

Executive Summary

**Rapid Impact Evaluation of NWDPR in
Maharashtra**

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Executive Summary

RAPID IMPACT EVALUATION OF NWDPRRA IN MAHARASHTRA

1. Introduction:

Rain-fed farming is predominantly practised in Indian agriculture. As of today, rain-fed cultivated area accounts for about 63 per cent in the gross cropped area. The contribution of rain-fed agriculture is phenomenal in the total production of cereals, pulses, oilseeds and cotton. Besides contributing a larger share to the food economy of the country, it also carries the major share of poor population of the nation. Though its importance in the aggregate growth of agricultural economy is well established, adequate steps were not taken to improve the overall condition of the rain-fed agriculture including the people living in these regions till the Sixth Five Year Plan. The green revolution programme introduced during the mid-sixties in Indian agriculture also could not make any perceptible change in the productivity of the crops cultivated in the rain-fed areas. Due to a larger constraint of irrigation water and poor agricultural growth, the capital formation both from private and public sectors has also not taken place at a required pace and quantum in the rain-fed areas. This has created severe problems for the people who depend on rain-fed cultivation for their livelihood. The level of poverty in these regions is very high and the seasonal out-migration of both people and livestock has been rampant in these regions.

Considering the urgent need of getting the rain-fed areas in the main stream agricultural growth, some programmes like Drought Prone Area Programme (DPAP) and Desert Development Programme (DDP) were taken up after the independence. But, these programmes could hardly solve the problems of the vast rain-fed areas because the introduced programmes were not comprehensive in nature. The Planning Commission, while reviewing the problems of rain-fed agriculture during the Sixth Five Year Plan period, has noted that the basic problems of the dry-land farmers are poor resource base, moisture stress and uncertainty in crop output leading to low income. Therefore, a large scale public investment comparable to that in irrigated areas is the basic requirement for the improvement of rain-fed agriculture. Keeping this in view, during the Sixth Plan, some model watershed programmes were introduced in certain areas of the rain-fed regions with the help of the Government of India and the World Bank with an aim to improve the overall performance of agriculture. These model projects have shown very encouraging results. Having seen the results, for the first time, during the Seventh Five Year Plan period, the National Watershed Development Project for Rainfed Areas (NWDPRRA) was introduced at a massive scale covering different regions of the country. The NWDPRRA was introduced with three fold objectives, namely, (i) taking the watershed as a basis to conserve and upgrade crop lands and waste lands as a vital resource; (ii) to develop and demonstrate location specific technologies for proper soil and moisture conservation measures and crop production; (iii) to augment the fodder, fruit and fuel resources of the village communities by use of

appropriate alternative land use system. These objectives were further revised and expanded in the subsequent plan periods using the feedback received from various studies. In the present study, an attempt has been made to study the impact of NWDPRRA programme on certain parameters in Gaosud Watershed, located in Osmanabad district of Maharashtra State. This project was implemented during the Eighth Five Year Plan period.

2. Objectives of the Study:

1. To find out the impact of the project on various forms of water bodies/water harvesting structures and their long-term impact on depth of water table in the dug well/recharge well.
2. To analyse the changes in cropping pattern, crop sequencing and crop components under the production systems in arable lands.
3. To analyse the socio-economic status of project beneficiaries against non-beneficiaries.
4. To analyse the over all changes in bio-mass production in the form of grasses, legumes, fodder, fuel-wood, horti-plantation canopies in treated watershed against the control.
5. To find out the status of migration of people, especially land-less labourers and livestock from watershed to outside area.

3. Methodology:

Osmanabad district of Maharashtra has been selected for this study as per the advise of the Ministry of Agriculture, Government of India, New Delhi. During the Eighth Five Year Plan period, six watershed projects were implemented in Osmanabad district under the NWDPRRA programme covering 10207 hectares of geographical area with an amount of Rs. 268.01 lakhs. As suggested by the Ministry of Agriculture, Government of India, we have selected one watershed out of six watersheds with the help of the officials of Directorate of Soil Conservation and Watershed Management, Government of Maharashtra, Pune and the officials who are involved in the NWDPRRA project at Osmanabad district. The name of the watershed selected for this pilot study is Gaosud Watershed, which comes under Osmanabad taluka. This watershed comes under the scarcity zone (071) as per the classification of agro-climatic zone.

With regard to selection of sample households, to understand the impact of watershed programme on land owning households, 20 beneficiary households (farmers having lands within the watershed area) and 20 non-beneficiary households (farmers having lands outside the boundary of watershed area) have been selected. In addition to this, 10 land-less labour households (5 each from watershed area and non-watershed area) have been selected to study the impact of watershed programme on labour households. Thus, a total of 50 sample households have been selected for this study. While sample households from the watershed area have been selected using random sampling method, purposive sampling method has been followed to select

sample households from the non-watershed area. Data relating to different aspects required for the study have been collected for both pre-project period (1991-92) and post-project period (1998-99) from the sample households. To assess the impact of watershed development programme on different parameters, comparison has been made between the beneficiary households and the non-beneficiary households.

4. Major Findings of the Study:

In the total outlay (Rs.100.69 lakhs) of the Gaosud watershed project, about 83 per cent has been utilised for various activities for the development of watershed. Drainage line treatment (36 per cent) and arable land conservation measures including production system (34 per cent) together accounted for over 70 per cent of the total expenditure of the project. Though Rs. 8.60 lakhs were allocated for the livestock management, the utilisation was only about 14 per cent under this head.

Under the drainage line treatment, 500 live-check and brushwood dams, 300 loose boulder check dams, 500 loose boulder structures, 300 earthen structures and 39 run-off management structures have been constructed using Rs. 30.75 lakhs. However, small dug-out ponds were not constructed under this programme.

The land utilisation pattern of the beneficiary households is distinctly different from the non-beneficiary households though the average land holding size is relatively higher for the non-beneficiaries (4.84 ha.) as compared to the beneficiaries (4.52 ha.). While the cultivable wasteland accounts for 14 per cent of the total land holdings of the beneficiaries, the same comes to over 30 per cent for the non-beneficiaries. Net cultivated area accounts for about 85 per cent in the total land holdings of the beneficiaries whereas, the same is about 68 per cent for the non-beneficiaries. Area cultivated more than once accounts for over 49 per cent of the land holdings of the beneficiaries but, it comes to only 29 per cent for the non-beneficiaries.

Area under irrigation is substantially higher for the beneficiary households when compared to the non-beneficiary households though well irrigation accounts for major share among both group of households. The average gross irrigated area comes to 4.05 ha/household for the beneficiaries but, it is only 0.91 ha/household for the non-beneficiaries. While the percentage of irrigated area to gross cropped area (GCA) comes to as high as 78 per cent for the beneficiaries, the same comes to only about 20 per cent for the non-beneficiaries. Various treatments taken under the watershed development programme for rainwater harvesting have increased the area under irrigation for the beneficiary households.

The well (irrigation) owning beneficiary households has increased significantly from 15 per cent in pre-project period (1991-92) to 75 per cent in post-project period (1998-99). This is mainly because of assured availability of water in the wells due to treatments taken under the watershed development programme. Among the non-beneficiary households, although the farmers owning wells have increased from 10 per cent to 40 per cent during this period, most of the wells have suffered with poor recharge of water due to absence of any structured rainwater harvesting system.

Water level in the irrigation wells owned by the beneficiaries has increased significantly from the pre-project period to the post-project period. Similar trend is also observed in the wells of neighbouring farm as well as in the drinking water wells. In *kharif* season, water level of the irrigation wells has increased about 120 per cent (28 feet from bottom of the well to 61.70 feet) between the two periods considered for the analysis. The increase of water level in the irrigation wells is about 348 per cent during *rabi* season. Importantly, during the summer season, the water level has increased about 1068 per cent (from 5 feet to 58.4 feet) in the wells owned by the beneficiaries. In contrast to this, water level of the wells owned by the non-beneficiaries has declined (in all the three seasons) between the two periods considered for the analysis.

The long-term impact of various water harvesting structures created under the watershed development programme is expected to have positive impact on water level in the wells because of two reasons. First, though there were fluctuations in the rate of rainfall after implementing the watershed development programme, it has not made any adverse impact on the depth of water level in the wells. Second, the beneficiary farmers have clearly understood the importance of various water harvesting structures which helped improving the water level in the wells and thus, the beneficiaries are expected to continue to maintain the water harvesting structures through collective participation.

The cropping pattern of the beneficiaries is distinctly different from that of the non-beneficiaries. Crops such as jowar, tur and udid are the important crops of *kharif* season for both the beneficiaries and the non-beneficiaries. Except udid, there are major differences in the share of these crops to gross cultivated area between the two groups households. Crop area of *kharif* season accounts for nearly three fourth of the gross cultivated area of the non-beneficiaries whereas, the same accounts for about 64 per cent in the beneficiary households.

In the cropping pattern of *rabi* season, we have observed a clear cut difference between the two groups. In the total cropped area of *rabi* season, wheat (water-intensive crop) accounts for nearly 39 per cent in the beneficiary group while, its share is only 14 per cent in the non-beneficiary group. Less water-intensive crops like *rabi* jowar account for about 82 per cent of the total *rabi* area of the non-beneficiary households.

While the annual and perennial crops are completely absent in the cropping pattern the non-beneficiary households, the annual crops (sugarcane and fruit crops) account for about 8 per cent of GCA of the beneficiary households. Sugarcane (a heavy water-intensive crop) accounts for nearly seven per cent of GCA of the beneficiary households. In 1998-99, seven sample farmers out of 20 have cultivated sugarcane. Before the introduction of watershed development programme, only one farmer was cultivating sugarcane that too in 0.40 ha. of area.

The total share of irrigated crops¹ to GCA is much higher for the beneficiary households than that of the non-beneficiary households. Area under irrigated crops

¹ The crops considered for this estimate are paddy, groundnut, wheat, gram, sugarcane and fruit crops.

accounts for about 27 per cent of the GCA for the beneficiaries whereas, the same accounts for only about 10 per cent in the non-beneficiary group.

The watershed development programme (WDP) has brought changes in crop sequences because of increased availability of irrigation for the beneficiaries. Before the introduction of WDP, the important crop sequences were; (i) green gram - rabi jowar; (ii) kharif jowar - gram; and (iii) jowar + tur. Annual and summer crops were completely absent in this area before the introduction of WDP. This has completely changed now due to WDP. The present crop sequences of the beneficiaries are: (i) hybrid jowar - wheat - vegetable crops; (ii) hybrid jowar + tur - vegetable crops; (iii) moong - rabi jowar - vegetable crops; (iv) sugarcane, and (v) fruit crops.

Majority of the beneficiaries have been continuing with mixed and inter-cropping system even after the introduction of WDP. However, some of the farmers especially those having lands at the lower reach of the watershed, have started cultivating sole crop in the recent years. This is due to higher availability of irrigation water. Similar changes are not observed among the non-beneficiaries.

The overall adoption of improved farming practices is not only higher among the beneficiaries when compared to the non-beneficiaries but also increased substantially over the pre-project position. While all the 20 beneficiaries have used high yielding/hybrid varieties, 16 out of 20 non-beneficiaries have used these varieties for different food-grain crops. As far as the use of fertilisers is concerned, about 70 per cent the beneficiaries have used chemical fertilisers for different crops, whereas, the same comes to 55 per cent for the non-beneficiary group. About 50 per cent of the beneficiaries have used tractors for ploughing but, only 10 per cent of the non-beneficiaries have used tractors. While all the 100 per cent of the beneficiaries have used mechanical threshers for threshing cereal crops, only about 15 per cent of the non-beneficiaries have used this. Assured output due to increased availability of irrigation has induced the beneficiaries to adopt improved farming practices for different crops.

Cost of cultivation² is higher for the beneficiaries' farm when compared to the non-beneficiaries' farm for majority of the crops due to higher use of yield increasing inputs. The difference in cost of cultivation between the beneficiaries' farm and the non-beneficiaries' farm comes to about 51 per cent for yellow jowar, 26 per cent for hybrid jowar, 35 per cent for bajra, 16 per cent for tur, 55 per cent for groundnut and about 12 per cent for rabi jowar.

The productivity of crops (except some pulse crops) is higher for the beneficiaries when compared to the non-beneficiaries. The productivity difference between the two group of farmers comes to about 36 per cent for hybrid jowar, 81 per cent for tur, 73 per cent for udid, 166 per cent for paddy, 57 per cent for rabi jowar and about 41 per cent for wheat. Higher use of yield increasing inputs and less moisture stress have helped the beneficiaries to obtain higher yields from different crops.

² Our cost of cultivation refers to Cost A₁.

To understand the impact of WDP on socio-economic condition of the beneficiary households, we have studied three aspects: employment position, assets position including livestock and household income from different sources. In the status of employment, a substantial differences have observed between the beneficiaries and the non-beneficiaries. During the pre-project period, both the group of households were hiring-out 46 to 51 per cent of their total labour days per year. In the post-project period, this has changed completely. The beneficiary households have hired-out only about 23 per cent of their total labour days (374 days) and the remaining days are used in their own farm itself. In the non-beneficiary households, over 46 per cent of their total labour days (376 days) were hired out and no change was observed in this between the two periods considered for the analysis. Due to intensive agricultural activities in the watershed area, the beneficiary households could use their labour days (which were hired-out earlier) in their own farm itself.

The assets position of the beneficiary households is not only better than the non-beneficiary households but also improved significantly over their own pre-watershed position. In 1998-99, the total value of assets (excluding lands) comes to Rs. 84,277/household for the beneficiaries and Rs. 53,576/household for the non-beneficiaries. While the value of assets increased by about 170 per cent for the beneficiary households between pre and post-project period, the same has increased only by about 39 per cent for the non-beneficiary households. Among the farm assets, number of electric pumpsets owned by the beneficiaries have increased from four in pre-watershed period to 21 in 1998-99. The number of electric pump-set has increased only from two to three during this period among the non-beneficiary households. In the non-farm assets, both the value of house and the number of households owning TV sets have increased significantly for the beneficiaries after the introduction of watershed development programme. Although the total value of livestock has increased from Rs. 12,650/household in pre-project period to Rs. 19,457/household in post-project period for the beneficiaries, there is no significant difference in this between the two group of households in 1998-99.

The gross income of the beneficiary households has not only increased significantly over their pre-project position but also substantially higher than that of the non-beneficiary households. In 1998-99, while the per household income comes to about Rs. 71075 for the beneficiaries, the same is only Rs. 34000 for the non-beneficiary households, indicating a difference of about 109 per cent. Among different sources of income of the beneficiary households, income from crops has significantly increased: from Rs. 14330/household in pre-project period to Rs. 53675/household in post-project period, an increase of about 275 per cent. In contrast to this, the crop income has increased only by about 89 per cent (from Rs. 8540 to Rs. 16200) for the non-beneficiary households during this period. In 1998-99, crops income accounts for over 75 per cent in the total income of non-beneficiary households, whereas, the same accounts for only about 47 per cent for the non-beneficiary households. The share of livestock income to the total income of the households is relatively higher for the non-beneficiaries (about 38 per cent) when compared to the beneficiaries (about 15 per cent).

The availability of fuel-wood has increased from 16 quintals per household in pre-project period to 22 quintals per household in 1998-99 (an increase of 31 per cent) for the beneficiaries. Similarly, fodder availability (grass, legumes and others)

has increased from 48 quintals to 58 quintals (an increase of 20 per cent) for the beneficiaries during the period considered for the analysis. Contrary to this, for the non-beneficiaries, while the availability of fuel-wood has increased just one quintal (from 16 to 17 quintals), a reduction of three quintals (from 52 to 49 quintals) is observed in the fodder production between the two periods. In 1998-99, the availability of fuel-wood and fodder is higher by 21 per cent and 18 per cent respectively for the beneficiary households over the availability of the non-beneficiary households.

As in the case of land owning households, the watershed development programme has also brought some advantages for the land-less labour households in certain parameters. One among the benefits is the increased availability of casual employment days. The available days of employment to the land-less labour households of the watershed area is not only higher than that of the non-watershed area but also increased significantly over its pre-project position. During the year 1998-99, while the availability of employment was 444 days per labour household belonging to the watershed area, the same was 314 days for the labour households of the non-watershed area, a difference of 41 per cent. The increase of employment days between the two periods considered for the analysis comes to 60 per cent for the labour households of the watershed area but, the same comes to only about 26 per cent for the labour households belonging to the non-watershed area. Factors like increased cropping intensity, cultivation of annual and water-intensive crops in the watershed area have increased the availability of casual employment days for land-less labour households of the watershed area.

The seasonal out-migration is very less among the land-less labour households in the watershed area both before and after the introduction of the project. During the pre-watershed period, three out of five land-less labour households were involved in out-migration and this declined to two in 1998-99. Employment days gained through out-migration declined from 36 days per household in pre-project period to 18 days per household in 1998-99. The migration status of the land-less labour households of the non-watershed area is also not much different from the watershed area. Since the watershed is very near to Osmanabad city (8 km), the land-less labourers of this area traditionally get labour works at the city itself during the lean season. This does not encourage the land-less labourers to go for out-migration in search of employment opportunities. We have also not observed any seasonal out-migration of livestock owned by the land-less labour households in the sample area, both before and after the introduction of watershed development programme. This is due to poor position of livestock among the land-less labour households.

As in the case of land owning households, the availability of fuel-wood materials and fodder have increased for the land-less labour households of the watershed area after implementing the project. The availability of fuel-wood materials have increased from 9.6 quintals per household in pre-project period to 15.2 quintals per household in 1998-99, an increase of about 58 per cent. Similarly, fodder availability has increased from 3.2 quintals per household to 6.4 quintals per household (an increase of 100 per cent) during this period. The availability of fuel-wood materials and fodder are about 100 per cent and 45 per cent respectively higher for the land-less labour households of the watershed area over the availability of land-less labour households belonging to the non-watershed area.

5. Policy Suggestions:

1. Some of the farmers owning lands in the lower reaches of the watershed area, have started cultivating water-intensive crops like sugarcane using bore-well irrigation in the recent years. Exploitation of groundwater is very high among these farmers compared to others. This, besides creating adverse impact in the groundwater level, will affect the farmers who own dug-wells in the future. Therefore, keeping in view the food security of the people belonging to the watershed area, necessary measures should be introduced to stop the reckless exploitation of groundwater by restricting the cultivation of water-intensive crops like sugarcane in the watershed area (**Attention to: The Ministry of Agriculture, Government of India, New Delhi and The Department of Soil Conservation and Watershed Management, Government of Maharashtra, Pune**).

2. Efficient use of irrigation water is essential for achieving sustainable growth in agriculture, especially in the watershed area. Therefore, water-intensive crops should not be allowed to cultivate under flood (conventional) method of irrigation where water use efficiency is very low. However, the cultivation of water-intensive crops like sugarcane and fruit crops can be encouraged by drip method of irrigation, which is proved to be most efficient method of irrigation (Narayanamoorthy, 1997) (**Attention to: The Ministry of Agriculture, Government of India, New Delhi**).

3. Various rain water harvesting structures created under the watershed development programme are not in good shape in many places in the whole watershed area due to downpour and poor maintenance. Since rain water harvesting structures are essential for increasing the level of water in the wells and soil moisture availability, these structures are required to be maintained through collective participation of the beneficiaries. At present, the participation of the beneficiaries seems to be declined and therefore, the concerned authorities should take necessary steps to revitalise the participation of the beneficiaries in the watershed related works by explaining the importance of farmers' participation in managing the rain water harvesting structures (**Attention to: The Department of Soil Conservation and Watershed Management, Government of Maharashtra, Pune**).

4. Although Gaosud watershed comes under the scarcity zone, the villages of the watershed area never faced any drinking water problem especially after the introduction of watershed development programme despite wide fluctuations in the rainfall. Therefore, mini-watershed work can be taken up wherever possible not only for improving the performance of rain-fed agriculture but also to make permanent remedy for drinking water problem faced by the rain-fed areas of different States in the recent months (**Attention to: The Ministry of Rural Development and The Ministry of Agriculture, Government of India, New Delhi, and The Department of Rural Development and Department of Agriculture, Government of Maharashtra, Pune**).

5. Although majority of the beneficiaries have used high yielding/hybrid varieties for cultivating cereal crops, the newly released varieties are not used commonly in pulse crops. Moreover, many farmers have used their own crop produce as seed in pulse crops. As a result of this, the productivity of pulse crops is

low for the beneficiaries' farm despite less moisture stress. Since area under pulse crops accounts for considerable share in the total cultivated area of the watershed, farmers should be advised to use high yielding varieties (including quality seed) for increasing the productivity through quality extension services (**Attention to: The Department of Agriculture, Government of Maharashtra, Pune**).

6. In order to fully utilise the allocated funds and to harness the maximum potential benefits from the watershed development programme, it is essential to bring all the watershed development activities under a single control at the watershed level. This will also help to improve the planning and implementation of the watershed development programme in a better way (**Attention to: The Department of Soil Conservation and Watershed Development, Government of Maharashtra, Pune**).

7. Development of livestock is essential for increasing as well as stabilising the household income in the rain-fed areas. However, the utilisation of funds allocated for the livestock development was very low in this project. Therefore, keeping in view the importance of livestock, more emphasis should be given to utilise the funds allocated for the livestock management under the watershed development programme (**Attention to: The Department of Soil Conservation and Watershed Development, Government of Maharashtra, Pune**).

8. To improve the quality of planning and implementation, Universities and Research Institutes may be allowed to involve along with the watershed development agency right from the planning stage of the watershed development programme (**Attention to: The Department of Soil Conservation and Watershed Development, Government of Maharashtra, Pune**).

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Foreword

Rainfed farming has been traditionally practiced in India's agriculture. It accounts for over 63 per cent of cultivated area and contributes substantially in the total production of food-grains, oilseeds and cotton. In spite of this, the level of poverty is very high in these regions mainly due to strong constraint of water availability and inadequate capital formation both from private and public sectors. The people living in the rainfed areas are unable to actively participate in market activities both as producers and consumers due to poor performance of agriculture. The Green Revolution introduced in the mid-sixties also could not bring any discernible improvement in the rainfed areas. This has created serious concern among the policy makers and forced them to introduce a comprehensive programme for the development of rainfed regions. In view of this, a comprehensive programme entitled the National Watershed Development Project for Rainfed Areas (NWDPA) was introduced during Seventh Plan on a massive scale, covering different parts of rainfed regions in the country. The basic objective of the programme is to improve the overall conditions of agriculture and the people living in the rainfed areas by arresting the rain water run-off and improving soil moisture availability. This programme also continued in the Eighth Plan with the expanded objectives and increased financial outlay.

In order to understand the beneficial impact of the watershed development programme, the Ministry of Agriculture, Government of India advised the Institute to evaluate one of the watersheds located in Osmanabad district of Maharashtra. In this context, a modest attempt has been made in this study to find out the impact of Gaosud Watershed on different parameters such as water level in the wells, irrigated area, cropping pattern, productivity of crops, gross income, assets position, availability of fodder and fuel wood, etc., mainly using field level data. This Gaosud Watershed was taken up for treatment during the Eighth Plan under the NWDPA scheme. Dr. A. Narayanamoorthy and Dr. K.G. Kshirsagar of our Institute have carried out this study.

The study compared a sample of beneficiaries of the programme with that of non-beneficiaries (i.e., farmers with lands in contiguous areas outside the watershed) in respect of the above-mentioned parameters. The results of the study show that the watershed programme, besides changing the cropping pattern from low value crops to high value crops, also made remarkable improvement in water level of the wells, irrigated area, adoption of improved farming practices, productivity of crops, gross income, assets position and availability of fodder and fuel wood for the land owning households. This programme has also markedly improved the employment days, fodder and fuel wood availability for the land-less labour households. The study suggests that watershed development programme can be taken up wherever possible not only for improving the performance of rainfed agriculture but also as a permanent remedy for the drinking water problem of the rural areas.

It is hoped that the findings of the study would be useful for making policies relating to rainfed areas besides helping the researchers working in the area of watershed technology.

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V.S. Chitre
Director

Preface

Rainfed agriculture is predominantly practiced in India and it contributes substantially to the food economy of the country. However, because of strong constraint of water for irrigation and inadequate capital formation both from public and private sectors, the incidence of poverty is very high in rainfed areas. The new agricultural technology introduced during the mid-sixties also could not make any perceptible improvement in agriculture as well as in the living standard of the people. Considering the importance and potential of rainfed areas in the aggregate growth of agriculture and rural economy, a comprehensive programme entitled the National Watershed Development Project for Rainfed Areas (NWDPR) was introduced during the Seventh Plan on a large scale covering different parts of the country. The main objective of this programme was to improve the overall performance of rainfed areas. This programme has been in operation since the Seventh Plan in the country. In this study, we bring out the impact of the NWDPR programme on different parameters using the field level data collected from one of the watersheds located in Osmanabad district in Maharashtra. This watershed was taken up for treatment during the Eighth Plan.

This study was carried out in the Agro-Economic Research Centre of the Institute as per the advise of the Ministry of Agriculture, Government of India, New Delhi. While carrying out the study, we have benefited from different individuals at different stages of the study. We are grateful to Dr. J.P. Mahalle, Director, Dr. S.D. Wankhede, Joint Director and Shri R.B. Deshmukh, Technical Officer, Department of Soil Conservation and Watershed Management, Government of Maharashtra, Pune for providing all possible help whenever we required. Many officials working in the Government Departments at Osmanabad district have also helped for this study. Among them notable are Shri S.G. Purke, District Superintending Agricultural Officer, Shri D.M. Zende, Sub-Divisional Agricultural Officer, Shri V.V. Patil, Agricultural Officer of Osmanabad Taluka, Shri D.R. Jadhav, Circle Agricultural Officer, Shri R.M. Ingle and Shri U.A. Pathan, Assistant Agricultural Officers. We thank sincerely all of them for providing information and also extending all possible support to complete the field survey.

Prof. V.S. Chitre, Director of our Institute, has taken keen interest right from the beginning of the study and granted all possible support that required for the completion of the study. We express our sincere gratitude to him. The onerous duty of field work including the final tabulation of the results was done by Shri S.S. Dete and Shri V.B. Lokare of our Institute. Shri Bipin K. Deokar has helped us in processing the field level data. We are thankful to all of them for their indefatigable help. Finally, we would like to thank all our sample respondents for providing necessary information without any expectation. Nevertheless, none of the individuals mentioned above are responsible for errors remaining in the study.

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Chapter 1

INTRODUCTION

1.1 Introduction:

In India, despite massive development of irrigation since the independence, area under rain-fed cultivation accounts for over 63 per cent of the gross cultivated area as of today. Rain-fed area contributes over 42 per cent of total food-grains production and over 75 per cent of total production of pulses, oilseeds and cotton (Singh, 1988). Majority of the rural population also depend upon rain-fed crops for their livelihood. In spite of importance of rain-fed agriculture in the aggregate growth of Indian economy, adequate attention was not given for the development of rain-fed agriculture till the Sixth Five Year Plan. The new seed-fertiliser technology introduced in the mid-sixties also could not bring any impressive improvement in the productivity of the crops cultivated under rain-fed condition due to various constraints. The constraint of water availability is very strong and the capital formation, both from public and private sectors, also did not take place at the required level in these regions. As a result of these, the following problems are commonly observed in the rain-fed areas. First, the farmers of these areas could not change the cropping pattern from low value crops to high value crops. Second, the productivity of different crops not only fluctuates widely but it is much lower than the crops cultivated under irrigated condition. Third, because of slow growth of agriculture, the population of rain-fed areas could not actively participate in the market activities both as producers as well as consumers. Fourth, the adverse irrigation availability of these areas has compelled the farmers to depend on forest and similar resources. This has made enormous pressure on these resources. Fifth, because of low growth of

agriculture, the employment opportunities and the wage rates of these regions are very low which resulted in high incidence of poverty in these areas. Sixth, the seasonal out-migration has become a common phenomenon in these areas because of poor performance of agriculture and less employment opportunities.

While reviewing the problems of rain-fed agriculture during the Sixth Five Year Plan, the Planning Commission has noted that the basic problems faced by the dry land farmers are poor resource base, moisture stress and uncertainty in crop output leading to low income. Therefore, public investment and intervention on a scale comparable to that in irrigated areas are the basic requirements to improve the rain-fed areas (GOI, 1986). Considering the importance of rain-fed farming and to bring these areas under the mainstream economic development, some steps were taken up in the form of Drought Prone Area Programme (DPAP) and Desert Development Programme (DDP) after the independence. However, these programmes were not comprehensive and were targeted towards few regions facing some specific problems (Deshpande and Narayanamoorthy, 1997 and 1999). During the Sixth Five Year Plan, some model watershed programmes were introduced in the rain-fed regions with the help of the Government of India and the World Bank in certain States with an aim to improve the overall performance of rain-fed agriculture. These projects have shown very encouraging results (Singh, 1988). After experiencing the positive impact of model watershed programmes, for the first time, during the Seventh Five Year Plan period, the National Watershed Development Project for Rain-fed Areas (NWDPR) was introduced on a massive scale across different regions of the country. Since land and water are the basic resources required for improving the productivity of the crops and income of the people living in the rain-fed areas, initial thrust was given to water and land conservation activities under the watershed development programme.

1.2 Evolution of Watershed Development Programme in India:

Well before the introduction of National Watershed Development Project for Rain-fed Areas (NWDPA), references were made about the watershed development approach in the Government of India's model Bill on Soil Conservation in the fifties and sixties and the National Policy on Ravinous Watersheds of 1967 (Singh, 1988). Watershed based research activities were initiated in 1956 at the Central Soil and Water Conservation Research and Training Institute (CSWCRTI), Dehradun. The Ministry of Rural Development has also initiated programmes like Drought Prone Area Programme (DPAP) and the Desert Development Programme (DDP) during the seventies to improve the performance of the rain-fed based agriculture in the country.

Although there were programmes implemented for conserving soil and water in the rain-fed areas, these programmes were targeted to solve certain problems separately and no specific programmes were introduced in an integrated manner. An integrated approach to watershed programmes as a strategy for overall development of rain-fed areas was initiated during the period of 1975 and 1983 by launching three pilot projects financed by the World Bank and the International Development Association (IDA) to develop agriculture in the regions where assured irrigation facilities were poor (Reddy and Rao, 1999). In 1982, the Government of India under the auspices of ICAR sanctioned 46 model watershed projects to be implemented in the dry-land areas of the country (Singh, 1988). These projects were latter being implemented by the State governments through their Departments of Agriculture and Soil Conservation with the technical help of Central Research Institute for Dry-Land Agriculture (CRIDA) and CSWCRTI (Singh, 1988).

Based on the experience of pilot watershed projects implemented over 19 watersheds in the country during the Sixth Five Year Plan and the recommendation of

the mid-term review of the Seventh Five Year Plan, a massive watershed development programme was planned for a large number of districts across different States in the country. Accordingly, in July 1986, the National Watershed Development Project for Rain-fed Areas (NWDPRAs) covering 99 districts in 16 States was taken up for the purpose of implementation. That is, for the first time, the NWDPRAs came into force in 1986 and implemented for the years 1986-87 to 1989-90 at the total cost of Rs. 239 crore (Deshpande and Thimmaiah, 1999). The other ongoing programmes related to watershed development were also merged with the NWDPRAs. The NWDPRAs were introduced with three fold objectives, namely, (i) taking the watershed as a basis to conserve and upgrade crop lands and waste lands as a vital resource; (ii) 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; and (3) to augment the fodder, fruit and fuel resources of the village communities by use of appropriate alternative land use systems (GOI, 1986a).

The NWDPRAs programme was initially focused on growth and stabilisation of eco-system balance. After three years of implementation of watershed programme, a committee was appointed to review the guidelines prepared at the time of introduction of NWDPRAs. This committee revised the guidelines which were published under the title of Watershed Area Rain-fed Agricultural System Approach (WARASA). The project guidelines prepared in the light of the recommendations of the Committee of Secretaries and the working group of Planning Commission set forth five fold objectives for NWDPRAs (GOI, WARASA, 1992). The five-fold objective of NWDPRAs are:

1. 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, fiber, timber and bio-mass for rural and cottage industries to meet the growing demand of human and livestock population through diversified land use system.
2. Generation of massive employment during the project period and regular employment after the project completion for enhancing the employment opportunities in the backward rain-fed areas to ensure livelihood security particularly for under-privileged sections of the rural population like small and marginal farmers, land-less labourers, tribals, etc.
3. Improvement in 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 run-off management structures and devices for recharge of groundwater will ensure enhanced availability of water for human and livestock drinking purposes, domestic consumption, life saving irrigation.
4. Reduction of inequalities between irrigated and rain-fed areas. Ultimately, stable production and processing of biomass would contribute towards better life in rural areas. This will reduce large scale migration from rural areas to the cities.
5. In addition to the enhanced availability of food, fuel and fodder, the project would endeavour to improve cash in flow to the rain-fed farmers and land-less agricultural labourers through increased employment,

marketable surplus of agricultural and dairy products, growing of cash crops like vegetables, coriander, cumin, medicinal plants, etc., in suitable areas.

The emphasis of NWDPRA was also changed between Seventh and Eighth Five Year Plan periods (Reddy and Rao, 1999). During the Seventh Five Year Plan period, funds were not provided for the treatment of non-arable lands. This was modified during the Eighth Five Year Plan to provide a single window financing for both arable and non-arable lands, with 100 per cent finance (75 per cent grant and 25 per cent loan). Union Territories without legislature received 100 per cent grant-in-aid. An amount of Rs. 11000 crores was allotted during the Eighth Five Year Plan to treat 2479 watersheds spread over 350 districts located in 25 States and 2 Union Territories. The community development blocks having less than 30 per cent of arable land under assured irrigation were qualified to include in the project (Reddy and Rao, 1999).

1.3 Review of Impact of Watershed Development Projects:

Since the introduction of watershed management technology in India, many researchers have attempted to assess the impact of it at different level across the States. A study related to Sukhomajari watershed of Haryana State showed an exemplary results of Watershed Programme (Joshi and Seckler, 1981; Chopra *et al.*, 1989). The incremental benefits included more environmental benefits besides significant gains of income and employment. An another similar kind of study (Sarin and Ryan, 1983) conducted by ICRISAT showed stabilisation of cash flows and substantial increase in the productivity of crops and incremental income of the beneficiaries (also see, Kshirsagar and Ghodake, 1991).

While studying the State level Comprehensive Watershed Development programme (COWDEP) of Maharashtra, Deshpande and Reddy (1990) observed significant changes in the development of the household economy. A favourable changes in the cropping pattern, with an increase in intensity of cropping, reduction in the proportion of wastelands and improvement in yield per hectare were observed by this study. Besides, an improvement in the moisture availability in treated regions when compared with non-watershed areas was also observed. Similar to this, an impact study conducted in three regions of Maharashtra, where the National Watershed Development Programme for Rain-fed Agriculture (NWDPR) was implemented, has shown considerable improvement in certain economic and non-income parameters (Deshpande and Reddy, 1991). The three watershed zones studied were scarcity zone, moderate rainfall zone and assured rainfall zone. The results of the three watershed zones were quite different. Although both the moderate rainfall zone and assured rainfall zone showed better results in terms of increased income, yield improvement with stability and increased employment along with higher level of wages compared to the scarcity zone, in general overall development has taken place in all the three zones after the introduction of watershed programme. In an another study, Deshpande (1996) analysed the issue of watershed management from the perspective of differential impact parameters across agro-climatic zones. This study has concluded 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 location specific studies, the study by Singh (1994) on Mittermari Watershed in Karnataka is important as a holistic work dealing with all the aspects of watershed development. This study found that the net incremental benefit was Rs.

1970 per hectare because of watershed development programme (also see, Singh, 1998). Another recent study conducted in the same Mittemari watershed also observed significant overall development in different parameters due to watershed programme (Laxmikanthamma, 1997).

While a large number of studies have analysed the different impact parameters of watershed programme, a few studies have estimated the benefit-cost ratio of the watershed programme in certain areas. For example, a study (Arya *et al.*, 1994) carried out in the degraded Aravali foothills of Haryana found that the B-C ratio of the watershed treatment was as 1.90 and the same for different components ranged between 1.68 and 4.91. This project helped to generate employment to the extent of about 70 thousand mandays in about 1095 hectares of project area. It is clear from this study that the watershed programme is not only economically viable but also welfare oriented as it generates lot of employment days.

With regard to experience of NWDPRAs, a recent study conducted using the data of 11 States showed that the impact is mixed nature across the States (Deshpande and Narayanamoorthy, 1999). Four important aspects observed from this study are worth maintaining here. Firstly, the impact parameters indicate improvement in yield and employment across the States. 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 noted prominently. Lastly, although the new guidelines of NWDPRAs emphasised on participation of the community for which the programme is designed, the experience regarding this aspect is quite mixed. Almost uniformly in all the States, the consultation during the planning stage was totally absent. The plans were prepared without involving community participation. The experience of "*Mitra Kisan*" or

"Gopal" is also not encouraging across the States. However, on the whole, despite the problems in the process of implementation, the impact of NWDPRAs on different developmental parameters (production, employment generation, adoption level of different technology, incremental income, shift towards high remunerative crops, environmental impact, etc.) was significant in most of the States.¹ The studies we reviewed have shown that the implementation of watershed development projects have resulted in control of soil erosion, optimum utilisation of rain water, improvement in moisture availability and recharging groundwater resource. It has also increased the productivity of crops besides improving income and employment opportunities. However, not many studies are available focusing the impact of watershed development programme on the seasonal out-migration of people and livestock in the rain-fed areas.

1.4 The Present Study:

Maharashtra is one of the poorest States in terms of area under irrigation (Narayanamoorthy and Deshpande, 1999). As of today, only about 16 per cent of its gross cultivated area is irrigated which is one of the lowest among the major States of India. Owing to moisture stress and other soil related problems, productivity of majority of crops cultivated under rain-fed condition is very low when compared to many States (Narayanamoorthy, 1998). Considering the importance of rain-fed farming in the State, the watershed development programmes were taken up by the State government under Employment Guarantee Scheme way back in 1982. The programme was entitled "Comprehensive Watershed Development Programme" (COWDEP). From the year 1982 to 1990, 27198 watersheds were taken up for

¹ For more details about the varied experiences of NWDPRAs observed across different States see, Deshpande and Narayanamoorthy (1999).

treatments across different districts of the State. Studies conducted to find out the impact of COWDEP showed very encouraging results (Deshpande and Reddy, 1990).

The centrally sponsored NWDPRAs were implemented first time in 1986 in Maharashtra. For the implementation of NWDPRAs, it was decided to select 20 watersheds from each district. All the districts considered earlier for the implementation of COWDEP were included under NWDPRAs programme as well (Deshpande and Rajasekarn, 1995). From the selected 19 districts, 380 watersheds were taken up for the treatment. The NWDPRAs are administratively implemented by the Department of Soil Conservation under the Directorate of Agriculture. Under the Eighth Five Year Plan Programme of NWDPRAs, the government of Maharashtra has identified 266 watersheds for implementation. The total geographical area covered under these watersheds is about 4.65 lakh hectares and out of this, about 4.44 lakh hectares is treatable area. The total cost involved for the development of these projects is Rs. 12787.53 lakhs or about Rs. 48.07 lakhs per watershed (Deshpande and Rajasekaran, 1995). For this pilot study, we have selected one of the watersheds implemented under NWDPRAs scheme during the Eighth Plan period. The name of the selected watershed is Gaosud watershed, which comes under the Osmanabad district of Maharashtra.

1.5 Objectives of the Study:

1. To find out the impact of the project on various forms of water bodies/water harvesting structures and their long-term impact on depth of water table in the dugwell/recharge well.

2. To analyse the changes in cropping pattern, crop sequencing and crop components under the production systems in arable lands.

3. To analyse the socio-economic status of the project beneficiaries against the non-beneficiaries.

4. To analyse the overall changes in biomass production in the form of grasses, legumes, fodder, fuel-wood, horti-plantation canopies in treated watershed against the control.

5. To find out the status of migration of people, especially land-less labourers and livestock from watershed to outside area.

1.6 Methodology:

As advised by the Ministry of Agriculture, Government of India, Osmanabad district of Maharashtra has been selected for this study. During the Eighth Five Year Plan period, under the NWDPRAs scheme, six watershed projects were implemented in Osmanabad district covering 10207 hectares of geographical areas with an amount of Rs. 268.01 lakhs. Since it is a pilot study, it is difficult to conduct survey in all the projects implemented in Osmanabad during the Eighth Five Year Plan period. Therefore, as advised by the Ministry of Agriculture, we have selected only one watershed from the selected district. For selecting the watershed, as a first step, we had a detailed discussion with the officials of Directorate of Soil Conservation and Watershed Management, Government of Maharashtra, Pune, which is the nodal agency for implementing NWDPRAs projects. After having discussions with the State level officials, we had a detailed discussions with the officials who are dealing with NWDPRAs project at Osmanabad district. It is from the discussion, we have selected Gaosud watershed from Osmanabad taluka, Osmanabad district. As per the classification of agro-climatic zone, Gaosud watershed comes under scarcity zone (071).²

² A detailed profile of the Gaosud watershed is presented in chapter two of this report.

Keeping in view the objectives of the study, we have made visits to Gaousd watershed areas to understand the overall condition of the project before selecting the sample farmers for collecting field level information. With regard to the selection of sample farmers, since it is a pilot study, it will not be possible to collect data from large number of sample households. Therefore, 20 beneficiary households and 20 non-beneficiary households³ have been selected to study the impact of watershed development programme on land owning households. In addition to this, to study the impact of watershed development programme on the land-less labour households, 10 land-less labour households (5 each from the watershed area and the non-watershed area) have been selected. Thus, a sample 50 households have been selected altogether for this study. While the sample households (including land-less labour households) from the watershed area have been selected using random sampling method covering all the villages of the watershed area, the sample households from the non-watershed area have been selected using purposive sampling method with the help of *Patwari (Talathi)* and the officials of Gaosud watershed. Data relating to status of irrigation and water level in the wells, cropping pattern, crop sequence, productivity of crops, bio-mass production, socio-economic status including availability of employment, migration status of the people and cattle have been collected for both pre-project period (1991-92) and post-project period (1998-99) from the sample farmers. The survey was conducted during the months of October to November, 1999. To understand the impact of watershed development programme on different parameters, comparison has been made between the data of beneficiaries with the non-beneficiaries.

³ In this study, the beneficiary is referred as those households having lands in the watershed area and the household having lands outside the boundary of watershed area is referred as the non-beneficiary.

1.7 Organisation of the Study:

The present study on "*Rapid Impact Evaluation of NWDPRRA in Maharashtra*" has four chapters. After this *first* introductory chapter, a detailed profile of the watershed area based on the secondary level data is presented in chapter *two*. The chapter *three* presents the analyses of the impact of watershed development programme on land use pattern, availability of irrigation and water level in the wells, cropping pattern and crop sequence, cost of cultivation and productivity of the crops, socio-economic status of the farmers, changes in bio-mass production and migration status of the land-less labour households using the data collected from the sample households. The *fourth* and final chapter presents the findings and the conclusions of the study including policy suggestions for improving the performance of the watershed development programme.

Chapter 2

A PROFILE OF GAOSUD WATERSHED

This chapter is divided in two parts. The first part is devoted to provide the agro-economic profile of the Gaosud watershed vis-à-vis Osmanabad district. The focus of the second part of this chapter is on the various programmes undertaken by the watershed development authorities for the development of Gaosud watershed during 1991-92 to 1996-97. This chapter is based on the data provided by the Department of Soil Conservation and Watershed Management, Government of Maharashtra, the agency responsible for the implementation of the NWDPRRA project. The broad appraisal of the resources of Gaosud watershed and the implementation of the watershed development work may help in providing the background information for assessing the impact of the NWDPRRA project on various parameters, which is the focal point of the present study.

2.1 The Study District:

Osmanabad district is located in the semi-arid tropical scarcity zone of Maharashtra State. It is elongated from north west to south east and is situated on the south east fringe of Maharashtra State. It lies between 17.37 and 18.42 degrees north latitude and 75.17 and 76.47 degrees east longitude having a geographical area of 7569 square kilometers with a population of 12,76, 327 (Table 2.1). It accounts for 2.46 per cent of the area and 1.62 per cent of the population of the State. The location of this district in Maharashtra is shown in Figure 2.1.

The climate of Osmanabad district is generally dry and the seasons are on the pattern of those found in the Deccan districts. December is the coldest month with the

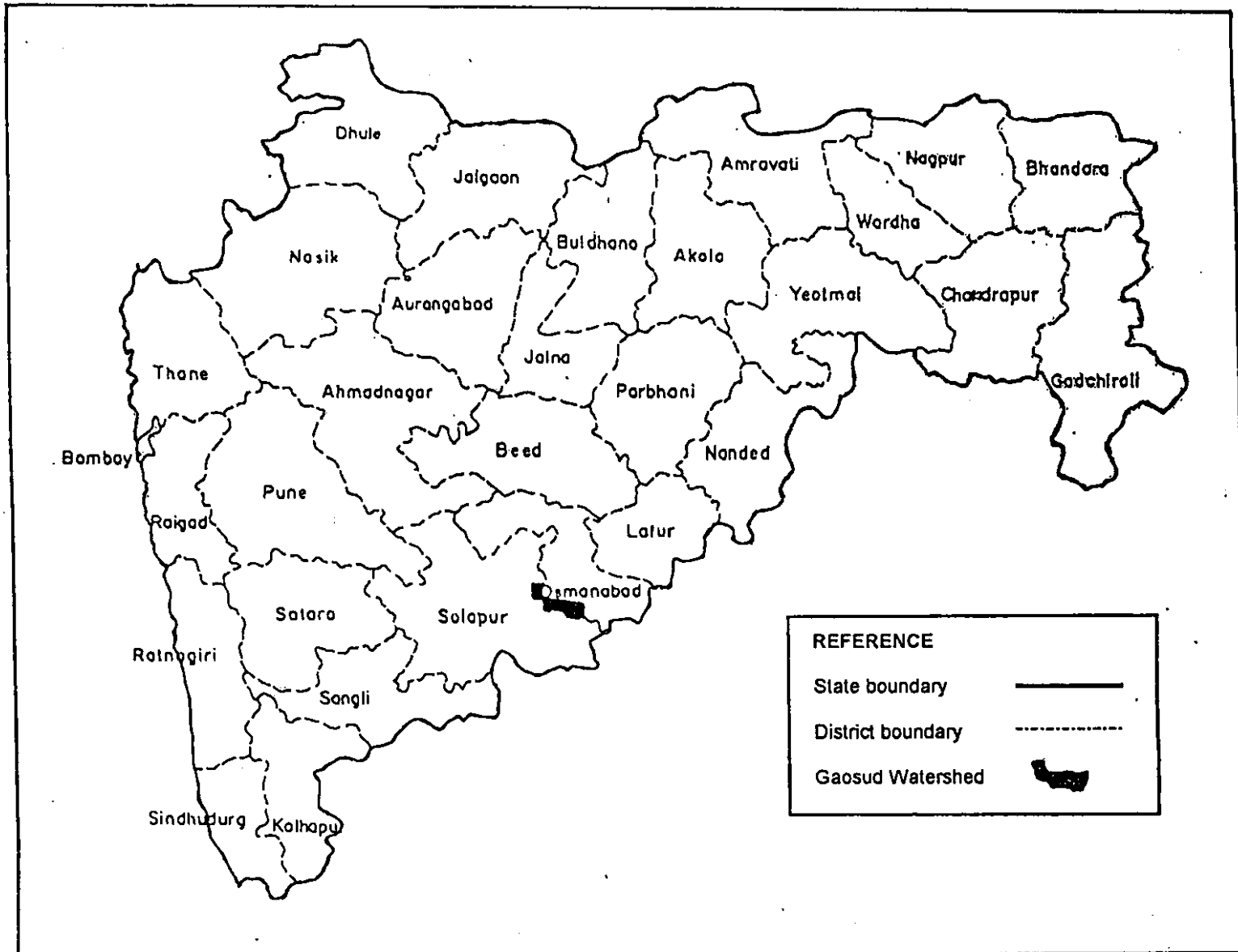


Figure 2.1 : Maharashtra State, Osmanabad District and Gaosud Watershed

mean daily minimum temperature at 15° celsius. May is the hottest month, the mean daily maximum temperature being 40° celsius.

Table 2.1: Important Features of Osmanabad District vis-a-vis Maharashtra State

Sr. No.	Important Features	Unit	Osmanabad District	Maharashtra State
1.	Geographical Position and Area: <ul style="list-style-type: none"> • North latitude • East langitude • Area 	Degree Degree 000 ha	17.35 to 18.40 75.16 to 76.40 749	16.40 to 22.10 72.60 to 80.90 30758
2.	Climate (1996): <ul style="list-style-type: none"> • Minimum temperature • Maximum temperature • Normal rainfall • Number of raing days 	Degree Celsius Degree Celsius Mm Number	10.20 43.00 810.00	4.80 47.10 1164.00
3.	Demographic Features: <ul style="list-style-type: none"> • Population (1991) • Density of population • Population growth rate (1981 – 91) • Sex ratio (Female per 1000 males) • Literacy rate • Proportion of cultivators to main workers • Proportion of agricultural labour to main workers 	Number per sq. km. % Number % % %	12,76,327 169 23.95 937 54.27 40.51 41.09	7,89,37,187 257 25.73 934 64.87 32.81 26.81
4.	Agriculture (1996-97): <ul style="list-style-type: none"> • Percentage of forest area to geographical area • Percentage of culturable land to geographical area • Percentage of net area sown to geographical area • Percentage of area sown more than once to net sown area. • Land use intensity • Cropping intensity • Average size of Operational holding (1990-91) 	% % % % % % ha	0.32 96.00 70.30 24.30 74.13 134.71 3.10	17.15 72.14 58.70 16.50 80.56 121.18 2.21

Table 2.1 continues...

Sr. No.	Important Features	Unit	Osmanabad District	Maharashtra State
	• Net area sown per cultivator	ha	2.50	1.80
	• Per capita food-grain production	Kgs	264.00	173.00
	• Percentage of net area irrigated to net area sown	%	21.90	13.90
	• Percentage of gross irrigated area to gross cropped area	%	21.50	15.40
	• Percentage of actual irrigated area to irrigation potential created	%	21.30	35.30
5.	Livestock and Tractors (1992)			
	• Number of tractors per 10,000 hectares of net area sown	Number	9	26
	• Number of working cattle, buffaloes per 1000 hectares of net area sown area	Number	284	390
	• Number of cows and buffaloes in milk per 1000 human population	Number	84	53
	• Number of livestock per 1000 human population	Number	62	45
	• Livestock (bovine) per square Kilometer of geographical area.	Number	70	74

Source: Government of Maharashtra (various years), *Socio-Economic Review and Statistical Abstract of Osmanabad District*, Directorate of Economics and Statistics, Mumbai.

The data for 21 years (1977-97) show that the district receives an annual precipitation of 750 mm with a maximum monthly mean of 190 mm in September and a minimum monthly mean of 2 mm in February. About 90 per cent of the precipitation occurs during the south-west monsoon which starts in June and continues till October. The year to year variation in the annual rainfall is large.

The types of soil found in Osmanabad district are generally shallow to medium black, deep black laterite and alluvial, basically derived from the Deccan

Trap Rock which is the predominant rock formation of the district. On the plateau and near the hills murum and trap are found with a shallow upper crust of inferior light soils while some parts of the district are covered with soils which are black in colour and have high moisture retention capacity showing distinctive features for facilitating dry cultivation.

Wells are the primary source of irrigation. The per cent of net irrigated area to net sown area in the district is 21.90 per cent which is 8 per cent higher than the State average. The important *kharif* crops of the district are sorghum, pearl millet, paddy and pigeonpea. Sorghum, wheat, chickpea, and sunflower are the major crops of the *rabi* season.

2.2 The Gaosud Watershed:

2.2.1 Location:

The selected watershed - named as Gaosud watershed - is located 8 kilometers south of Osmanabad, the taluka and district headquarter (Figure 2.1). Besides Gaosud, the selected watershed comprises the area of other eight villages, namely, Warwanti, Begada, Shekhapuri, Pohner, Wadgaon, Chilwadi, Osmanabad (rural) and Surdi. Village-wise geographical, arable and non-arable area located in Gaosud watershed is given in Table 2.2. The Gaosud watershed falls under the part of the scarcity Agro-climatic Zone No. 071 and Eco-unit No. 1 of Osmanabad district. The Gaosud village is situated about 669 meters above the mean sea level in the Balaghat ranges.

2.2.2 Physical Features:

The shoe shaped Gaosud watershed measures 7 kilometers along the length and 4 kilometers along the breadth. The topography of Gaosud watershed is highly undulating with the presence of barren hillocks at the edge of the boundary and

depressions at the bottom of the watershed. The average slope of the watershed is 2 to 3 per cent.

A well-identified stream forms the central drainage line of the watershed. There are 14 secondary tributaries running across the main drainage line, i.e., the stream. The network of the stream and the 14 tributaries forms the natural waterways in the Gaosud watershed. According to villagers, the main stream will be in full spate at least 7 to 8 times during the rainy season. There are seven settlements in the Gaosud watershed area and these are all inhabited villages.

Table 2.2: Villages and their Area Covered under Gaosud Watershed.

Sr. No	Name of the Village	Geographical Area		Arable land		Non-arable land	
		Ha	Percentage to total	ha	Percentage to total	ha	Percentage to total
1	Gaosud	680.33	16.60	386.31	14.62	238.71*	17.05
2	Pohner	764.15	18.65	641.51	24.28	122.64	08.76
3	Osmanabad (Rural)	138.37	03.38	00.00	00.00	138.37	09.88
4	Wadgaon	611.35	14.92	311.35	11.79	300.00	21.43
5	Warwanti	827.26	20.19	527.26	19.96	300.00	21.43
6	Begada	443.25	10.82	343.25	12.99	100.00	07.14
7	Surdi	395.47	09.65	259.47	09.82	136.00	09.72
8	Chilwadi	149.98	03.66	139.47	05.28	10.51	00.75
9	Shekhapuri	87.15	02.13	33.38	01.26	53.77	03.84
Total		4097.31	100.00	2642.00	100.00	1400.00	100.00

Note: * - in this 55.31 ha. has been accounted for roads, buildings, etc.

Source: *Project Report on NWDPR for Gaosud Watershed, 1991-92 to 1996-97*, Department of Agriculture, Government of Maharashtra.

2.2.3. Climate:

The climate of the Gaosud watershed is characterised by hot summer and cool winter. Though the summer commences in March and continues up to June, April

and May are the hottest months in the district. The maximum temperature is in April and May, 43° to 44° celsius, where as, the minimum temperature for the year goes down to 10° celsius in December. The period from December to May constitutes the driest part of the year.

2.2.4. Rainfall and Water Resources:

No rainfall data has ever been recorded at Gaosud watershed. Therefore, the average daily rainfall recorded at Osmanabad town, Taluka and District headquarter which is located on the boundary of the Gaosud watershed was, used to represent the rainfall pattern of the Gaosud watershed area. The average annual rainfall is 758 mm with a coefficient of variation (CV) of 32 per cent for the 21 years from 1977 to 1997 (Figure 2.2). On an average, 80 per cent of total rainfall is received during the months of June to September. The average annual rainy days are 59 with a CV of 25 per cent.

Although the extent of annual average precipitation may be adequate for most of the years for farming, its capricious nature is very clear from Figure 2.2. On an average, six years were relatively dry having less than 600 mm of rainfall while four years were very wet having more than 1000 mm of rainfall. This erratic distribution of rainfall often causes drought and/or floods during the crop growth period concurrently and results in substantial losses to rain-fed farmers.

A percolation tank constructed in seventies is an important source of surface irrigation in Gaosud watershed. Besides this, there were 110 dug-wells in the Gaosud watershed area before the commencement of the project. These wells vary in their depth and recharge capacity. On an average, the depth of water table in these wells varies from 2 meters to 12 meters depending upon the season and location of the well.

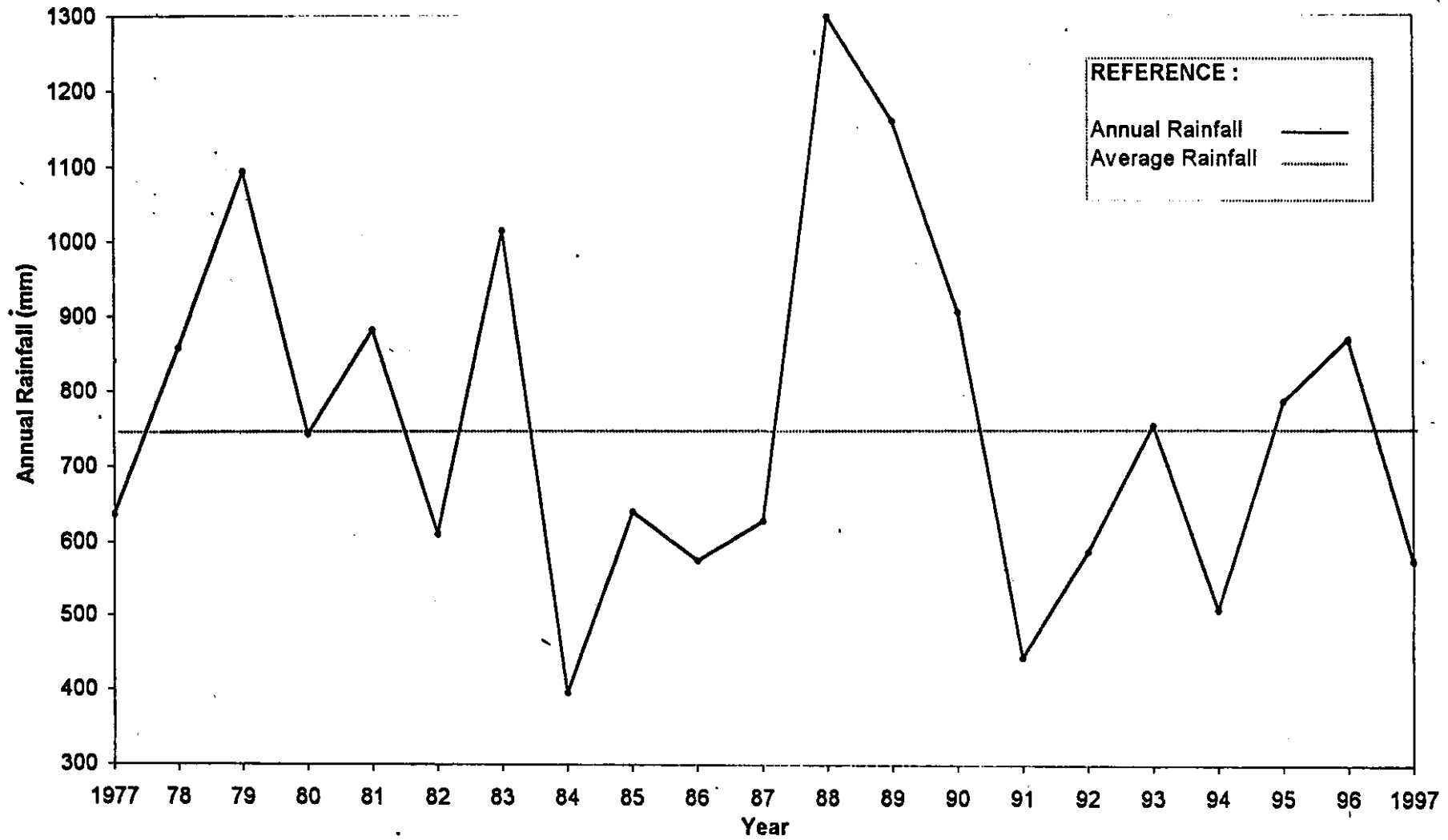


Figure 2.2 : Annual Rainfall In Gaosud Watershed Area : 1977-1997

Nearly 18 per cent of Gaosud watershed area is being irrigated annually with the help of these dug-wells.

2.2.5 Soils and Soil Survey:

Broadly, the soils in the Gaosud watershed area can be divided in two groups. First, the soils found at the bottom of the hillocks, ridges and upper reaches of the watershed are shallow soils and are suitable for *kharif* cropping and/or agro-forestry. These soils are highly susceptible to erosion and are poor in fertility as well as low in nitrogen content. The soils at the top of the watershed and at the hillocks are extensively denuded. Second, the medium to deep black soils found in middle and lower reaches of the Gaosud watershed are relatively good in fertility. These soils are suitable for both *kharif* and *rabi* cropping. According to the soil survey carried out in Gaosud watershed, the distribution of area based on land capability class is given in Table 2.3.

Table 2.3: Land Capability-wise Classification of Gaosud Watershed Area.

Land Capability Class	Per cent to total area
II	14.93
III	22.88
IV	26.08
VI	36.11

Source: *Project Report on NWDPR for Gaosud Watershed, 1991-92 to 1996-97*, Department of Agriculture, Government of Maharashtra.

Most of the area comprising the Gaosud watershed is susceptible to erosion except very limited area in class II and III. More than 60 per cent of soils grouped under class IV and VI are well drained soils having moderate to low waterholding capacity. These soils are not the best soils to grow seasonal field crops.

2.2.6 Distribution of Land and Size of Landholding:

The distribution of landholding in Gaosud watershed clearly indicates the high inequality in the distribution of the basic resource. More than 40 per cent of households own on an average less than one hectare of land, i.e., hardly 14 per cent of the area while at the extreme 18 per cent of the households control more than 43 per cent of the total land in Gaosud watershed (Table 2.4). The average size of the landholding is 2.66 hectares.

Table 2.4: Per centage Distribution of Households by Size of Landholding

Sr. No.	Size group (ha)	Per cent of total households	Per cent of total area
1.	Up to 1.00	40.99	13.62
2.	1.01 to 2.00	17.30	12.12
3.	2.01 to 3.00	11.12	10.57
4.	3.01 to 4.00	7.30	10.46
5.	4.01 to 5.00	5.33	9.57
6.	5.01 and above	17.96	43.66
	Total	100.00 (1520)*	100.00 (4042)**

Note: * - total number of household; ** - total area in hectares.

Source: As in Table 2.3.

2.2.7 Land Utilisation Pattern:

The geographical area of the Gaosud watershed is 4097.31 ha. Out of this, 2642 ha has been classified as cultivable land while 1400.00 ha accounting for 35.52 per cent of total geographical area is classified as non-arable land (Table 2.5). The non-arable land also includes 180 ha area under permanent pastures and grazing, and 27.97 ha area under forests. The area under roads, village settlements, etc., is accounted for 55.31 hectares.

Table 2.5: Land Utilization Pattern of Gaosud Watershed: 1991-92

Sr. No.	Particulars	Area (ha)	Per cent to total geographical area
1.	Geographical area of watershed	4097.31	100.00
2.	Arable land under the watershed	2642.00	64.48
3.	Non-arable land under the watershed	1192.03	29.10
4.	Permanent pastures and grazing land	180.00	4.39
5.	Area under forest	27.97	0.68
6.	Area under roads, buildings, etc.	55.31	1.35

Source: As in Table 2.3.

The negligible area under forest corresponds well with the district average of 0.80 per cent, which is the second lowest among all the districts in Maharashtra State. This indicates that there is an urgent need with concerted efforts, not only in Gaosud watershed but for the entire district of Osmanabad, to increase the area under forest for improving the overall production environment of the district.

2.2.8 Natural Vegetation:

As noted earlier, Gaosud watershed falls under the semi-arid tropical area of Maharashtra and the natural vegetation is very sparse. This includes the tree species such as Mango (Mangifera indica), Neem (Azadirachta indica), Ber (Siziphus mauritiana), Tamarind (Tamarindus indica), Subhabul (Leucaena leucocephala), Babul (Acacia nilotica), Vilayati babul (Prosopis juliflora) and Ghaneri (Lantana camara). Besides, one can find several kind of local bushes and grasses growing wildly during the monsoon season.

2.2.9 Crops and Cropping Pattern:

Only *kharif* season crops are cultivated in the upper reaches of the watershed area where shallow soils are found. Both *kharif* and *rabi* crops are grown in medium black and deep black soils found in middle and lower reaches of the watershed area.

The important *kharif* crops grown in Gaosud watershed are sorghum, groundnut, blackgram, greengram and pigeonpea while, crops like sorghum, wheat, chickpea, sunflower and safflower are cultivated in *rabi* season. With the introduction of the watershed development project, the availability of groundwater has increased which resulted in increasing number of wells and area under irrigation. This has facilitated the farmers to grow water-intensive crops like sugarcane, vegetables and fruit crops. Incidentally, the cattle population is quite high in this watershed indicating the pressure on land and therefore, cropping with fodder orientation receives high priority.

2.2.10 Village Institutions and General Infrastructure:

The Gaosud village has the Gram Panchayat that is composed of elected members by the villagers. The Secretary of the Gram Panchayat lives in the village. He is also a village level extension worker of the Block Development Office. The important institutions and other infrastructural facilities available in Gaosud village are presented in Table 2.6.

A Cooperative Credit Society is present in the Gaosud village and is affiliated to the District Central Cooperative Bank located at Osmanabad. Gaosud has school facilities (upto high school) and the colleges are at a distance of 8 kilometers from the villages. The watershed villages have electricity for domestic, agricultural and commercial uses. The drinking water facilities are good in all the villages. Gaosud village has a post office, a fair price shop and a primary health centre as well.

Table 2.6: Village Institutions and General Infrastructure in Gaosud Watershed:

Particulars	Year 1991-92
Distance from nearest town/marketing centre (Kms)	08
Distance from nearest railway station (Kms)	30
Distance from national highway (Kms)	55
Distance from nearest bus stand (Kms)	0
Post Office in the village	Present
Education facilities	Up to High School,
Medical facilities	Primary Health Centre
Veterinary facilities	Present
Drinking water facilities	Good
Village electrified	Yes
Weekly market	No
Agricultural Marketing Committee at (Kms)	08
Government Fair Price Shop	Present
Co-operative Credit Society	Present
District Central Cooperative Bank at (Kms)	08
Commercial Bank at (Kms)	08
Village Development Officer	Present

Source: As in Table 2.3.

2.3 Development of Gaosud Watershed:

On the basis of detailed analysis of soils, climate, associated plants, animals and farmers' requirements, a comprehensive plan was developed for the development of Gaosud watershed. The primary aim of development of this watershed, like any other watersheds, was to check soil erosion, improve the water resources, enhance the moisture retention capacity and natural fertility of the soil, reverse the decline in the extent and quality of vegetative cover, increase productivity and restore the ecological balance in the watershed. To achieve this objective, systematic development activities

were carried out since 1991-92 under appropriate technical guidance from the implementing agency.

While the total budget for the Gaosud watershed was Rs. 100.69 lakhs, the actual expenditure incurred for the development of watershed was Rs. 83.70 lakhs, indicating about 83 per cent of utilisation of funds. The development of Gaosud watershed was achieved by integrating the following activities which are also summarised in Table 2.7.

2.3.1 The Primary Activities:

The important basic activities of the Gaosud watershed development programme include the activities such as survey work, establishment of nurseries, identifying and including the innovative activities in the development of watershed, research support, establishment of the Barani Chetana Kendra and conducting training for the watershed participants.

The basic idea of the establishment of Barani Chetana Kendra and conducting other training programmes was to convert the watershed development project from a government scheme to peoples movement besides systematically integrating the technical and managerial skills of the project staff with that of accumulated experience of villagers through the involvement of participating farmers ("Mitra Kisans" and "Gopals") from the watershed area. Although there was reasonable use of funds allocated to activities such as establishment and management of Barani Chetana Kendra and training, nursery plot was not established in the watershed area with the help of participating farmers. If nursery plot was established, this would have fulfilled the requirements of the planting materials for contour vegetative hedges, silvipastoral system, pasture development and production programme of dry-land horticulture from the watershed area itself. Moreover, it is evident from the

data provided by the implementing agency that there seems to be less research support for the development of basic activities than initially planned for the project. The total expenditure incurred for the development of primary activities is reported to be Rs. 11.50 lakhs as against the sanction amount of Rs. 15.98 lakhs.

2.3.2 Arable Land Development:

The arable land development programme is divided in two activities: (a) conservation measures and (b) production system. The conservation activities consist of vegetative filter strips, contour vegetative hedges, opening of dead furrows, repairs of existing bunds and gully control measures. Although all these activities are mentioned under this programme, the data provided by the watershed development agency show neither allocation of funds nor the expenditure incurred for the treatments except repairs of existing bunds and gully control measures. Thus, under this programme no or less emphasis was laid on treatments involving vegetation.

Under the production system, emphasis was laid on the treatments such as crop demonstration, dry-land horticulture, organic farming and household production. The crop demonstration treatment included the single and double cropping demonstrations. The single crop demonstrations were conducted for the crops such as sorghum, soybean, sunflower, groundnut, etc. The double crop demonstrations included sorghum (*kharif*), wheat and soybean - sorghum (*rabi*).

Tree crops play a strategic role in providing sustained tree crop yields from limited water available in rain-fed agriculture. Under the programme of dry-land horticulture, the planting of various fruit trees such as mango, ber, guava, kagiri lime, etc., were undertaken. The seedlings of fruit trees were also distributed to participant farmers under this programme. Activities such as digging of compost pits and processing of organic manures were undertaken in the organic farming programme.

Table 2.7: Programmes Undertaken for the Development of Gaosud Watershed

Sr. No	Programme / Treatment	Financial (Rs. lakh)		Physical		
		Proposed Expend.	Actual Expend.	Unit	Proposed Target	Achi-vement
1	Primary Activities:					
	• Survey	1.50	0.44	ha	4042	4042
	• Establishment and management	8.48	7.64	--	--	--
	• Nurseries	1.50	--	--	--	--
	• Innovative activities	1.00	0.72	--	--	--
	• Research	0.50	--	--	--	--
	• Barani Chetana Kendra	1.07	1.54	No.	1	1
	• Training	1.23	1.16	No.	--	123
Total		15.98	11.50			
2 (a)	Arable Land:					
	Conservation Measures:					
	• Vegetative filter strips	--	--	--	--	--
	• Contour vegetative hedges	--	--	ha	1400	1400
	• Repairs of existing works	1.30	0.94	No.	1590	1590
• Gully control measures	15.68	16.18	No.	560	560	
Total 2 (a)		16.98	17.12			
(b)	Production System:					
	• Crop demonstration	9.90	7.08	No.	70	70
	• Agro – forestry	1.50	--	--	--	--
	• Dryland horticulture	0.75	0.63	No.	--	6400
	• Organic farming	1.00	0.17	ha	1133	1133
	• Homestead garden	1.20	--	ha	--	--
	• Household production	2.62	3.02	No.	302	302
Total 2 (b)		16.97	11.19	--	--	--
3 (a)	Non Arable Land					
	Conservation measures:					
	• Live fencing	2.00	1.95	Mts.	19,500	19,500
	• Vegetative filter strips	0.07	0.07	Mts.	500	500
• Vegetative contour hedges	5.60	6.05	Mts.	1585	1585	
Total 3 (a)		7.67	8.07	--	--	--
(b)	Production System:					
	• Overseeding of grasses	2.80	2.78	ha	1400	1400
	• Planting of shrubs	0.30	0.57	No.	5700	5700
	• Planting of trees	0.75	0.39	No.	5200	5200
Total 3 (b)		3.85	3.74	--	--	--
4	Drainage Line Treatment:					
	• Nala bank stabilization	--	--	--	--	--
	• Live check and brushwood dams	--	--	No.	500	500
	• Loose boulder check dams	2.25	2.25	No.	300	300
	• Small dugout ponds	--	--	--	--	--
	• Loose boulder structures	15.00	15.00	No.	500	500
	• Earthen structures	3.75	3.75	No.	300	300
	• Run off Management structures	9.75	9.75	No.	39	39
Total		30.75	30.75	--	--	--
5	Livestock Management:					
	• Castration of scrub bulls	0.06	0.08	No.	196	257
	• Breed improvement	0.65	0.04	No.	170	44
	• Fodder production	7.49	0.40	ha	40	40
	• Small livestock development	0.00	0.70	No.	58	70
Total		8.60	1.22	--	--	--
Grand Total		100.69	83.70	--	--	--

Source: As in Table 2.3.

Other major activities carried out under the household production programme included activities of helping the village artisans to improve their product quality, productivity and profitability. The land-less and agricultural labourers were also benefited from this activity. The major weakness in the programme of arable land development is that despite allocation of funds for the treatments such as agro-forestry and homestead garden, the funds were not utilised for the development. However, it was reported that these activities were undertaken through the training and visit programme by the Department of Agriculture. This activity could as well have been handled by the implementing agency themselves for better coordination in planning and execution of the activity. It is observed from Table 2.7 that the conservation activities in arable lands are the largest activity in the watershed development programme accounting 1/3 of the total allotment of the project. The implementing agency has utilised more than 83 per cent of the allocated funds and has claimed that the various activities undertaken in this programme has reduced soil erosion, increased cropping intensity and enhanced the production levels of *kharif* and *rabi* crops in the watershed area.

2.3.3 Non-Arable Land Development:

Similar to the arable land development programme, the non-arable land development programme is also divided into two sub-programmes as (a) conservation measures, and (b) production system. The conservation measures undertaken in the non-arable land development programme included the treatments such as live fencing, vegetative filter strips and vegetative contour hedges (Table 2.7). As per the data provided by the implementing agency, the length of live fencing undertaken was 19,500 meters while the length of contour vegetative hedges was 1585 meters and that of vegetative filter strips was 500 meters. These measures were expected to help

optimum utilization of rainwater, filter run-off water and thereby control the soil erosion. An excess amount of Rs. 0.40 lakhs over the originally earmarked amount of Rs.7.67 lakhs was spent to carry out the above mentioned measures.

Three important measures were adopted under the non-arable land production system. They were overseeding of grasses, planting of shrubs and planting of trees. An amount of Rs. 3.74 lakhs was spent as against the allocation of Rs. 3.85 lakhs for these activities. As per the data provided by the government officials, overseeding was done in the entire area of 1400 hectares of non-arable land in the watershed. Besides this, 5700 shrubs and 5200 trees were also planted under this programme. Although we could not verify that how much actual area come under grass or how many shrubs and trees survived over the years, it has been claimed by the implementing authority that these activities resulted in marked improvement in the availability of fodder and fuel wood (see, Table 3.15 in Chapter 3).

2.3.4 Drainage Line Treatment:

Drainage line treatment is the second largest activity in the watershed development programme accounting about 30 per cent of the share in the total budget of the watershed. This is also the largest activity in terms of the actual utilisation of the funds. This component consists the activities such as construction of loose boulder structures, loose boulder check dams, earthen structures and structures for the management of run-off. The number of loose boulder structures built under this programme were 500 with the expenditure of Rs. 15.00 lakhs (Table 2.7). Construction of 300 loose boulder check dams and another 300 earthen structures were also completed with the cost of Rs. 2.25 lakhs and Rs. 3.75 lakhs respectively. Besides this, Rs. 9.75 lakhs were also spent for the construction of 39 run-off management structures. All these works were targeted to manage and recycle the

run-off water, recharge the groundwater resource besides reducing the soil erosion due to rains and improving the soil moisture availability in the watershed area.

2.3.5 Livestock Development:

The implementation of various grass land and fodder development treatments outlined earlier were aimed at to improve the prospects of animal husbandry programme in the watershed area. The castration of scrub bulls and other measures were undertaken in this programme for the improvement of breeds of local animals available in the target area, while better perennial grasses were grown for enhancing the availability of fodder. Out of Rs. 8.60 lakhs of proposed outlay, only Rs. 1.22 lakhs were spent for the development of livestock in the watershed area. Some of the activities such as breed improvement and castration of scrub bulls were undertaken by the Animal Husbandry Department. Although there was gross under utilisation of allocated funds, the implementing agency has reported that the various treatments undertaken in this programme not only improved the availability of fodder and productivity of animals but also contributed in promoting the quality as well as the quantity of livestock owned by the beneficiaries of the watershed.

2.4 Concluding Comments:

The Gaosud Watershed development programme was implemented during the period from 1991-92 to 1996-97. Various activities such as conservation and production measures in arable and non-arable lands, drainage line treatments and livestock development programmes were taken up under the watershed development programme.

The soil conservation and water management practices adopted in Gaosud watershed include live fencing, vegetative filter strips, contour vegetative hedges, repair of existing works, gully control measures and construction of check dams,

loose boulder and earthen structures. With the development of Gaosud watershed, each of these measures had resulted in better management of the rain-water and thereby reducing soil erosion and increasing recharge of groundwater in the watershed area. Because of higher availability of groundwater, the number of irrigation wells have increased from 70 in 1991-92 to 110 in 1996-97. Not only the number of wells have increased but the level of water table and recharging capacity of wells have also increased in the watershed area. The data provided by the implementing agency showed that the net area under irrigation has increased from 10.5 per cent in 1991-92 to 18 per cent in 1996-97. The area under *rabi* and summer cropping has also increased over the years thereby increasing the cropping intensity (by about 15 per cent) besides increasing productivity of various crops. It is also mentioned that the land-less labourers and the artisans of the watershed area were also benefited from the NWDPRRA project.

Under the livestock development programme, activities such as castration of scrub bulls, control of population of less productive animals and improving the quality and productivity of livestock through breeding were followed. However, the utilisation of allocated funds for this activity was very low. There is need to give more emphasis on the livestock development programme so that it forms an important subsidiary occupation of farmers as well as land-less labour households.

Although the total planned financial outlay of the Gaosud watershed was Rs. 100.69 lakhs, the actual amount spent on various activities was only Rs. 83.70 lakhs. The treatment cost works out to be Rs. 2070 per hectare. This per hectare cost falls within the estimate arrived from 16 of the ICAR model watersheds where the cost per hectare varies between Rs. 1,000 and Rs. 9,500 (Dhruvanarayana, *et al.*, 1990). Although a great deal of expenditure is spent for the development of watershed

especially on soil and water conservation activities and to increase the productivity of crops and livestock, there are several difficulties in computing per hectare development costs directly across the watersheds. The difference in the development costs of watersheds can be attributed to the variations in the agro-climatic factors such as topography, soil, rainfall, water resources, etc., across the watersheds.

However, the costs incurred alone are meaningless unless they are viewed in relation to the benefits received. It is here that in most of the cases the dependable information on benefits from the field level is not available. Therefore, as suggested by the Ministry of Agriculture, Government of India, a rapid impact assessment survey was made in the Gaosud watershed located in Osmanbad district of Maharashtra. This survey was conducted after allowing sufficient time for the manifestation of full benefits from various treatments adopted for the development of watershed. The results of this study are presented in the next chapter.

Chapter 3

IMPACT OF WATERSHED DEVELOPMENT PROGRAMME

3.1 Introduction:

As mentioned in first chapter, to understand the impact of watershed development programme (WDP) on certain parameters, 20 beneficiary households and 20 non-beneficiary households have been selected for this study. In addition to this, 10 land-less labour households (5 each from the watershed area and non-watershed area) have also been selected to understand the impact of WDP on land-less labour households. In this chapter, we analyse the impact of watershed development programme on different parameters by comparing the data of the beneficiary sample households with the non-beneficiary sample households. Specifically, we analyse the following five aspects in this chapter: (1) Impact of water bodies/water harvesting structures created under the WDP on depth of water table in the wells; (2) Changes in cropping pattern, crop sequencing and crop components under the production system; (3) Changes in overall bio-mass production; (4) Improvement in socio-economic status of the beneficiaries, and (5) Employment position and the migration status of the land-less labour households including cattle from watershed area to outside area.

3.2 Land Utilisation Pattern:

Before analysing the cropping pattern and crop sequences, it is essential to understand the land utilisation pattern of beneficiary and non-beneficiary group of households as it will help to analyse and understand the cropping pattern and other related issues in a better way. It has been proved by various studies that the availability of water and moisture is substantially higher in the watershed areas

compared to the non-treated rain-fed areas mainly due to treatments taken up under WDP to improve the rain water harvesting. Therefore, it is expected that the land utilisation pattern of the beneficiaries would be different from the non-beneficiary sample households. Table 3.1 presents the land utilisation pattern of the beneficiaries and the non-beneficiaries. As expected, the pattern of land utilisation of the beneficiary households is distinctly different from the non-beneficiary households.

Table 3.1: Land Utilisation Pattern of Beneficiary and Non-Beneficiary Households: 1998-99.

Particulars	Beneficiary		Non-Beneficiary
	In Watershed Area	Outside of Watershed Area	
1. Total Land holding	82.32*	8.00	96.76
2. Cultivable Waste Land	11.46 (14.24)	2.00	29.36 (30.34)
3. Current fallow	0.40 (0.50)	--	0.80 (0.82)
4. Net Cropped Area (NCA)	68.60 (85.26)	6.00	66.60 (68.83)
5. Area Cropped more than Once	41.10 (49.93)	--	28.70 (29.66)
6. Gross Cropped Area (GCA)	103.50	--	95.30
7. Land Use Intensity (%)	83.33	--	68.83
8. Cropping Intensity (%)	150.87		143.09

Notes: * - includes 1.86 ha of lease-in land.

Figures in brackets are percentage to total land holding.

Due to various treatments¹ taken up under WDP to bring wasteland into cultivation, the percentage of cultivable waste land is much less among the beneficiary group of households compared to the non-beneficiary households. While the cultivable waste land accounts for about 14 per cent in the total land holding of the beneficiaries, the same accounts for over 30 per cent in the total land holdings of the non-beneficiaries,

¹ Various treatments taken in the watershed area and the amount of money incurred for each treatment are presented in chapter two.

indicating a difference of about 16 per cent points. Although the difference in area under current fallow is negligible between the beneficiaries and the non-beneficiaries, the differences are substantial in case of net cropped area (NCA) and area cropped more than once. For instance, NCA accounts for about 83 per cent in the total land holding of the beneficiaries but, the same is about 68 per cent in the case of the non-beneficiaries. Similar to this, while area cultivated more than once accounts for about 49 per cent of the total land holdings of the beneficiaries, the same accounts for only about 29 per cent in the total land holding of the non-beneficiaries. Most of the farmers of watershed area have expressed that they could convert most of their wasteland into cultivable land and increase the area cultivated more than once because of the various treatments taken under the watershed programme. On the whole, although the average land holding size of the non-beneficiaries (4.84 ha) is slightly higher than that of the beneficiaries (4.52 ha), the land utilisation pattern of the beneficiaries is distinctly better than the non-beneficiaries.

3.3 Area under Irrigation:

One of the major constraints faced by the farmers of rain-fed area is scarcity of water and poor irrigation facility. Since irrigation water is important for improving the performance of agriculture and the socio-economic conditions of the people living in the rain-fed areas, major thrust is given to improve the availability of water for irrigation by constructing rain water harvesting structures like nalla bunds, contour trenches, water absorbing trenches, contour guidelines, farm ponds, dug-out ponds and other run-off management structures under the WDP. These treatments were taken up during the Eighth Five Year Plan in the sample watershed area as well. Therefore, these measures must have made some impact on the availability of irrigation. In this context, it is interesting to see the irrigation status of the

beneficiaries by comparing it with the non-beneficiaries. Table 3.2 presents the details of area under irrigation for the beneficiaries and the non-beneficiaries. It is evident from the table that area under irrigation is much higher among the beneficiaries when compared to the non-beneficiaries. Area under well irrigation accounts for a major share in the total net irrigated area (NIA) of both the beneficiary

Table 3.2: Area under Irrigation by Beneficiary and Non-Beneficiary Households: 1998-99.

Particulars	(in ha)	
	Beneficiary	Non-Beneficiary
1. Well Irrigated Area	27.40 (60.54)	11.20 (84.85)
2. Other Sources Irrigated Area	17.86 (39.46)	3.00 (22.73)
3. Net Irrigated Area	45.26 (100.0)	13.20 (100.0)
4. Area Irrigated More than Once	35.80	5.00
5. Gross Irrigated Area	81.06	18.20
6. Percentage of NIA to NCA	52.19	19.82
7. Percentage of GIA to GCA	78.32	20.43
8. Irrigation Intensity	179.09	137.88

Notes: NIA - Net Irrigated Area; NCA - Net Cropped Area; GIA - Gross Irrigated Area; GCA - Gross Cropped Area.

Figures in brackets are percentages to net irrigated area.

and non-beneficiary households. However, there is a considerable difference in the average area under irrigation per household between the two group of farmers. While the average NIA comes to 2.26 ha per household for the beneficiaries, the same is only 0.66 ha per household for the non-beneficiaries. Importantly, area irrigated more than once is also significantly higher for the beneficiaries (1.79 ha per household) compared to the non-beneficiaries (0.25 ha per household). As a result of higher NIA and area irrigated more than once, gross irrigated area (GIA) of the beneficiaries is substantially higher than that of the non-beneficiaries. The average GIA comes to 4.05 ha per household for the beneficiaries whereas, it comes to only

0.91 ha per household for the non-beneficiaries, a marked difference of about 345 per cent over the GIA of the non- beneficiaries.

Though the average irrigated area of the beneficiaries is substantially higher than that of the non-beneficiaries, the real status of irrigation can be judged only by comparing with gross cropped area. The higher level of irrigated area of the beneficiaries is clearly reflected in the percentage of net irrigated area (NIA/NSA) as well as in the percentage of gross irrigated area (GIA/GCA). While the percentage of GIA to GCA comes to about 78 per cent for the beneficiaries, the same is about 20 per cent for the non-beneficiaries. The percentage of irrigated area of the beneficiaries is comparable with any assured irrigated area of the country. Since the percentage of gross irrigated area is much higher among the beneficiaries, in-depth enquiries were made with the sample farmers to understand the process of irrigation development due to watershed programme. What we understand from the discussion is that the area under irrigation of the beneficiaries was almost similar to the non-beneficiaries at the time of the inception of the watershed programme. It is only after adopting various treatments to improve the rain water harvesting under WDP, the area under irrigation has increased substantially among the beneficiaries. On the whole, the analysis on irrigation clearly shows that area under irrigation of the beneficiaries is substantially higher than that of the non- beneficiaries.

3.4 Change in Water Level in the Wells:²

Surface irrigation sources like tanks and canals are rarely to be seen in the rain-fed areas. Groundwater (well) is the only source available for irrigation in the rain-fed areas. The wells are also often suffered with poor recharge resulting in low

² Various forms of water bodies/water harvesting structures created under the watershed development programme are explained in detail in chapter two. Here, we analyse only the impact of WDP on the level of water in the wells.

level of water availability mainly due to absence of any structured rain water harvesting system. Since proper rain water harvesting measures are essential to improve the water level in the wells, treatments such as farm ponds, check dams, percolation ponds, sunken dug-cuts, contour guide lines, run-off management structures, etc., are taken up in the watershed area. Let us see how these measures have helped in improving the water level in the wells owned by the beneficiaries.³ Table 3.3 presents season-wise water level in the wells for both pre-project period (1991-92) and the present period (1998-99). It is clear from the table that the water level in the irrigation wells of the beneficiaries has increased significantly from the pre-project period to 1998-99 in all the three seasons. A similar trend is also observed in the wells of the neighbouring farms as well as in drinking water wells of the beneficiaries. For instance, in *kharif* season, while the water level in the irrigation wells of the beneficiaries during pre-project period was just 28 feet from the bottom of the well, the same has increased to 61.70 feet in 1998-99, indicating an increase of about 120 per cent. As in *kharif* season, the water level in the irrigation wells of the beneficiaries has increased about 348 per cent between 1991-92 and 1998-99 in *rabi* season as well. Importantly, the water level of the wells during summer season has increased tremendously, from 5 feet in the pre-project period to about 58.4 feet in the post-project period. In contrast to this, the water level in the wells of the non-beneficiaries has declined between the two periods considered for analysis. The beneficiary farmers have expressed that the various treatments taken for harvesting of

³ Although the main aim of study is to compare the present position of the beneficiaries with that of the non-beneficiaries in different parameters, we have also made comparison between pre and post-project position of different parameters among both the beneficiaries and the non-beneficiaries, specifically to strengthen the analysis.

rain water under the WDP are very effective and helped substantially to increase to recharging capacity of the wells.

As far as the long-term impact of various water harvesting structures created under the WDP on the depth of water level is concerned, it is expected that the rain water harvesting structures will continue to have positive impact on water level in the wells. This is because of two reasons. Firstly, although there were fluctuations in the rate of rainfall between 1991-92 to 1998-99, it has not made any severe impact on the depth of water level. Secondly, farmers of the watershed area have also clearly understood the importance of various runoff structures in improving the moisture availability and water level of the wells. It is expected, therefore, that farmers will continue to maintain the water harvesting structures through community participation because they know this is the only option available to them for improving the depth of water level in their wells.

Table 3.3: Season-wise Water Level in the Wells during Pre-project and Post-Project Period.

(in feet from bottom of the well)

Particulars	Pre-Project			Post-Project			Change in % over Pre-Project		
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
A. Non-Beneficiaries:									
1. Irrigation Well	20.0	18.0	0.0	16.7	12.5	5.00	-16.50	-30.56	--
2. Well in Neighboring Farm	--	--	--	19.6	15.0	5.80	--	--	--
3. Drinking Water Well	--	--	--	--	--	--	--	--	--
B. Beneficiaries:									
1. Irrigation Well	28.0	15.0	5.0	61.7	67.2	58.4	120.36	348.00	1068.00
2. Well in Neighboring Farm	43.3	35.0	40.0	42.1	35.6	32.9	-2.77	1.71	-17.75
3. Drinking Water Well	32.0	21.5	12.2	32.2	23.5	14.1	0.63	9.30	-15.57

Notes: Number of families having wells have increased from 3 in pre-project period to 15 in post-project period among the beneficiaries and the same has increased from 2 to 8 among the non-beneficiaries.

In the course of field survey, we have also noticed some interesting changes in number of wells that are owned and operated by the beneficiaries. During the pre-project period, only 3 beneficiaries were having wells but it has increased to 15 in the

level of water availability mainly due to absence of any structured rain water harvesting system. Since proper rain water harvesting measures are essential to improve the water level in the wells, treatments such as farm ponds, check dams, percolation ponds, sunken dug-cuts, contour guide lines, run-off management structures, etc., are taken up in the watershed area. Let us see how these measures have helped in improving the water level in the wells owned by the beneficiaries.³ Table 3.3 presents season-wise water level in the wells for both pre-project period (1991-92) and the present period (1998-99). It is clear from the table that the water level in the irrigation wells of the beneficiaries has increased significantly from the pre-project period to 1998-99 in all the three seasons. A similar trend is also observed in the wells of the neighbouring farms as well as in drinking water wells of the beneficiaries. For instance, in *kharif* season, while the water level in the irrigation wells of the beneficiaries during pre-project period was just 28 feet from the bottom of the well, the same has increased to 61.70 feet in 1998-99, indicating an increase of about 120 per cent. As in *kharif* season, the water level in the irrigation wells of the beneficiaries has increased about 348 per cent between 1991-92 and 1998-99 in *rabi* season as well. Importantly, the water level of the wells during summer season has increased tremendously, from 5 feet in the pre-project period to about 58.4 feet in the post-project period. In contrast to this, the water level in the wells of the non-beneficiaries has declined between the two periods considered for analysis. The beneficiary farmers have expressed that the various treatments taken for harvesting of

³ Although the main aim of study is to compare the present position of the beneficiaries with that of the non-beneficiaries in different parameters, we have also made comparison between pre and post-project position of different parameters among both the beneficiaries and the non-beneficiaries, specifically to strengthen the analysis.

rain water under the WDP are very effective and helped substantially to increase to recharging capacity of the wells.

As far as the long-term impact of various water harvesting structures created under the WDP on the depth of water level is concerned, it is expected that the rain water harvesting structures will continue to have positive impact on water level in the wells. This is because of two reasons. Firstly, although there were fluctuations in the rate of rainfall between 1991-92 to 1998-99, it has not made any severe impact on the depth of water level. Secondly, farmers of the watershed area have also clearly understood the importance of various runoff structures in improving the moisture availability and water level of the wells. It is expected, therefore, that farmers will continue to maintain the water harvesting structures through community participation because they know this is the only option available to them for improving the depth of water level in their wells.

Table 3.3: Season-wise Water Level in the Wells during Pre-project and Post-Project Period.

(in feet from bottom of the well)

Particulars	Pre-Project			Post-Project			Change in % over Pre-Project		
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
A. Non-Beneficiaries:									
1. Irrigation Well	20.0	18.0	0.0	16.7	12.5	5.00	-16.50	-30.56	--
2. Well in Neighboring Farm	--	--	--	19.6	15.0	5.80	--	--	--
3. Drinking Water Well	--	--	--	--	--	--	--	--	--
B. Beneficiaries:									
1. Irrigation Well	28.0	15.0	5.0	61.7	67.2	58.4	120.36	348.00	1068.00
2. Well in Neighboring Farm	43.3	35.0	40.0	42.1	35.6	32.9	-2.77	1.71	-17.75
3. Drinking Water Well	32.0	21.5	12.2	32.2	23.5	14.1	0.63	9.30	-15.57

Notes: Number of families having wells have increased from 3 in pre-project period to 15 in post-project period among the beneficiaries and the same has increased from 2 to 8 among the non-beneficiaries.

In the course of field survey, we have also noticed some interesting changes in number of wells that are owned and operated by the beneficiaries. During the pre-project period, only 3 beneficiaries were having wells but it has increased to 15 in the

post-project period (1998-99). That is, the percentage of family having wells has increased from 15 per cent in 1991-92 to 75 per cent in 1998-99. Interestingly, some of the beneficiaries have installed bore-wells instead of having dug-wells in the recent years to have uninterrupted water supply. In contrast to the watershed area, in the non-watershed area, the number of family owning wells have increased moderately from 10 per cent in pre-project period to 40 per cent in 1998-99. However, we came to know that the wells of non-watershed area are often suffered with poor recharge because of dearth of any structured rain water harvesting system. This is also one of the reasons why the growth of irrigation wells is sluggish in the non-watershed area. The analysis regarding the water level in the wells offers two important points. Firstly, the watershed programme improves the water level in the wells and thereby increases area under irrigation substantially. Secondly, the watershed programme also allows the farmers to have individual irrigation well which not only provides assured water supply but also helps them to cultivate better remunerative crops.

Another important point comes out from the data on water level is about the increasing level of water in the drinking water wells in the watershed area. Though the watershed selected for study comes under scarcity zone, the villages coming under the watershed area never had any drinking water problem especially after the commencement of the watershed programme. This offers an important policy directions for the ongoing drinking water problem in the rural areas of Gujarat, Rajasthan and Andhra Pradesh. Since the watershed programme helps to strengthen the groundwater recharging parameters by arresting the rain water run-off, this can be a permanent remedy for the problem of drinking water in the rural areas. On the whole, the treatments adopted under the watershed development programme for

improving the harvesting of rain water have substantially increased the water level both in the irrigation wells as well as in the drinking water wells.

3.5 Cropping Pattern:

Among the different factors determining the cropping pattern, irrigation availability plays a paramount role. Generally, area under water-intensive crops will be higher where the availability of irrigation is higher. We have seen earlier that the availability of irrigation is substantially higher for the beneficiaries compared to the non-beneficiaries due to various treatments taken up for improving the rain water harvesting system under the WDP. Therefore, it is expected that the cropping pattern of the beneficiaries will be different from that of the non-beneficiaries. In this section, besides comparing the present cropping of pattern of the beneficiaries with the non-beneficiaries, we have also made an attempt to find out as how the cropping pattern has changed between pre-watershed position to post-position, i.e., present position among both group of farmers. Table 3.4 presents the cropping pattern for both the beneficiaries and the non-beneficiaries.

Data provided in the tables clearly depict differences in the cropping pattern between the beneficiaries and the non-beneficiaries. Let us first compare the present cropping pattern of the beneficiaries with that of the non-beneficiaries. Crops such as jowar, tur and udid are the important *kharif* crops for both the beneficiaries and the non-beneficiaries. Except udid, there are major differences in the share of these crops to GCA between the beneficiaries and the non-beneficiaries. Similarly, there are differences in the share of total area under *kharif* season to gross cultivated area between the beneficiaries and the non-beneficiaries. While *kharif* season accounts for nearly three fourth of the total cultivated area among the non-beneficiary group, the same accounts for about 64 per cent in the beneficiary group, a difference of about 11

per cent. This difference is mainly because of the complete absence of annual crops among the non-beneficiary group of farmers.

Table 3.4: Cropping Pattern of Beneficiary and Non-Beneficiary Households.

Crop (1)	(Per cent to Gross Cropped Area)					
	Beneficiaries			Non-Beneficiaries		
	Pre (2)	Post (3)	3-2 (4)	Pre (5)	Post (6)	6-5 (7)
Kharif Seasons:						
1. Yellow Jowar	20.67	0.35	-20.32	27.13	3.36	-23.77
2. Hybrid Jowar	4.79	24.37	19.58	8.19	33.47	25.28
3. Bajra	3.99	3.80	-0.19	7.60	6.51	-1.09
4. Tur	14.66	14.35	-0.31	18.83	10.49	-8.34
5. Hulga	5.98	1.73	-4.25	0.94	0.42	-0.52
6. Udid	7.08	6.40	-0.68	6.08	6.72	0.64
7. Matki	8.57	3.11	-5.46	5.38	1.68	-3.70
8. Moong	3.79	3.80	0.01	3.51	4.72	1.21
9. Paddy	--	0.17	0.17	--	1.68	1.68
10. Sunflower	1.50	--	1.50	--	--	--
11. Groundnut*	--	6.31	6.31	--	4.62	4.62
Total Kharif Share	71.03	64.39	--	77.66	73.67	
Rabi Season						
12. Jowar	22.83	14.35	8.48	18.71	21.72	3.01
13. Wheat	4.99	10.54	5.55	1.87	3.88	2.01
14. Gram	0.80	2.16	1.36	1.75	0.73	-1.02
Total Rabi Share	28.62	27.05	--	22.33	26.33	
Annual & Perennial Crops:						
15. Sugarcane	0.40	6.91	6.51	--	--	--
16. Lemon	--	0.52	0.52	--	--	--
17. Guava	--	0.69	0.69	--	--	--
18. Orange	--	0.35	0.35	--	--	--
19. Mango	--	0.09	0.09	--	--	--
Total Share of Annual Crops	0.40	8.56	--	--	--	--
Total	100.00	100.00		100.00	100.00	100.00

Notes : * - includes both kharif and summer seasons.

As in *kharif* season, we could also observe clear differences in the cropping pattern of *rabi* season between the two group of farmers. Although *rabi* season accounts for almost a similar share of cultivated area for both the beneficiaries (about 27 per cent of GCA) and the non-beneficiaries (26 per cent of GCA), significant differences are noticed at the individual crop level. In the total cropped area of *rabi* season, wheat, a water-intensive crop, accounts for nearly 39 per cent in the

beneficiary group, whereas, the same accounts for only 15 per cent among the non-beneficiary group (see, Table 3.5). On the other hand, while the less water consuming crop like jowar accounts for over 82 per cent of the total *rabi* cropped area of the non-beneficiaries, the same accounts for only about 53 per cent of the area of the beneficiaries. According to the beneficiary farmers, the higher share of area under wheat is mainly because of the higher availability of irrigation from the wells due to treatments carried out for improving the rain water harvesting under the watershed development programme.

Table 3.5: Share of Rabi Crops to Total Rabi Cropped Area.

Crop's Name	Beneficiaries		Non-Beneficiaries	
	Pre-Position	Post-Position	Pre-Position	Post-Position
Jowar	79.79	53.04	83.77	82.48
Wheat	17.42	38.98	8.38	14.74
Gram	2.79	7.98	7.95	2.79
Total	100.00	100.00	100.00	100.00

One of the important differences of cropping pattern between the beneficiaries and the non-beneficiaries is the complete absence of area under annual crops among the non-beneficiaries. Annual and perennial crops such as sugarcane, lemon, guava, mango and orange account for about 8 per cent of GCA of the beneficiaries. Of this, sugarcane, which is a heavy water intensive crop, accounts for nearly seven per cent of GCA. Out of 20 sample beneficiaries, seven farmers have been cultivating sugarcane presently. Before the introduction of watershed programme in this area, only one farmer was cultivating sugarcane that too in 0.40 ha. of area. The watershed programme has made tremendous impact on the availability of water in the irrigation wells which has ultimately helped the farmers to increase the area under heavy water intensive crops such as sugarcane.

We have also estimated the total share of irrigated crops to GCA for both the beneficiaries and the non-beneficiaries, specifically to understand the impact of watershed programme on irrigated crops. The crops included for this analysis are paddy, groundnut, wheat, gram, sugarcane and fruit crops. The result shows that the area allocated for these crops is 1.61 ha per household for the beneficiaries and 0.52 ha for the non-beneficiaries. In terms of percentage, irrigated crops account for 27.70 per cent of GCA for the beneficiaries and 10.90 per cent of GCA for the non-beneficiaries. This shows the positive influence of watershed programme on the area under water-intensive as well as irrigated crops.

3.6 Cropping Sequence and Cropping System:

Generally, the introduction of irrigation brings changes in the cropping sequences as well as in whole cropping system. Farmers belonging to the rain-fed area normally cultivate only one crop in a year that too low value crop because of the constraint in water/moisture availability. We have seen earlier that the watershed development programme has made significant improvement in the availability of water for irrigation for the beneficiaries. Therefore, one may expect some changes in cropping sequence between pre-project period and post-project period among the beneficiaries and also between the beneficiaries and the non-beneficiaries. We have collected information regarding crop sequences of the watershed area for both the pre-project period and the post-project period from the beneficiary and non-beneficiary farmers to get an overall idea about the changes in crop sequences. The important crop sequences are given below for both before and after the introduction of watershed programme,. Generally, summer crops were not grown before the initiation of the watershed development programme. The WDP has changed the crop sequences. Sugarcane and horticultural crops such as lemon,

guava, orange and mango are the new addition to the cropping pattern of the beneficiaries. Although the farmers cultivating summer crops (mainly vegetables) were not found in our sample, we came to know from the beneficiaries that quite a

Before the WDP	After the WDP
1. green gram – rabi jowar	1. hybrid jowar - wheat - vegetable crops
2. kharif jowar – gram	2. hybrid jowar + tur - vegetable crops
3. jowar + tur	3. moong - rabi jowar - vegetable crops
	4. sugarcane
	5. fruit crops

good number of the beneficiaries have been cultivating vegetable crops during summer season. Data provided by the officials of Gaosud watershed on cropping sequence also indicate a significant changes in crop sequences followed by the farmers in the watershed area (see, Table 3.6).

Table 3.6: Crops Sequences of Gaosud Watershed Area.

Sr. No.	Pre-Project Sequence	Present Sequence
1.	Jowar	Jowar – Wheat
2.	Jowar - Wheat Jowar - Gram	Jowar – Wheat – Vegetable crops Soyabean - Rabi Jowar
3.	Jowar + Tur	Soyabean - Wheat – Sunflower
4.	Paddy – Wheat	Soyabean - Wheat – Sunflower
5.	Moong - Rabi Jowar	Moong – Rabi Jowar – Vegetable crops
6.	Udid - Rabi Jowar	Udid – Jowar – Vegetable crops
7.	Sunflower	Moong/Udid – Gram – Sunflower/Groundnut
8.	Tur	Moong – Jowar – Sunflower/Groundnut
9.		Sugarcane
10.		Fruit crops

Source: *Project Report on NWDPR for Gaosud Watershed, 1991-92 to 1996-97*, Department of Agriculture, Government of Maharashtra, Pune.

Besides bringing changes in crop sequence, the watershed programme has also changed the cropping system. Before the introduction of watershed programme, the beneficiary farmers were mainly using local varieties in both

foodgrain and oilseed crops. The watershed programme, by improving the availability of water, has helped the farmers to shift from local varieties to high yielding/hybrid varieties. The survey shows that over 70 per cent of the farmers, especially those who are cultivating important cereal crops such as jowar, bajra and wheat, have used HYV/hybrid seeds in the recent years. Similar to cereal crops, considerable percentage of beneficiary farmers have used HYV/hybrid seeds in pulses (tur, moong, gram etc.) as well as in oilseed crops (sunflower and groundnut) in the recent years.

Table 3.7: Cropping System followed by Beneficiaries and Non-Beneficiaries.

Type of cropping	Beneficiaries		Non-Beneficiaries	
	Pre	Post	Pre	Post
1. Sole cropping	Yes (9) No (11)	Yes (11) No (9)	Yes (12) No (18)	Yes (13) No (7)
2. Mixed cropping	Yes (8) No (12)	Yes (7) No (13)	Yes (4) No (16)	Yes (8) No (12)
3. Strip cropping	Yes (5) No (15)	Yes (6) No (14)	Yes (3) No (17)	Yes (3) No (17)
4. Inter cropping	Yes (14) No (6)	Yes (14) No (6)	Yes (17) No (3)	Yes (17) No (3)
5. Relay cropping	Yes (0) No (20)	Yes (2) No (18)	Yes (0) No (20)	Yes (0) No (20)

Notes: Figures in brackets are number of farmers followed each method of cropping.

Mixed cropping and inter cropping are commonly practiced by the farmers belonging to the rain-fed area. This was also true for the sample area before the introduction of watershed programme. Although majority of the sample farmers (beneficiaries) have been continuing with mixed cropping even after the introduction of watershed programme, some of the farmers, especially those who are having lands at the lower reach of the watershed, have started cultivating sole crop in the recent years (Table 3.7). These changes were not observed among the non-beneficiary farmers. The beneficiary farmers have also indicated that they

would cultivate sole crop in the coming seasons if the availability of water improves further. On the whole, it is clear from the above that the WDP has brought changes in the cropping pattern and cropping system mainly due to improvement in the availability of moisture and irrigation.

3.7 Adoption of Improved Farming Practices:

The adoption of modern inputs (HYV seeds, fertilisers, pesticides, etc.,) and improved farming practices (removing weeds, following recommended level of inputs and adopting them at recommended time, use of machineries, etc.,) is normally found to be substantially higher in the irrigated farming compared to the rain-fed farming. As the modern inputs are expensive, farmers belonging to the rain-fed areas are not inclined to adopt these inputs for crops mainly due to uncertainty in the crop output. As mentioned earlier, the WDP not only improves the availability of moisture and irrigation but also stops crop failures and gives stability to crop yields. Therefore, it is expected that the farming practices followed by the farmers belonging to the watershed area would be relatively improved than the farmers of non-watershed area. In view of this, we tried to find out the extent of difference in the improved farming practices followed by the beneficiary and the non-beneficiary sample farmers. Table 3.8 presents the number of farmers followed improved farming practices in both the beneficiary and the non-beneficiary groups. We are very well aware that the farming practices followed by the farmers vary from crop to crop. However, it is very difficult capture the crop-wise position of improved farming practices followed by the farmers through survey like this (pilot survey) due to time constraint. Therefore, we have presented here the overall adoption of improved farming practices for different crops followed by the sample farmers.

As expected, it is evident from the Table 3.8 that the overall adoption of improved farming practices is higher among the beneficiaries when compared to the non-beneficiaries. The number of beneficiaries following the improved farming practices followed have also increased substantially from the pre-project period to the post-project period. During the pre-project period, none of the beneficiaries were using HYV/hybrid seeds. This has changed and all the 20 beneficiaries have used HYV/hybrid varieties in 1998-99. In the case of non-beneficiary group, 16 out of 20 farmers have used HYV/hybrid seeds during the same period.

Table 3.8: Adoption of Improved Farming Practices by Beneficiary and Non-Beneficiary Farmers

Operations	Number of Beneficiaries		Number of Non-Beneficiaries	
	Pre	Post	Pre	Post
Type of Seed	Local = 20 HYY/Hybrid = 0	Local = 0 HYY/Hybrid=20	Local = 20 HYY/Hybrid=0	Local = 4 HYY/Hybrid=16
Method of Ploughing	Bullock = 20 Tractor = 0	Bullock = 10 Tractor = 10	Bullock = 20 Tractor = 0	Bullock = 18 Tractor = 2
Sowing Implement	Tifan = 20	Tifan = 20	Tifan = 20	Tifan = 20
Manure Use	Yes = 18 No = 2	Yes = 20 No = 0	Yes = 19 No = 1	Yes = 19 No = 1
Fertilisers Use	Yes = 3 No = 17	Yes = 18 No = 2	Yes = 1 No = 19	Yes = 11 No = 9
Harvesting	Manual = 20	Manual = 20	Manual = 20	Manual = 20
Cutting	Manual = 20	Manual = 20	Manual = 20	Manual = 20
Threshing	Manual = 20	Manual = 20	Manual = 20	Manual = 20

Notes: The practices mentioned here are not for any specific crop. This is the over- all adoption of improved practices followed for different crops by the sample farmers.

As in the case of HYV/hybrid seeds, fertiliser is also an important input which helps to increase the yield significantly. The sample survey shows that the number of farmers who used fertilisers are higher among the beneficiary group compared to the non-beneficiary group. Many beneficiary farmers have indicated that they have not only used modern fertilisers but also followed recommended doses of fertilisers for important crops in the recent years. Farmers using recommended levels of fertilisers are rarely found in the non-beneficiary group because of uncertainty in crop output.

The other improved farming practices followed by the beneficiaries are tractors for ploughing and mechanical threshers for threshing. In the post-project period, while 50 per cent of the beneficiaries have used tractors for ploughing, the same is only ten per cent among the non-beneficiaries. Similarly, while all the 100 per cent of the beneficiaries have used mechanical threshers for threshing crops like jowar, bajra, wheat, etc, this percentage comes to only 15 per cent for the non-beneficiaries. The beneficiary farmers have opined that the improvement in the availability of soil moisture and irrigation due to the WDP and subsequent changes in cropping pattern have lead them to adopt improved farming practices in their crop cultivation.

3.8 Cost of Cultivation⁴ and Productivity of Crops:

Cost of cultivation of any crop is positively associated with the adoption of improved farm practices. We have seen earlier that the adoption of improved farm practices in different crops is higher among the beneficiaries than the non-beneficiaries. Therefore, it is expected that cost of cultivation of the beneficiaries would be higher than that of the non-beneficiaries. Available studies in this regard have also confirmed the same (Singh, 1988; Deshpande and Reddy, 1991; Deshpande and Narayanamoorthy, 1999; Kulkarni *et al.*, 1999). Table 3.9 presents the cost of

⁴ Our cost of cultivation refers to cost A1. This includes all actual expenses in cash and kind incurred in production by owner. For more details on different cost concepts, see CACP (1998), *Reports of the Commission for Agricultural Costs and Prices for the Crops Sown During 1998-99 Season*, Commission for Agricultural Costs and Prices, Ministry of Agriculture, Government of India, New Delhi.

Table 3.9: Crop-wise Cost of Cultivation^{\$} of Beneficiaries Farm and Non-Beneficiaries Farm

(Rs/ha)

Crop	Beneficiaries (B)			Non-Beneficiaries (NB)			Difference in Present Cost between B and NB (per cent)
	Pre-Project	Present	% over Pre-Project	Pre-Project	Present	% over Pre-Project	
1. Yellow Jowar(k)	2844	3960	39.24	2014	2621	30.14	51.08
2. Hybrid Jowar (k)	3300	4286	29.88	2677	3387	26.99	26.54
3. Bajra (k)	2750	3550	29.09	1925	2625	36.36	35.24
4. Tur (k)	3388	4219	24.53	2772	3611	30.27	16.84
5. Hulga (k)	2250	1900	-15.56	--	--	--	--
6. Udid (k)	2514	2800	11.38	--	--	--	--
7. Matki (k)	2750	3075	11.82	1550	2000	29.03	53.75
8. Moong (k)	2100	2850	35.71	2133	3000	40.65	-5.00
9. Groundnut (k&s)	5500	7000	27.28	3500	4500	28.57	55.56
10. Jowar (r)	2950	3627	22.95	2978	3229	8.43	12.33
11. Wheat (r)	3817	4625	21.71	3762	4633	23.15	-0.17
12. Gram (r)	3850	3575	-7.14	3250	3750	15.38	4.67
13. Sugarcane	14000	15143	8.16	--	--	--	--

Notes: k - kharif; r - rabi; s - summer.

\$ - This refers to cost A₁.

cultivation of different crops for both the beneficiaries and the non-beneficiaries. As confirmed by the earlier studies, the cost of cultivation of the majority of the crops is higher for the beneficiaries when compared to the non-beneficiaries. This is because of the fact that the beneficiaries have used relatively higher amount of modern inputs like fertilisers, etc., compared to the non-beneficiaries. Though wheat is an important irrigated crop for the beneficiaries, there is no much difference in the cost of cultivation between the two group of farmers. This is because of two reasons. First, the number of farmers cultivating wheat in the non-beneficiary group is only two, and second, the non-beneficiary farmers who cultivated wheat have their fields very near to the watershed boundary and therefore, they could also adopt higher amount of yield increasing inputs due to the availability of irrigation. Except wheat, the cost of cultivation of the beneficiaries is substantially higher for all other important crops than that of the non-beneficiaries.

As far as the productivity of crops is concerned, except some pulse crops, the productivity of other crops is higher for the beneficiaries compared to the non-beneficiaries (see, Table 3.10). In 1998-99, the productivity difference between the beneficiaries' farm and the non-beneficiaries' farm is about 36 per cent in hybrid jowar, 81 per cent in tur, 73 per cent in udid, 166 per cent in paddy, 57 per cent in *rabi* jowar and about 41 per cent in wheat. There are two main reasons for higher productivity among the beneficiaries' farm. Firstly, the beneficiaries have used relatively higher amount of yield increasing inputs which augmented productivity of different crops. Secondly, due to various treatments taken under the WDP, the availability of moisture has improved which ultimately increased the productivity of various crops. This is also reinforced by the increased productivity of wheat crop for the beneficiaries. That is, despite no significant difference in the cost of cultivation of

Table 3.10: Productivity of Different Crops in Beneficiaries and Non-Beneficiaries Farm

Crops	Beneficiaries			Non-Beneficiaries			Incremental Benefit (per cent)*
	Pre-Project	Present	% over Pre-Project	Pre-Project	Present	% over Pre-Project	
1. Yellow Jowar(k)	5.80	37.50	29.31	4.80	6.56	36.67	14.33
2. Hybrid Jowar (k)	13.54	14.13	4.36	9.00	10.37	15.22	36.26
3. Bajra (k)	1.50	3.86	2.57	6.00	8.87	47.83	-56.48
4. Tur (k)	4.05	5.69	40.49	3.82	3.14	-17.80	81.21
5. Hulga (k)	4.66	6.00	28.76	5.00	5.00	--	20.00
6. Udid (k)	4.58	6.49	41.70	3.08	3.75	21.75	73.07
7. Matki (k)	2.85	5.28	85.26	2.50	6.25	150.00	-15.52
8. Moong (k)	3.82	4.77	24.87	4.33	5.55	28.18	-14.05
9. Paddy	--	10.00	--	--	3.75	--	166.67
10. Groundnut (k&s)	--	8.08	--	--	7.72	--	4.63
11. Sunflower (k)	8.00	--	--	--	--	--	--
12. Jowar (r)	4.59	8.89	93.68	4.06	5.65	39.16	57.35
13. Wheat (r)	11.20	12.99	15.98	10.00	9.19	-8.1	41.35
14. Gram (r)	8.75	6.80	-22.29	4.67	8.57	83.52	-20.65
15. Sugarcane	625.00	749.00	19.84				

Notes : * - This refers to difference in productivity of beneficiaries and non-beneficiaries in the present position.

wheat between the two group of farmers, productivity of the beneficiaries' farm is substantially higher (about 41 per cent) than that of the non-beneficiaries' farm. On the whole, as confirmed by various earlier studies related to the WDP, the results of our study also indicate that the productivity (majority of the crops) of different crops is higher on the beneficiaries' farm than the non- beneficiaries' farm.

3.9 Socio-Economic Status:

A large number of studies have proved that the socio-economic conditions of the farmers living in the irrigated regions are much better than that of the rain-fed areas (Kulkarni *et al.*, 1999; Deshpande and Reddy, 1991; ISAE, 1991). One of the main reasons for this is that irrigation not only provides assured output and higher productivity for different crops but also allows farmers to take up the crops which provide higher remuneration (commercial crops). As a result of increased income gained through higher productivity and cultivation of commercial crops, farmers belonging to irrigated regions could spend money for buying essential as well as luxury items and ultimately improve their overall standard of living.

In this study, as seen earlier, significant improvements in area under irrigation and availability of moisture after the introduction of the WDP were observed. Therefore, it is expected that the socio-economic condition of the beneficiaries must have improved after the introduction of WDP and also better than the non-beneficiaries. Though many factors can be used for judging the socio-economic condition of the people living in the rural areas, we have considered only three important factors in this study. They are, status of employment days, assets position and income from different sources.

Let us first see the status of employment including the number of labour days available for the beneficiaries and the non-beneficiaries. It is evident from Table 3.11

Table 3.11: Employment Position of Beneficiary and Non-Beneficiary Households.

(Average days/household/ year)

Particulars	Pre-Watershed Position			Post-Watershed Position			Change in Total Labour days due to WDP
	Male	Female	Total	Male	Female	Total	
Beneficiary Group:							
1. Number of Hired-out Labour Days	104	83	187 (51.09)	45	42	87 (23.26)	-100
2. Labour Days Used on Own Farm	97	82	179 (48.91)	147	140	287 (76.74)	108
Total Labour Days	210	165	366 (100.00)	192	182	374 (100.00)	8
Non-Beneficiary Group:							
1. Number of Hired-out Labour Days	99	77	176 (46.81)	98	75	173 (46.01)	-03
2. Labour Days Used on Own Farm	110	90	200 (53.19)	100	96	206 (54.79)	06
Total Labour Days	209	167	376 (100.00)	208	171	376 (100.00)	0

Note: Figures in brackets are percentages to total labour days.

that there is substantial difference in the status of employment between the beneficiaries and the non-beneficiaries. During the pre-project period, the total labour days available per household to the beneficiaries and the non-beneficiaries were 366 days and 376 days respectively. Out of this, the beneficiaries and the non-beneficiaries households were hiring-out 51 per cent and 46 per cent respectively. That is, nearly 50 per cent of the total labour days were hired-out by both group of households. The watershed development programme has brought tremendous changes in this for the beneficiaries. In 1998-99, the beneficiaries' households have hired-out only about 23 per cent of their total labour days (374) and the remaining (about 76 per cent) labour days were used on their own farm. In contrast to this, no change was observed in the proportion of labour days hired-out between the two periods considered for the analysis in the non-beneficiary households. Due to increased availability of water and moisture after the introduction of WDP, the beneficiary households could use their hired-out labour hours on their own farm itself. The beneficiary farmers have expressed that working on their own farm rather than going for wage labour is not only more profitable but also it enhances ones status and gives greater satisfaction. Many beneficiary farmers have also expressed that this is one of the changes in the socio-economic condition of the people brought out by the watershed development programme.

The watershed development programme, by bringing substantial changes in productivity and production of crops, also helps to strengthen the assets position (both farm and non-farm assets) of the beneficiaries. This is also confirmed by a recent study conducted at Mendhwan watershed area of Ahmednagar district in Maharashtra (Kulkarni *et al.*, 1999). We have also tried to find out the changes in the assets position of the beneficiaries due to watershed development programme. Table 3.12

Table 3.12: Assets Position of Beneficiary and Non-Beneficiary Households.

Name of the Assets	Beneficiary				% Change over Pre-Project	Non-Beneficiary				% Change over Pre-project	Incremental Value* (per cent)
	Pre-Project		Present Position			Pre-Project		Present Position			
	No.	Value	No.	Value		No.	Value	No.	Value		
A. Farm Assets:											
1. Seed Drill	14	275	14	368	33.82	16	225	17	244	8.44	50.82
2. Harrow	13	234	14	296	26.49	17	197	17	242	22.84	22.31
3. Hoe	7	221	8	250	13.12	14	182	15	203	11.54	23.15
4. Bullock Cart	9	4011	10	7900	96.96	4	4875	5	6200	27.18	27.42
5. Electric Pump-set	4	4500	21	26809	495.76	2	7000	3	7330	4.71	265.74
6. Wooden Plough	8	372	11	636	70.96	10	275	10	360	30.91	76.67
B. Non-Farm Assets:											
7. House	20	8950	20	22450	150.84	20	7333	20	13375	82.39	67.85
8. TV	Nil	--	9	6111	--	1	5000	10	5450	9.00	12.13
C. Livestock:											
9. Cows	16	3219	34	5168	60.55	13	3154	27	4852	53.84	6.52
10. Bullocks	29	3931	36	5639	43.45	24	4550	30	6800	49.45	-17.07
11. Calves	1	500	5	900	80.00	5	700	7	1357	93.86	33.68
12. Buffaloes	1	5000	4	7750	55.00	11	4909	30	7163	45.92	8.19
Total Value of Assets	--	31213	--	84277	170.00	--	38400	--	53576	39.52	57.30

Note: *- This refers to difference between beneficiaries and non-beneficiaries in the present position.

presents the assets position of both the beneficiary and the non-beneficiary households. It is evident from the table that the assets position of the beneficiary households is not only better than that of the non-beneficiary households but also improved significantly than their own position of the pre-project period. The total value of assets for the beneficiaries increased from Rs. 31213 per household in pre-project period to Rs. 84277 per household in 1998-99, an increase of about 170 per cent. But in the case of non-beneficiaries, the total value of assets increased only by about 39 per cent (from Rs. 38400 to Rs. 53576) during this period.

Among different farm assets, significant improvement is observed in the number and value of electric pump-set of the beneficiaries. The number of electric pump-set has increased from four in pre-project period to 21 in 1998-99 and the value of per pump-set also increased from Rs. 4500 to 26809, an increase of about 495 per cent in just seven years. This huge increase in the value of pump-set is because of two reasons. Firstly, the beneficiary farmers have relatively higher horse power pump-sets and hence, the value is higher. Secondly, in the recent years, some of the farmers have also installed submersible pump-sets which are costly than the centrifugal pump-sets.

As far as the non-farm assets of the beneficiaries are concerned, we could see marked improvements in the value of house and in the number of farmers owning TV sets. During the pre-project period, most of the houses were *kutcha* having thatched roof and there were no concrete houses. Presently (1998-99), because of increased income due to WDP, while some of the farmers have modified their house structure with cement walls and floor, some others have constructed new houses. Because of these reasons, the average value of house has increased considerably for the beneficiaries. TV sets were completely absent among the beneficiary households

during the pre-watershed period whereas, 9 out of 20 households (45 per cent) own TV sets at present. Many farmers have stated that this was possible only because of the WDP, which has augmented their gross income to a larger extent.

As in the case of farm assets and non-farm assets, some improvements have also noticed in both the number and the value of livestock owned by the beneficiaries between the pre and the post-project period. While the number of cows increased from 16 in pre-project period to 34 in post-project period, bullocks number have also increased from 29 to 36 among the beneficiary households during this period. However, unlike other assets, the livestock position of the beneficiaries is not distinctly different from that of the non-beneficiaries. In fact, the present value of bullocks is relatively higher for the beneficiaries than that of the non-beneficiaries. This is because of the reason that since the non-beneficiaries get less income from crop husbandry (due to scarcity of water for irrigation and moisture stress) compared to their counterpart, they would like to keep more livestock to increase the gross income of the household. On the whole, it is clear from the above that the assets position of the beneficiaries have increased substantially after the introduction of the watershed development programme.

One of the main objectives of the watershed development programme is to improve the household income of the farmers belonging to the rain-fed areas besides conserving the land and water resources. Studies conducted in the watershed areas have confirmed that the WDP not only increased the income but also stabilized the income of the beneficiaries (Kulkarni, *et al.*, 1999; Laxmikanthamma, 1997; Deshpande and Reddy, 1991; Kshirsagar and Ghodake, 1991; Singh, 1988). Keeping this in view, we have tried to find out the impact of WDP on the source-wise income of the sample households. Table 3.13 presents the source-wise household income of

Figure 3.1: Household Income of Beneficiary and Non-Beneficiary

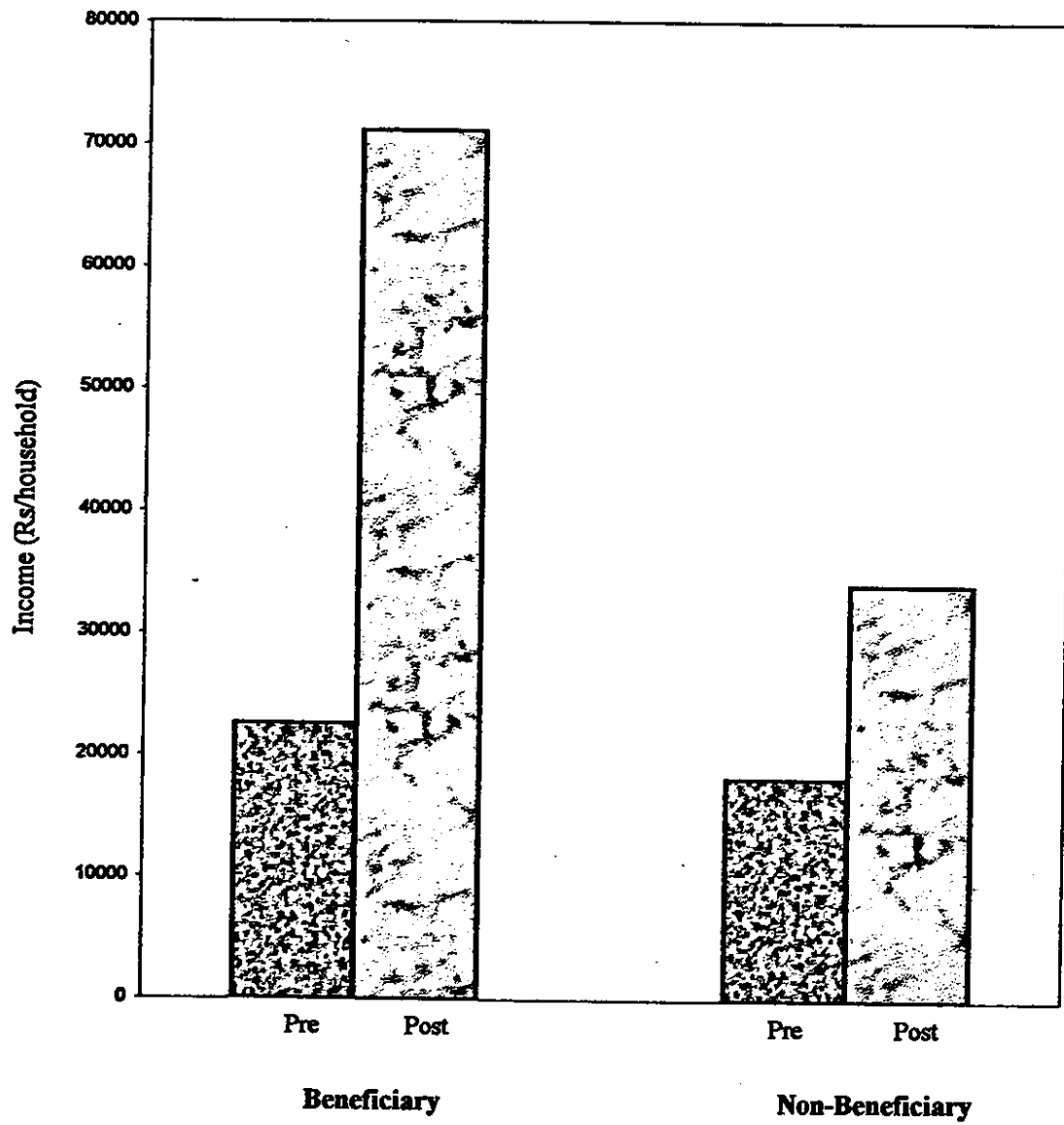


Table 3.13: Source-wise Income for Beneficiary and Non-Beneficiary Households.

(Value in Rs/household)

Source of Income	Beneficiaries			Non-Beneficiaries			Incremental Value (per cent)*
	Pre-Project Position	Present Position	% Change over Pre- Project	Pre-Project Position	Present Position	% Change over Pre- Project	
1. Income from Crop	14330 (63.60)	53675 (75.52)	274.56	8540 (47.08)	16200 (47.64)	89.70	231.33
2. Income from Livestock	5000 (22.19)	11000 (15.48)	120.00	6900 (38.04)	13000 (38.24)	88.41	-15.38
3. Income from Labour	2700 (11.98)	5250 (7.39)	94.44	2400 (13.23)	4200 (12.35)	75.00	25.00
4. Others	500 (2.22)	1150 (1.62)	130.00	300 (1.65)	600 (1.76)	100.00	91.67
5. Total Household Income (1+2+3+4)	22530 (100.00)	71075 (100.00)	215.47	18140 (100.00)	34000 (100.00)	87.43	109.04
6. Per hectare Crop Income	2854.58	9270.29	224.75	1995.33	3396.23	70.21	172.96

Note: Figures in brackets are percentages to total household income.

* - This refers to difference between beneficiaries and non-beneficiaries in the present position.

the beneficiaries and the non-beneficiaries. As expected, the income (present position) of the beneficiary households is not only increased significantly over the pre-project position but is also substantially higher than that of the non-beneficiary households (see, Figure 3.1). Among the sources of income, significant increase is observed in crops income of the beneficiary households. For instance, the income from crops increased from Rs. 14330 per household in pre-project period to Rs. 53675 in the post-project period, an increase of about 275 per cent. In contrast to this, the income from crops has increased only about 89 per cent (from Rs. 8540 to Rs. 16200) during this period for the non-beneficiary households. The crops income (present position) of the beneficiary households is about 231 per cent higher than the non-beneficiary households. This impressive increase in the crops income of the beneficiary households is mainly because of three reasons. Firstly, the watershed programme has increased the cropping intensity that has ultimately increased the gross income from per unit of land. Secondly, the watershed development programme, by improving the availability of moisture and water, has helped to increase the productivity of different crops. Thirdly, owing to availability of irrigation, the beneficiaries have shifted the cropping pattern from low value crops to high value commercial crops such as sugarcane and groundnut.

The income from livestock has increased by about 120 per cent (from Rs. 5000 to Rs. 11000) for the beneficiary households between the pre and post-project period. However, the livestock income of the beneficiaries is about 15 per cent less than that of the non-beneficiaries in the post-project period. The non-beneficiaries could not increase their income from crops due to constraint in water availability and hence they have given relatively more preference for livestock so as to increase their

household income. This is also reflected in their livestock position analysed earlier. The income earned from wage employment (labour) has increased at a higher rate for the beneficiary households between the pre and post-project period compared to the non-beneficiary households. In 1998-99, the labour income of the beneficiaries is 25 per cent higher over the wage income of the non-beneficiary households. This is hard to believe because of the reason that the number of hired-out labour days are higher among the non-beneficiary households compared to the beneficiary households. In-depth inquiry revealed two reasons for this. Firstly, the wage rate of the watershed area is relatively higher than that of the non-watershed areas. Secondly, unlike the beneficiaries, almost all the non-beneficiaries have mainly worked in the farm where the wage rates are low. On the whole, one can conclude from above that the watershed development programme has significantly improved the socio-economic conditions of the beneficiaries by improving the position of assets and gross income of the household.⁵

3. 10 Changes in Bio-mass production:

Besides bringing positive changes in water availability, cropping pattern and productivity of crops, the watershed development programme also helps to improve the bio-mass production in the form of grass, legumes, fodder, fuel wood and horticultural plantations. This could be possible because of three reasons. Firstly, the increased availability of moisture and irrigation helps to increase the growth of existing tree crops and other plants, which result in higher production of bio-mass.

⁵ Besides this, two more worth noting changes have taken place due to improvement in the socio-economic status of the beneficiaries after the introduction of watershed development programme. First, the availability of credit for the beneficiaries both from the institutional and the non-institutional sources has improved mainly because of assured crop output and better recovery rate. Second, before the introduction of WDP, the people from better villages were not willing to marry the girls of the families belonging to the villages of the watershed area because of frequent occurrence of drought. This condition has changed today and the families belonging to the irrigated villages also prefer to have marriage relations with the families of the watershed area mainly due to improvement in the socio-economic conditions of the households.

Secondly, the newly planted trees and other plants, in both arable and non-arable lands, under the watershed development programme also provide fodder and fuel wood. Thirdly, because of increased availability of irrigation under watershed area, both cropping intensity and growth of grass will increase substantially. As a result of these, the availability of fodder from crops and others (grass, plants and others) will also increase substantially. However, it is not possible to see substantial changes in all these aspects mentioned above in short period. In the case of availability of fuel wood and horti-plantation canopies, the impact can visibly be seen only after 10 or 15 years. But in the case of availability of fodder, the impact can be seen in a short period. Keeping these in view, an attempt has been made to find out the impact of the WDP on the production of fodder and fuel wood using the data collected from the sample households.

Table 3.14 presents the average availability of fuel wood and fodder per household for both the beneficiaries and the non-beneficiaries. The table shows a moderate improvement in the availability of both fuel wood and fodder for the beneficiaries after the introduction of watershed programme. The availability of fuel wood has increased from 16 quintals per household during the pre-project period to 22 quintals in the post-project period (an increase of 31 per cent) for the beneficiaries. Similarly, fodder production has increased from 48 quintals to 58 quintals/household (an increase of 20 per cent) during this period for the beneficiaries. Contrary to this, for the non-beneficiary households, while the availability of fuel wood has increased just one quintal between the two periods considered for the analysis, a reduction of three quintals is noticed in the fodder production between the two periods.

While comparing the position of the beneficiaries with the non-beneficiaries

for the year 1998-99, our data show that the availability of fuel wood is about 21 per cent higher for the beneficiaries over the availability for the non-beneficiaries. Similarly, the fodder production of the beneficiaries is higher about 18 per cent over the value of the counterpart. It is essential to mention here that the main components of fuel wood are babul, subabul and by-products of some of the crops cultivated by the farmers. The fodder components mainly include jowar straw, groundnut straw, the residuals of some pulse crops and grass from common lands. Jowar by-product accounts for over three fourth of fodder production for both the beneficiaries and the non-beneficiaries. Since the area under jowar is almost same for both group of households, the difference is not significant in the fodder production between these two group of households. However, the availability of green fodder (grass and others) from common lands is higher for the beneficiaries than the non-beneficiaries mainly because of increased availability of moisture in the watershed area. Besides these improvements, the beneficiaries have also pointed out that due to various treatments taken in both arable and non-arable lands under watershed programme, the growth of grass (green fodder) has increased in the common lands. This has allowed the farmers to send their cattles for open grazing.

Table 3.14: Availability of Fuel wood and Fodder for the Beneficiary and the Non-Beneficiary Households.

Particulars	Beneficiaries			Non-Beneficiaries			Incremental Availability (per cent)*
	Pre-Project	Present	% over Pre-Project	Pre-Project	Present	% over Pre-Project	
1. Fuel Wood	16	22	31.50	16	17	6.25	29.41
2. Fodder Production	48	58	20.83	52	49	-5.77	18.36

Note: * - This refers to difference between beneficiaries and non-beneficiaries in the present position.

The data provided by the officials of Gaosud watershed also strengthen the point that the availability of fuel wood and fodder has increased for the beneficiaries after the introduction of watershed programme. However, the quantity provided by the officials seems to be on the higher side compared to our survey data. We have presented the data provided by the officials in Table 3.15 for the purpose of comparison. On the whole, though there are differences between our sample survey data and the one provided by the officials, the availability of fuel wood and fodder has increased to some extent for the beneficiaries after the introduction of watershed programme. It is expected that the availability of fuel wood will further increase in another 5 to 10 years because of trees planted in the arable and non-arable lands.

Table 3.15: Availability of Fuel Wood and Fodder in Watershed and Non-Watershed Area.

Particulars	Non-watershed Area	Watershed Area	
		Pre-Project	Present
Arable Land:			
1. Babul (fuel)	85-100 kg./plant	70-80 kg/plant	100-150 kg/plant
2. Subabul (fuel)	50-60 kg/plant	40-50 kg/plant	65-80 kg/plant
3. Jowar (fodder)	35-50 q/ha	30-35 q/ha	50-80 q/ha
4. Maize (fodder)	55-65 q/ha	40-50 q/ha	98-100 q/ha
Non-Arable Land:			
5. Fodder Grass	25-30 q/ha	15-20 q/ha	35-40 q/ha
6. Fodder Legumes	5-6 q/ha	4-5 q/ha	6-8 q/ha
7. Fodder Tree Leaves	4-5 q/ha	3-4 q/ha	5-7 q/ha

Notes: q – quintal; kg – kilogram; ha – hectare.

Source: *Project Report on NWDPR for Gaosud Watershed, 1991-92 to 1996-97*, Department of Agriculture, Government of Maharashtra, Pune.

3.11 Status of Land-less Labour Households:

Watershed development programme not only improves the socio-economic conditions of the land owning farmers but also helps to improve the overall socio-

economic conditions of the land-less labour households by increasing the availability of employment days, etc. In view of this, an attempt has been made to assess the impact of watershed development programme on the land-less labour households, especially in respect to:

- employment position;
- status of seasonal out-migration of people and livestock, and
- availability of fodder and fuel.

For this, as indicated earlier, specific data have been collected from 10 land-less labour households, five each from watershed area and non-watershed area. A comparative analysis has been made between the data collected from the labour households of the watershed area and the non-watershed area on the above mentioned aspects.

Watershed development programme, by improving the availability of moisture and irrigation, increases the cropping intensity as well as helps the beneficiary farmers to cultivate more annual crops. This in-turn increases the sustained demand for agricultural labour. We have also seen earlier a significant changes in cropping pattern from low value crops to high value crops including annual crops like sugarcane in the study area (watershed area). Therefore, it is expected to increase the availability of employment days for the land-less labour households after the introduction of watershed development programme. The results relating to employment are presented in Table 3.16. The availability of employment days is not only higher for the land-less labour households of the watershed area over the non-watershed area but also increased significantly over its pre-project position. For instance, during 1998-99 (post-project period), while the availability of employment

was 444 days per labour household of the watershed area, the same was 314 days per labour household belonging to the non-watershed area. The difference in the availability of labour days between the households of watershed area and the non-watershed area comes to about 41 per cent. Similarly, the availability of total labour days for the land-less labour household of watershed area has increased substantially from 276 days in pre-project period to 444 days in 1998-99, an increase of about 60 per cent. The increase of labour days for the labour households belonging to the non-watershed area is only about 26 per cent during this period. There are three reasons for the substantial improvement in the availability of employment days for the land-less labour households of the watershed area. Firstly, the increased cropping intensity due to watershed development programme has augmented the overall demand for the agricultural labour. Secondly, the introduction of annual crops such as sugarcane and fruit crops have also increased the demand for labour. Thirdly, because of the changes in farm practices (employing labour for weeding, applying fertilisers and pesticides, threshing, etc.,) followed by the farmers after the introduction of watershed programme have also increased the demand for labour in the watershed area.

Table 3.16: Availability of Employment Days for Land-less Labour Households

(labour days/household/year)

Period	Watershed Area			Non-Watershed Area			Increase in Per Cent over Non-Watershed Area		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Pre-Position	174	102	276	116	132	248	50.00	-29.42	11.29
Post-Position	264	180	444	154	160	314	71.43	12.50	41.40
Increase in Per Cent over Pre-Position	51.72	76.47	60.87	32.76	21.21	26.61	--	--	--

Seasonal out-migration can be commonly observed among the members of the land-less labour households (in search of better employment opportunities) in many parts of the rain-fed areas in the country. This is mainly because the employment opportunities are very limited in the rain-fed areas as crops are cultivated in only one season in these regions. Since watershed development programme provides higher employment opportunities for the land-less labour households by increasing the cropping intensity, the seasonal out-migration is expected to be less in the watershed area. Keeping this in view, we have tried to find out the status of seasonal out-migration of the land-less labour households of the watershed area. We have presented employment days gained through seasonal out-migration and the number of land-less labour households involved in seasonal out-migration in Table 3.17.

Table 3.17: Details of Seasonal Out-Migration of Land-less Labour Households

Period	(Number of days household/year)	
	Watershed Area	Non-Watershed Area
Pre-Position	36 (3)	72 (1)
Post-Position	18 (2)	72 (1)
Reduction in Percentage over Pre-Position	50.00	0.00

Notes: Figures in brackets are number of family involved in out-migration. None of the female members were involved in out-migration in both the watershed and the non-watershed areas.

Against our expectation, the employment days gained through seasonal out-migration are very less among the labour households in the watershed area. Though members from two households out of five were involved in seasonal out-migration in 1998-99, the number of employment days gained through seasonal out-migration are less than one month. During the pre-project period, on an average, 36 days of

employment was gained through seasonal out-migration by a labour household belonging to the watershed area. This has declined to 18 days per household in 1998-99. The migration status of the labour households of the non-watershed is also not much different from that of the watershed area. Our enquiry about the low seasonal-out migration reveals that since the watershed area is very near to Osmanabad city (8 kms), the land-less labourers of this watershed area traditionally get the employment in the city itself. This does not encourage the labourers to go for out-migration and therefore, the seasonal out-migration is very less among the land-less labour households in the watershed area. Some of the respondents have also expressed that because of the increased availability of employment opportunities in the village itself due to watershed development programme, they have stopped going to Osmanabad city in search of the employment opportunities.

As far as the seasonal out-migration of livestock is concerned, we have not observed any out-migration of livestock owned by the land-less labour households in the sample area both before and after the introduction of watershed development programme. This is mainly because of poor position of livestock among the land-less labour households. During 1998-99, in the watershed area, altogether all the five land-less labour households had only two buffaloes, one cow and 26 goats. Since goats can withstand under any kind of rain-fed condition, the seasonal out-migration has not taken place in this area. Similar condition was observed in the non-watershed area as well. On the whole, the seasonal out-migration is not found very much among the members of the land-less labour households in the watershed area.

As in the case of land owning farmers, watershed development programme has increased the availability of fuel wood and fodder for land-less labour households.

The availability of fuel materials will increase because of various plants planted in the common lands under the watershed development programme. We have also tried to see the impact of watershed development programme on the availability of fuel wood and fodder by comparing the pre-project position with the post-project position and also with the land-less labour households of the non-watershed area. Table 3.18 presents the availability of fuel wood and fodder for the land-less labour households belonging to the watershed area and the non-watershed area.

Table 3.18: Availability of Fuel Wood and Fodder for the Land-less Labour Households

Period	Watershed Area		Non-Watershed Area		Increase in Per Cent over Non-Watershed Area	
	Fuel	Fodder	Fuel	Fodder	Fuel	Fodder
Pre-Position	9.6	3.2	6.2	3.6	54.84	-11.11
Post-Position	15.2	6.4	7.6	4.4	100.00	45.45
Increase in Per Cent over Pre-Project Position	58.33	100.00	22.58	22.22	--	--

As noticed among the land owning farmers of the watershed area, the availability of fuel wood and fodder have increased significantly for the land-less labour households of the watershed area compared to their pre-project position. The availability of fuel wood materials increased from 9.6 quintals per household in pre-project period to 15.2 quintals per household in 1998-99, an increase of about 58 per cent. Similarly, fodder availability has increased 100 per cent, from 3.2 quintals per household to 6.4 quintals per household during this period. While comparing the watershed area position with the non-watershed area, our data relating to the period 1998-99 show that the availability of fuel wood materials and fodder is about 100 per cent and 45 per cent higher respectively for the land-less labour households of the

watershed area compared to their counterpart. Most of the respondents have indicated that the increased availability of fuel materials and fodder is mainly because of various treatments (including planting of tree plants) taken under the watershed development programme. On the whole, the analysis of the data of land-less labour households shows that the watershed development programme has improved the availability of employment days. The seasonal out-migration among people and livestock is not very much found among the land-less labour households, both before and after the introduction of watershed development programme due to location of the watershed area.

To sum up, the analysis carried out using the field level data shows that the watershed development programme has brought positive changes in the availability of water for irrigation, cropping intensity, cropping pattern, adoption of improved farming practices, productivity of different crops and household income for the land owning households besides improving the availability of fodder and fuel wood. Similarly, the programme has also improved the status of the land-less labour households by increasing the availability of employment days, etc. The seasonal out-migration was not very much found in the watershed area.

Chapter 4

SUMMARY AND CONCLUSIONS

4.1 Introduction:

Rain-fed farming is predominantly practised in Indian agriculture. As of today, rain-fed cultivated area accounts for about 63 per cent in the gross cropped area. The contribution of rain-fed agriculture is phenomenal in the total production of cereals, pulses, oilseeds and cotton. Besides contributing a larger share to the food economy of the country, it also carries the major share of poor population of the nation. Though its importance in the aggregate growth of agricultural economy is well established, adequate steps were not taken to improve the overall condition of the rain-fed agriculture including the people living in these regions till the Sixth Five Year Plan. The green revolution programme introduced during the mid-sixties in Indian agriculture also could not make any perceptible change in the productivity of the crops cultivated in the rain-fed areas. Due to a larger constraint of irrigation water and poor agricultural growth, the capital formation both from private and public sectors has also not taken place at a required pace and quantum in the rain-fed areas. This has created severe problems for the people who depend on rain-fed cultivation for their livelihood. The level of poverty in these regions is very high and the seasonal out-migration of both people and livestock has been rampant in these regions.

Considering the urgent need of getting the rain-fed areas in the main stream agricultural growth, some programmes like Drought Prone Area Programme (DPAP) and Desert Development Programme (DDP) were taken up after the independence.

But, these programmes could hardly solve the problems of the vast rain-fed areas because the introduced programmes were not comprehensive in nature. The Planning Commission, while reviewing the problems of rain-fed agriculture during the Sixth Five Year Plan period, has noted that the basic problems of the dry-land farmers are poor resource base, moisture stress and uncertainty in crop output leading to low income. Therefore, a large scale public investment comparable to that in irrigated areas is the basic requirement for the improvement of rain-fed agriculture. Keeping this in view, during the Sixth Plan, some model watershed programmes were introduced in certain areas of the rain-fed regions with the help of the Government of India and the World Bank with an aim to improve the overall performance of agriculture. These model projects have shown very encouraging results. Having seen the results, for the first time, during the Seventh Five Year Plan period, the National Watershed Development Project for Rainfed Areas (NWDPR) was introduced at a massive scale covering different regions of the country. The NWDPR was introduced with three fold objectives, namely, (i) taking the watershed as a basis to conserve and upgrade crop lands and waste lands as a vital resource; (ii) to develop and demonstrate location specific technologies for proper soil and moisture conservation measures and crop production; (iii) to augment the fodder, fruit and fuel resources of the village communities by use of appropriate alternative land use system. These objectives were further revised and expanded in the subsequent plan periods using the feedback received from various studies. In the present study, an attempt has been made to study the impact of NWDPR programme on certain parameters in Gaosud Watershed, located in Osmanabad district of Maharashtra State. This project was implemented during the Eighth Five Year Plan period.

4.2 Objectives of the Study:

1. To find out the impact of the project on various forms of water bodies/water harvesting structures and their long-term impact on depth of water table in the dug well/recharge well.
2. To analyse the changes in cropping pattern, crop sequencing and crop components under the production systems in arable lands.
3. To analyse the socio-economic status of project beneficiaries against non-beneficiaries.
4. To analyse the over all changes in bio-mass production in the form of grasses, legumes, fodder, fuel-wood, horti-plantation canopies in treated watershed against the control.
5. To find out the status of migration of people, especially land-less labourers and livestock from watershed to outside area.

4.3 Methodology:

Osmanabad district of Maharashtra has been selected for this study as per the advise of the Ministry of Agriculture, Government of India, New Delhi. During the Eighth Five Year Plan period, six watershed projects were implemented in Osmanabad district under the NWDPRRA programme covering 10207 hectares of geographical area with an amount of Rs. 268.01 lakhs. As suggested by the Ministry of Agriculture, Government of India, we have selected one watershed out of six watersheds with the help of the officials of Directorate of Soil Conservation and Watershed Management, Government of Maharashtra, Pune and the officials who are involved in the NWDPRRA project at Osmanabad district. The name of the watershed selected for this pilot study is Gaosud Watershed, which comes under Osmanabad

taluka. This watershed comes under the scarcity zone (071) as per the classification of agro-climatic zone.

With regard to selection of sample households, to understand the impact of watershed programme on land owning households, 20 beneficiary households (farmers having lands within the watershed area) and 20 non-beneficiary households (farmers having lands outside the boundary of watershed area) have been selected. In addition to this, 10 land-less labour households (5 each from watershed area and non-watershed area) have been selected to study the impact of watershed programme on labour households. Thus, a total of 50 sample households have been selected for this study. While sample households from the watershed area have been selected using random sampling method, purposive sampling method has been followed to select sample households from the non-watershed area. Data relating to different aspects required for the study have been collected for both pre-project period (1991-92) and post-project period (1998-99) from the sample households. To assess the impact of watershed development programme on different parameters, comparison has been made between the beneficiary households and the non-beneficiary households.

4.4 Major Findings of the Study:

In the total outlay (Rs. 100.69 lakhs) of the Gaosud watershed project, about 83 per cent has been utilised for various activities for the development of watershed. Drainage line treatment (36 per cent) and arable land conservation measures including production system (34 per cent) together accounted for over 70 per cent of the total expenditure of the project. Though Rs. 8.60 lakhs were allocated for the livestock management, the utilisation was only about 14 per cent under this head.

Under the drainage line treatment, 500 live-check and brushwood dams, 300 loose boulder check dams, 500 loose boulder structures, 300 earthen structures and

39 run-off management structures have been constructed using Rs. 30.75 lakhs. However, small dug-out ponds were not constructed under this programme.

The land utilisation pattern of the beneficiary households is distinctly different from the non-beneficiary households though the average land holding size is relatively higher for the non-beneficiaries (4.84 ha.) as compared to the beneficiaries (4.52 ha.). While the cultivable wasteland accounts for 14 per cent of the total land holdings of the beneficiaries, the same comes to over 30 per cent for the non-beneficiaries. Net cultivated area accounts for about 85 per cent in the total land holdings of the beneficiaries whereas, the same is about 68 per cent for the non-beneficiaries. Area cultivated more than once accounts for over 49 per cent of the land holdings of the beneficiaries but, it comes to only 29 per cent for the non-beneficiaries.

Area under irrigation is substantially higher for the beneficiary households when compared to the non-beneficiary households though well irrigation accounts for major share among both group of households. The average gross irrigated area comes to 4.05 ha/household for the beneficiaries but, it is only 0.91 ha/household for the non-beneficiaries. While the percentage of irrigated area to gross cropped area (GCA) comes to as high as 78 per cent for the beneficiaries, the same comes to only about 20 per cent for the non-beneficiaries. Various treatments taken under the watershed development programme for rainwater harvesting have increased the area under irrigation for the beneficiary households.

The well (irrigation) owning beneficiary households has increased significantly from 15 per cent in pre-project period (1991-92) to 75 per cent in post-project period (1998-99). This is mainly because of assured availability of water in the wells due to treatments taken under the watershed development programme.

Among the non-beneficiary households, although the farmers owning wells have increased from 10 per cent to 40 per cent during this period, most of the wells have suffered with poor recharge of water due to absence of any structured rainwater harvesting system.

Water level in the irrigation wells owned by the beneficiaries has increased significantly from the pre-project period to the post-project period. Similar trend is also observed in the wells of neighbouring farm as well as in the drinking water wells. In *kharif* season, water level of the irrigation wells has increased about 120 per cent (28 feet from bottom of the well to 61.70 feet) between the two periods considered for the analysis. The increase of water level in the irrigation wells is about 348 per cent during *rabi* season. Importantly, during the summer season, the water level has increased about 1068 per cent (from 5 feet to 58.4 feet) in the wells owned by the beneficiaries. In contrast to this, water level of the wells owned by the non-beneficiaries has declined (in all the three seasons) between the two periods considered for the analysis.

The long-term impact of various water harvesting structures created under the watershed development programme is expected to have positive impact on water level in the wells because of two reasons. First, though there were fluctuations in the rate of rainfall after implementing the watershed development programme, it has not made any adverse impact on the depth of water level in the wells. Second, the beneficiary farmers have clearly understood the importance of various water harvesting structures which helped improving the water level in the wells and thus, the beneficiaries are expected to continue to maintain the water harvesting structures through collective participation.

The cropping pattern of the beneficiaries is distinctly different from that of the non-beneficiaries. Crops such as jowar, tur and udid are the important crops of *kharif* season for both the beneficiaries and the non-beneficiaries. Except udid, there are major differences in the share of these crops to gross cultivated area between the two groups households. Crop area of *kharif* season accounts for nearly three fourth of the gross cultivated area of the non-beneficiaries whereas, the same accounts for about 64 per cent in the beneficiary households.

In the cropping pattern of *rabi* season, we have observed a clear cut difference between the two groups. In the total cropped area of *rabi* season, wheat (water-intensive crop) accounts for nearly 39 per cent in the beneficiary group while, its share is only 14 per cent in the non-beneficiary group. Less water-intensive crops like *rabi* jowar account for about 82 per cent of the total *rabi* area of the non-beneficiary households.

While the annual and perennial crops are completely absent in the cropping pattern the non-beneficiary households, the annual crops (sugarcane and fruit crops) account for about 8 per cent of GCA of the beneficiary households. Sugarcane (a heavy water-intensive crop) accounts for nearly seven per cent of GCA of the beneficiary households. In 1998-99, seven sample farmers out of 20 have cultivated sugarcane. Before the introduction of watershed development programme, only one farmer was cultivating sugarcane that too in 0.40 ha. of area.

The total share of irrigated crops¹ to GCA is much higher for the beneficiary households than that of the non-beneficiary households. Area under irrigated crops accounts for about 27 per cent of the GCA for the beneficiaries whereas, the same accounts for only about 10 per cent in the non-beneficiary group.

¹ The crops considered for this estimate are paddy, groundnut, wheat, gram, sugarcane and fruit crops.

The watershed development programme (WDP) has brought changes in crop sequences because of increased availability of irrigation for the beneficiaries. Before the introduction of WDP, the important crop sequences were; (i) green gram - rabi jowar; (ii) kharif jowar - gram; and (iii) jowar + tur. Annual and summer crops were completely absent in this area before the introduction of WDP. This has completely changed now due to WDP. The present crop sequences of the beneficiaries are: (i) hybrid jowar - wheat - vegetable crops; (ii) hybrid jowar + tur - vegetable crops; (iii) moong - rabi jowar - vegetable crops; (iv) sugarcane, and (v) fruit crops.

Majority of the beneficiaries have been continuing with mixed and inter-cropping system even after the introduction of WDP. However, some of the farmers especially those having lands at the lower reach of the watershed, have started cultivating sole crop in the recent years. This is due to higher availability of irrigation water. Similar changes are not observed among the non-beneficiaries.

The overall adoption of improved farming practices is not only higher among the beneficiaries when compared to the non-beneficiaries but also increased substantially over the pre-project position. While all the 20 beneficiaries have used high yielding/hybrid varieties, 16 out of 20 non-beneficiaries have used these varieties for different food-grain crops. As far as the use of fertilisers is concerned, about 70 per cent the beneficiaries have used chemical fertilisers for different crops, whereas, the same comes to 55 per cent for the non-beneficiary group. About 50 per cent of the beneficiaries have used tractors for ploughing but, only 10 per cent of the non-beneficiaries have used tractors. While all the 100 per cent of the beneficiaries have used mechanical threshers for threshing cereal crops, only about 15 per cent of the non-beneficiaries have used this. Assured output due to increased availability of

irrigation has induced the beneficiaries to adopt improved farming practices for different crops.

Cost of cultivation² is higher for the beneficiaries' farm when compared to the non-beneficiaries' farm for majority of the crops due to higher use of yield increasing inputs. The difference in cost of cultivation between the beneficiaries' farm and the non-beneficiaries' farm comes to about 51 per cent for yellow jowar, 26 per cent for hybrid jowar, 35 per cent for bajra, 16 per cent for tur, 55 per cent for groundnut and about 12 per cent for rabi jowar.

The productivity of crops (except some pulse crops) is higher for the beneficiaries when compared to the non-beneficiaries. The productivity difference between the two group of farmers comes to about 36 per cent for hybrid jowar, 81 per cent for tur, 73 per cent for udid, 166 per cent for paddy, 57 per cent for rabi jowar and about 41 per cent for wheat. Higher use of yield increasing inputs and less moisture stress have helped the beneficiaries to obtain higher yields from different crops.

To understand the impact of WDP on socio-economic condition of the beneficiary households, we have studied three aspects: employment position, assets position including livestock and household income from different sources. In the status of employment, substantial differences have observed between the beneficiaries and the non-beneficiaries. During the pre-project period, both the group of households were hiring-out 46 to 51 per cent of their total labour days per year. In the post-project period, this has changed completely. The beneficiary households have hired-out only about 23 per cent of their total labour days (374 days) and the remaining days are used in their own farm itself. In the non-beneficiary households,

² Our cost of cultivation refers to Cost A₁.

over 46 per cent of their total labour days (376 days) were hired out and no change was observed in this between the two periods considered for the analysis. Due to intensive agricultural activities in the watershed area, the beneficiary households could use their labour days (which were hired-out earlier) in their own farm itself.

The assets position of the beneficiary households is not only better than the non-beneficiary households but also improved significantly over their own pre-watershed position. In 1998-99, the total value of assets (excluding lands) comes to Rs. 84,277/household for the beneficiaries and Rs. 53,576/household for the non-beneficiaries. While the value of assets increased by about 170 per cent for the beneficiary households between pre and post-project period, the same has increased only by about 39 per cent for the non-beneficiary households. Among the farm assets, number of electric pumpsets owned by the beneficiaries have increased from four in pre-watershed period to 21 in 1998-99. The number of electric pump-set has increased only from two to three during this period among the non-beneficiary households. In the non-farm assets, both the value of house and the number of households owning TV sets have increased significantly for the beneficiaries after the introduction of watershed development programme. Although the total value of livestock has increased from Rs. 12,650/household in pre-project period to Rs. 19,457/household in post-project period for the beneficiaries, there is no significant difference in this between the two group of households in 1998-99.

The gross income of the beneficiary households has not only increased significantly over their pre-project position but also substantially higher than that of the non-beneficiary households. In 1998-99, while the per household income comes to about Rs. 71075 for the beneficiaries, the same is only Rs. 34000 for the non-beneficiary households, indicating a difference of about 109 per cent. Among

different sources of income of the beneficiary households, income from crops has significantly increased: from Rs. 14330/household in pre-project period to Rs. 53675/household in post-project period, an increase of about 275 per cent. In contrast to this, the crop income has increased only by about 89 per cent (from Rs. 8540 to Rs. 16200) for the non-beneficiary households during this period. In 1998-99, crops income accounts for over 75 per cent in the total income of non-beneficiary households, whereas, the same accounts for only about 47 per cent for the non-beneficiary households. The share of livestock income to the total income of the households is relatively higher for the non-beneficiaries (about 38 per cent) when compared to the beneficiaries (about 15 per cent).

The availability of fuel-wood has increased from 16 quintals per household in pre-project period to 22 quintals per household in 1998-99 (an increase of 31 per cent) for the beneficiaries. Similarly, fodder availability (grass, legumes and others) has increased from 48 quintals to 58 quintals (an increase of 20 per cent) for the beneficiaries during the period considered for the analysis. Contrary to this, for the non-beneficiaries, while the availability of fuel-wood has increased just one quintal (from 16 to 17 quintals), a reduction of three quintals (from 52 to 49 quintals) is observed in the fodder production between the two periods. In 1998-99, the availability of fuel-wood and fodder is higher by 21 per cent and 18 per cent respectively for the beneficiary households over the availability of the non-beneficiary households.

As in the case of land owning households, the watershed development programme has also brought some advantages for the land-less labour households in certain parameters. One among the benefits is the increased availability of casual employment days. The available days of employment to the land-less labour

households of the watershed area is not only higher than that of the non-watershed area but also increased significantly over its pre-project position. During the year 1998-99, while the availability of employment was 444 days per labour household belonging to the watershed area, the same was 314 days for the labour households of the non-watershed area, a difference of 41 per cent. The increase of employment days between the two periods considered for the analysis comes to 60 per cent for the labour households of the watershed area but, the same comes to only about 26 per cent for the labour households belonging to the non-watershed area. Factors like increased cropping intensity, cultivation of annual and water-intensive crops in the watershed area have increased the availability of casual employment days for land-less labour households of the watershed area.

The seasonal out-migration is very less among the land-less labour households in the watershed area both before and after the introduction of the project. During the pre-watershed period, three out of five land-less labour households were involved in out-migration and this declined to two in 1998-99. Employment days gained through out-migration declined from 36 days per household in pre-project period to 18 days per household in 1998-99. The migration status of the land-less labour households of the non-watershed area is also not much different from the watershed area. Since the watershed is very near to Osmanabad city (8 km), the land-less labourers of this area traditionally get labour works at the city itself during the lean season. This does not encourage the land-less labourers to go for out-migration in search of employment opportunities. We have also not observed any seasonal out-migration of livestock owned by the land-less labour households in the sample area, both before and after the introduction of watershed development programme. This is due to poor position of livestock among the land-less labour households.

As in the case of land owning households, the availability of fuel-wood materials and fodder have increased for the land-less labour households of the watershed area after implementing the project. The availability of fuel-wood materials have increased from 9.6 quintals per household in pre-project period to 15.2 quintals per household in 1998-99, an increase of about 58 per cent. Similarly, fodder availability has increased from 3.2 quintals per household to 6.4 quintals per household (an increase of 100 per cent) during this period. The availability of fuel-wood materials and fodder are about 100 per cent and 45 per cent respectively higher for the land-less labour households of the watershed area over the availability of land-less labour households belonging to the non-watershed area.

4.5 Policy Suggestions:

1. Some of the farmers owning lands in the lower reaches of the watershed area, have started cultivating water-intensive crops like sugarcane using bore-well irrigation in the recent years. Exploitation of groundwater is very high among these farmers compared to others. This, besides creating adverse impact in the groundwater level, will affect the farmers who own dug-wells in the future. Therefore, keeping in view the food security of the people belonging to the watershed area, necessary measures should be introduced to stop the reckless exploitation of groundwater by restricting the cultivation of water-intensive crops like sugarcane in the watershed area.

2. Efficient use of irrigation water is essential for achieving sustainable growth in agriculture, especially in the watershed area. Therefore, water-intensive crops should not be allowed to cultivate under flood (conventional) method of irrigation where water use efficiency is very low. However, the cultivation of water-intensive

crops like sugarcane and fruit crops can be encouraged by drip method of irrigation, which is proved to be most efficient method of irrigation (Narayanamoorthy, 1997)

3. Various rain water harvesting structures created under the watershed development programme are not in good shape in many places in the whole watershed area due to downpour and poor maintenance. Since rain water harvesting structures are essential for increasing the level of water in the wells and soil moisture availability, these structures are required to be maintained through collective participation of the beneficiaries. At present, the participation of the beneficiaries seems to be declined and therefore, the concerned authorities should take necessary steps to revitalise the participation of the beneficiaries in the watershed related works by explaining the importance of farmers' participation in managing the rain water harvesting structures.

4. Although Gaosud watershed comes under the scarcity zone, the villages of the watershed area never faced any drinking water problem especially after the introduction of watershed development programme despite wide fluctuations in the rainfall. Therefore, mini-watershed work can be taken up wherever possible not only for improving the performance of rain-fed agriculture but also to make permanent remedy for drinking water problem faced by the rain-fed areas of different States in the recent months.

5. Although majority of the beneficiaries have used high yielding/hybrid varieties for cultivating cereal crops, the newly released varieties are not used commonly in pulse crops. Moreover, many farmers have used their own crop produce as seed in pulse crops. As a result of this, the productivity of pulse crops is low for the beneficiaries' farm despite less moisture stress. Since area under pulse crops accounts for considerable share in the total cultivated area of the watershed,

farmers should be advised to use high yielding varieties (including quality seed) for increasing the productivity through quality extension services.

6. In order to fully utilise the allocated funds and to harness the maximum potential benefits from the watershed development programme, it is essential to bring all the watershed development activities under a single control at the watershed level. This will also help to improve the planning and implementation of the watershed development programme in a better way.

7. Development of livestock is essential for increasing as well as stabilising the household income in the rain-fed areas. However, the utilisation of allocated funds for the livestock development was very low in this project. Therefore, keeping in view the importance of livestock, more emphasis should be given to utilise the funds allocated for the livestock management under the watershed development programme.

8. To improve the quality of planning and implementation, Universities and Research Institutes may also be allowed to involve along with the watershed development agency right from the planning stage of the watershed development programme.

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