the hill regions needs to be improved substantially. In the absence of timely availability of inputs, the cultivators have to compromise and this results in lower level of yields per hectare. Secondly, the marketing channels are not well established and most of the cultivators have to depend upon the contractors to sell their produce. Thirdly, the components of NWDPR were not planned keeping in view the requirements of the region. Farmers were not taken into confidence at the planning stage and this has resulted in non-sustainability of the watershed structures.

The State of West Bengal does not strictly fall under hill region but the districts selected by AERC, Shantiniketan, namely, Darjeeling and Birbhum come under hill regions and hence we preferred to analyse it under this chapter. These districts fall in the northern hilly regions of West Bengal. The experience of the implementation of NWDPR in West Bengal is not very encouraging. The total uptake of the funds has not been more than 40 per cent of the allocation in any year from the beginning of the programme. This points to the possibility of either weak planning or tardy implementation or both. The picture across districts is also more or less the same and the research team noted only a few districts which have exceeded 40 per cent mark in the expenditure of the allocated funds. The research team pointed out that the magnitude of the expenditure on assigned purposes has been neglected.

The micro-level impact of the programme has also not been very encouraging. The productivity, employment or other indicators on the fields of beneficiary do not show encouraging changes when compared with the non-beneficiaries. The research team clearly recorded a gap between the beneficiaries and the implementing agencies. This has caused a

choke in the information flow and thereby differential impact of the programme. The research team pointed out that unsuitable land, lack of information, financial limitations, non-availability of irrigation, high cost of inputs, untimely supply of inputs as the major constraints operating on productivity of crops. The environmental impact, sustainability, relevance and adequacy of watershed technology does not feature in the report. Lack of participation of the intended beneficiaries was pointed out as the major constraint. Even the efforts were not made to ensure such participation. The official machinery devised to implement the programme did not participate effectively and all these together resulted in the tardy progress of NWDPR in the State.

The situation in Assam has been quite different as compared to the other hill regions analysed above. The programme was launched in the State taking 110 watersheds for the purpose of development. Assam has a specificity of having large area under forest and hence the programme of NWDPR has to be tailored keeping in view the agriculture-forest linkages. The five tier system of implementing institutions was constituted in Assam but the impact of this elaborate arrangement was not discernible. At macro-level the uptake of funds as proportion of total allocation was satisfactory. The expenditure on the project comes to more than 60 per cent of the allocated funds.

For the purpose of micro-level analysis, the research team selected two micro-watersheds, one in the Upper Brahmaputra Valley and another in the Central Brahmaputra Valley. The research team chose to conceptualise beneficiaries as those who have received one or the other direct benefit from among the various schemes of the project. Hence, some times the non-beneficiaries have their land within the watershed boundary. Therefore, the differences on the fields of beneficiaries and non-beneficiaries are not perceptible. Even then the beneficiaries showed marginally better performance than the non-beneficiaries which is more a testimony of their participation in the programme. The cultivators from Lakhinizara watershed showed keen interest in the working of 'Mitra-Kisan' and 'Gopal' but the selected persons were not effective as Mitra Kisan or Gopal. The most vital component of sustainability, relevance and adequacy of the technology from the environmental point of view were not investigated by the research team.

The constraints pointed out by the research team included (i) poor administrative set up to manage the programme; (ii) lack of co-ordination; (iii) inadequacy of project funds; (iv) lack of training and technical support and (v) faulty planning. All these constraints point towards the hasty implementation of the programme without proper planning. It was felt that a proper bench mark survey and an elaborate work plan for the State would have been quite helpful. Various teams constituted at different levels need to participate in the regular process of implementation and monitoring of the programme but in practice this did not happen.

Overall impact of the programme needs to be looked from the point of view of three important sub-systems. Firstly, the impact on the production sub-system has to be analysed from the point of view of resource management, production system and technological changes. These changes can be ascertained through the impact on productivity and adoption level of new technology. Secondly, the most important changes brought about by watershed treatment are the changes in the domain of the environmental externalities. Positive externalities are planned and enhanced whereas, an attempt is made towards reducing the negative externalities. Lastly, the watershed treatment intervenes with the socio-economic parameters like distribution of income, generation of employment, adoption of new technology, capital formation etc. In Table 8.2, we tried to present the allocations for

NWDPRA during eighth plan period and in search of the rationale for such allocation. We have computed the plan allocations per hectare of rainfed area across the States (as the programme of National Watershed Development specifically aimed at the treatment in the rainfed areas). The results are quite intriguing, with Haryana getting Rs.141 per hectare of its rainfed area as allocation during eighth plan as against Rs.128 for Gujarat or Rs.115 for Madhya Pradesh (the States having large spans of rainfed area). We hasten to add that, it is not necessary to have a strict one to one correspondence in terms of allocation to the quantum of rainfed areas, however, it is essential to keep some ordering and preferences across States.

Table 8. 2: State-wise Allocation Proposed During Eighth Plan

Sl. No.	State	Allocation to NWDPRA during 1990-1997 (VIII Plan) (Rs. in lakhs)	Per cent to Total	Per hectare of Total Rainfed Area (in Rs.)
1.	Andhra Pradesh	9161	6.88	117.11
2.	Assam	2843	2.13	86.47
3.	Gujarat	9742	7.31	128.13
4.	Haryana	1884	1.41	141.30
5.	Himachal Pradesh	646	0.49	79.34
6.	Madhya Pradesh	21517	16.16	115.32
7.	Maharashtra	21138	15.87	120.19
8.	Tamil Nadu	4151	3.12	101.66
9.	Uttar Pradesh	9751	7.32	89.84
10.	West Bengal	4484	3.37	72.62
	India	133189	100.00	107.30

Notes: 1. We have included here only the States for which the impact evaluation studies have been conducted.

2. Percentages will not total to 100 as we have not included the other States.

Source: 1. Basic data on allocations from Shah and Patel (1996)

2. Data on Land Use from Fertilizer Statistics: 1990-91.

We have presented the impact of NWDPRA at a glance in Tables 8.3, 8.4 and 8.5. It is very clear from the tables that the impact is of mixed nature across States. However, four important aspects come out very boldly out of the tables. The impact of watershed development treatments can be grouped into three broad groups viz., (i) the impact on economic parameters, (ii) the impact on institutional parameters, and (iii) the impact on environmental parameters. Among the economic parameters crop productivity, employment, commercialization of agriculture, adoption of new technology and incremental income become important characteristics. Firstly, the impact parameters indicate yield and employment improvement across the States. This cannot be fully attributed to NWDPRA but still this impact parameter is easily discernible. Secondly, the administrative machinery recommended under WARASA has not been properly functioning in all the States. Thirdly, the adoption of new technology and shift towards cash crop was

Table 8.3: Impact of NWDPR Parameters at a Glance - Western and Central Rainfed Zone

Sl. No.	Impact Parameters	Western and Central Rainfed Zone			
		Guja.	M.P	Mah.	Raj.
A	Economic Impact Parameters				
1.	Improvement in Productivity per hectare	High	MOD	SIG	MOD
2.	Improvement in Employment	MOD	SIG	SIG	MOD
3.	Shift towards higher remunerative crops	High	High	MOD	Low
4.	Incremental Net Income per ha (Beneficiaries – Non-beneficiaries)	High	Low	High	MOD
5.	Adoption Level of New Technology	MOD	High	High	Low
B	Institutional Impact Parameters				
1	Effectiveness of Administrative Machinery	High	Low	MOD	Low
2.	Efficiency of the Multi-disciplinary Approach	High	Low	MOD	Low
3.	Adequacy of the Programme	AD	INAD	AD	INAD
4.	Relevance of the Programme	REL	REL	REL	REL
5.	People's Participation				
	i. Planning Process	MOD	Low	MOD	Low
	ii. Implementation	MOD	Low	Low	Low
	iii. Mitra Kisan and Gopal	MOD	MOD	MOD	MOD
	iv. Sustenance	High	MOD	High	Low
C	Environmental Impact Parameters				
1.	Sustainability of the Programme	MOD	MOD	High	Low
2.	Environmental Impact				
	i. Moisture Conservation	MOD	MOD	High	MOD
	ii. Biomass Generation	MOD	High	MOD	Low
	iii. Groundwater repletion	High	High	MOD	MOD
	iv. Arresting soil degradation	High	NA	High	NA

Notes: The levels of impact are scaled on an ordinal scale keeping in view a comparative perspective. MOD - Moderate; SIG - Significant; AD - Adequate; INAD: Inadequate; REL - Relevant. NA - Indicates the parameter not specifically analysed in the study. Guja - Gujarat; M.P - Madhya Pradesh; Mah - Maharashtra; Raj - Rajasthan.

Table 8.4: Impact of NWDPR Parameters at a Glance - Southern Plateau and Hill Regions and Northern Gangetic Plains

Sl. No.	Impact Parameters	Southern Plateau and Hill Regions		Northern Gangetic Plains	
		AP	TN	Har.	UP
A	Economic Impact Parameters				
1.	Improvement in Productivity per hectare	High	High	MOD	High
2.	Improvement in Employment	MOD	MOD	SIG	MOD
3.	Shift towards higher remunerative crops	MOD	High	High	MOD
4.	Incremental Net Income per ha (Beneficiaries - Non-beneficiaries)	High	High	MOD	High
5.	Adoption Level of New Technology	High	MOD	High	MOD
B	Institutional Impact Parameters				
1.	Effectiveness of Administrative Machinery	High	MOD	Low	Low
2.	Efficiency of Multi-disciplinary Approach	High	MOD	NA	MOD
3.	Adequacy of the Programme	NA	NA	NA	NA
4.	Relevance of the Programme	NA	NA	NA	NA
5.	People's Participation				
i.	Planning Process	MOD	Low	Low	Low
ii.	Implementation	High	Low	MOD	Low
iii.	Mitra Kisan and Gopal	MOD	Low	MOD	MOD
iv.	Sustenance	MOD	MOD	MOD	Low
C	Environmental Impact Parameters				
1.	Sustainability of the Programme	MOD	Low	NA	MOD
2.	Environmental Impact				
i.	Moisture Conservation	NA	NA	MOD	High
ii.	Biomass Generation	NA	NA	High	MOD
iii.	Groundwater repletion	NA	NA	MOD	MOD
iv.	Arresting soil degradation	NA	NA	MOD	MOD

Notes: The levels of impact are scaled on an ordinal scale keeping in view a comparative perspective. MOD - Moderate; SIG - Significant; NA - Indicates the parameter not specifically analysed in the study; AP - Andhra Pradesh; TN - Tamil Nadu; Har - Haryana and UP - Uttar Pradesh.

Table 8.5: Impact of NWDPR Parameters at a Glance – Hill Region

Sl. No.	Impact Parameters	Hill Region		
		HP	WB	Assam
A	Economic Impact Parameters			
1.	Improvement in Productivity per hectare	High	MOD	MOD
2.	Improvement in Employment	MOD	MOD	Low
3.	Shift towards higher remunerative crops	Low	MOD	Low
4.	Incremental Net Income per ha (Beneficiaries - Non-beneficiaries)	High	MOD	MOD
5.	Adoption Level of New Technology	MOD	Low	Low
B	Institutional Impact Parameters			
1.	Effectiveness of Administrative Machinery	Low	Low	Low
2.	Efficiency of the Multi-disciplinary Approach	Low	Low	Low
3.	Adequacy of the Programme	AD	AD	AD
4.	Relevance of the Programme	REL	REL	REL
5.	People's Participation			
i.	Planning Process	Low	Low	Low
ii.	Implementation	Low	Low	MOD
iii.	Mitra Kisan and Gopal	MOD	Low	Low
iv.	Sustenance	Low	MOD	MOD
C	Environmental Impact Parameters			
1.	Sustainability of the Programme	Low	MOD	MOD
2.	Environmental Impact			
i.	Moisture Conservation	High	MOD	Low
ii.	Biomass Generation	High	MOD	Low
iii.	Groundwater repletion	NA	High	Low
iv.	Arresting soil degradation	NA	High	MOD

Notes: The levels of impact are scaled on an ordinal scale keeping in view a comparative perspective. MOD - Moderate; AD - Adequate; INAD - Inadequate; REL - Relevant. NA - Indicates the parameter not specifically analysed in the study; HP - Himachal Pradesh; WB - West Bengal.

noted prominently. Lastly, the new guidelines of NWDpra emphasised on participation of the community for which the programme is designed. With the evidence presented by various AERCs, the experience regarding this aspect is quite mixed. Almost uniformly across the States, the consultation during planning stage was totally absent. The plans were prepared without involving them. The experience of '*Mitra Kisan*' or '*Gopal*' is also not very encouraging. But possibly due to the realisation of benefits, the sustainability of the programme seem to have good prospects.

It was located that the watershed treatment has significantly high influence on the parameters governing economic impact across the regions except in the hilly regions. The institutional impact can be located into four important aspects namely, (i) the participation of the beneficiaries in the programme; (ii) implementation process of the programme; (iii) the effectiveness of the administrative machinery; and (iv) efficiency of multidisciplinary approach. The relevance and adequacy of the programme is more felt by the participants. It was noted that in most of the regions, the institutionalisation of watershed treatment failed to catch roots in the rural livelihood system. In most of the cases the participation had been fragmentary and could be withdrawn as soon as the watershed team withdraws from the treatment. This creates doubts about the sustainability of the programme and its long run effects. Therefore, most of the studies did not concentrate on the long run impact of watershed treatment. In the environmental impact analysis, we have responses both in short run and long run perspective in most of the studies reviewed here. However, given the stress on environmental parameters it is difficult to ascertain the correct position of the change in environmental parameters due to watershed treatment. Among environmental parameters we had taken the sustainability of the programme, moisture conservation, groundwater depletion, soil degradation and bio-mass augmentation as important components of the environmental impact analysis. The States coming under the Southern Plateau and Central Rainfed zone have shown significant impact on the environmental parameters whereas, the Southern and Northern zones did not report such situation. It was located that the hilly regions have alarming environmental problems therefore the impact on environment will be difficult to generalise. In the given situation and as depicted from the reports we get a view that NWDpra has helped in maintaining the environmental balance.

8.4 Policy Implications

1. The NWDpra has been taken as a nationwide programme with modified guidelines beginning with 1990-91. The programme name itself indicates that it is for rainfed areas thereby indicating top priority for the weakly endowed regions. However, this does not come out clearly in the allocations across districts within States and also across States in the country. Highly degraded lands and fragile resource regions should get priority.

2. It has been noted that the allocations indicated across components has been followed as a strict guideline. This gives rise to situation wherein expenditure on one activity is short of the target whereas, there is a dearth of funds in implementing other activity. Therefore, it is essential to allow at watershed level inter-component flexibility in the process of implementation.

3. It is observed that the funds allocated to primary (basic) activities in most of the States have not been fully utilised. This indicates either some mis-calculation while planning for allocations of this activity or implementation level bottlenecks. It is interesting to note that primary activities involve preparation of plans, survey of watershed etc. If the

cost of activities carried out under primary (basic) activities was rational and even roughly realistic then this hiatus between allocation and actual expenditure would not have occurred. It is necessary to have a second look at the allocations at the beginning of every financial year and revise them based on the feedback.

4. In most of the States, we come across situations where there are components which have shortage of funds and at the same time the allocations for some other activities are not fully utilised. Reallocation across activities needs an elaborate process and therefore funds could not be optimally utilised. Therefore, flexibility in the inter-component allocation of funds should rest with the watershed level administration. This can be accomplished with the help of technical officers working with the Watershed Development Team (WDT).

5. Watershed Development Teams have been constituted in most of the States. But these teams do not have enough flexibility to alter the designed programme without an elaborate process. Watershed level flexibility will simplify the work procedures as well as the achievements can be improved. Many times some components cannot be taken at field level due to certain difficulties. In such cases alternatives can be worked out with the help of the technical staff without much time lapse.

6. An elaborate organisational structure to implement and monitor NWDPRAs was suggested under NWDPRAs. In most of the States, such bodies have been constituted at State, division, district and watershed level. However, their meetings have been reported to be infrequent. It is necessary that these bodies meet periodically and provide guidelines for the ongoing programme. The proceedings of such meetings should be recorded and circulated among the concerned departments.

7. The guidelines of NWDPRAs recommended internal as well as external monitoring of the project. The internal monitoring is carried out with the help of the various bodies constituted for the purpose in the State. But there is hardly any evidence indicating monitoring by external agencies. Funds have been allocated for this purpose but most of the States have not taken any initiative in this regard.

8. Horizontal and vertical integration is an essential component for success in implementation of any programme. In the case of NWDPRAs, quite a few line departments are involved in the process of implementation and thus horizontal and vertical integration becomes crucial. It cannot be derived by constituting committees but needs to be monitored at a higher level. A proper incentive structure at lower level official cadre may help in attracting the officers from related disciplines.

9. The new concepts of '*Mitra Kisan*' and '*Gopal*' have shown mixed results across States. It is necessary to review the concept in terms of a group of '*Mitra Kisans*' or '*Gopals*' so that the spread effect is more penetrative.

10. As regards the adequacy, relevance and sustainability of the programme is concerned, in most of the States, the research teams have indicated that the programme was adequate and relevant. But there was a mixed reaction about the sustainability of the programme. In order to make NWDPRAs sustainable, it is essential to ask the beneficiaries to contribute either by sharing labour or cash contribution or in supervisory role, to the process of implementation. This would go a long way in deriving complete participation from the beneficiaries. Such participation can be accomplished with the help of village panchayats. The 73rd Constitutional amendment has incorporated the soil-conservation as well as agriculture in its Schedule 11, transferring the power to village panchayats regarding these. This can be used to the advantage of better implementation and enhancing people's participation.

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