Study No.-163

STUDY ON IMPACT EVALUATION OF NATIONAL WATERSHED DEVELOPMENT FOR RAINFED AREAS ENVISAGED AS WARSA JAN SAHBHAGITA DURING TENTH PLAN (2002-2007) (Consolidated Report)

EXECUTIVE SUMMARY

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1.1 Introduction

Development, promotion and management of appropriate watershed technologies in dry land regions have been viewed as major priorities to ameliorate the problem of natural resource degradation. This results in multiple benefits such as ensuring food security, enhancing viability of farming and restoring ecological balance (Reddy, 2000). The present strategy of watershed development programme is to protect and sustain the livelihoods of resource poor farmers who are experiencing production constraints in addition to problems created by soil erosion and moisture stress. Watershed development is to ensure the availability of drinking water, fuel wood, fodder and helps in raising income and employment for farmers and landless labourers through improvement in agricultural productivity and production (Rao, 2000).

Challenges to meet the needs of growing population in a sustainable way require comprehensive insight to ecologically sound agriculture in resources-poor countries. This problem is severe in developing countries with a low growth rate of 1.7 per cent. It is estimated that population in South Asia will be 1.9 billion in 2020 and of this 1.4 billion will be in India. Hence, there is need to increase the production with limited land and water resources. More than 60 per cent of the cultivated area in India is rainfed. It supports 40 per cent population and contributes 44 per cent to food basket. It contributes 90 per cent of coarse cereals, 90 per cent of pulses, 80 per cent of oilseeds and 65 per cent of cotton in the country. By 2020, about 600 million people would depend on dry land agriculture for livelihood.

In view of the above, this study has been undertaken to assess the long-term economic impact on agriculture productivity, land use and cover, groundwater recharge watershed system and sustenance of watershed technologies/practices of different states in India. The broad perspective of aspects which have been covered in the report are (1) community organisation and institutional aspects, (2)

planning aspects, (3) implementation aspects, (4) environmental aspects, (5) social aspects, (6) economic aspects, (7) institutional aspects, (8) indirect benefit, (9) overall impacts and sustainability and (10) people's reaction.

1.2 Data Base and Research Methodology

In West Bengal all districts have been sub-divided into two groups on the basis of occurrence of land degradation i.e. below and above the average land degradation of West Bengal. Among all, 12 districts fall under below and rest 6 districts under above groups. Four districts (two from each group) i.e. Cooch Behar and Birbhum (from below) and 24-Parganas (North) and 24-Parganas (South) (from above) have been selected randomly. There are 6 sub-watersheds in Cooch Behar, 4 in Birbhum, 2 in 24-Parganas (N) and 12 in 24-Parganas (S). In the second stage, one watershed from each selected district has been selected randomly. Phulbari Watershed (Block : Dinhata-I) from Cooch Behar; Kanduri Watershed (Block : Rampurhat-I) from Birbhum; Hizta (Part-II) Watershed (Block : Hasnabad) from 24-Parganas (North) and Masjidbati Watershed (Block : Basanti) from 24-Parganas (South) have finally been selected for in-depth study. All total 320 households (80 from each watershed) were selected.

In Rajasthan, four districts falling in distinct agro-climatic zones of Rajasthan were selected in consultation with the state nodal agency. From each selected district, one watershed under 10^{th} plan NWDPRA was selected. All total 320 households (80 from each watershed) were selected. Field data were collected from sample households for pre-project year 2001-02 and project ending year 2006-07.

In Bihar, the study has been conducted based on both secondary and primary data. As far as secondary data is concerned the study has used the data collected from the nodal departments A sample of 320 village households was

selected for the purpose of study. The sample was drawn on the basis of a multistage stratified sampling method. In the first stage four districts were selected on the basis of larger physical and financial achievements under the projects/ schemes. These districts are Nawada, Kaimur, Aurangabad and Rohtas. In the second stage one micro watershed from each of the selected districts was selected on the basis of the same criteria as adopted in case of selection of the districts. There are two different reference periods viz., 2001-02 and 2006-07 respectively for the purpose of the study.

For the present study, four districts of Maharashtra namely, Kolhapur from the north, Nagpur in the Vidarbha region in the east, Raigarh from the Konkan region in the west and Nanded in the Marathawada region having a watershed where NWDPRA is in operation were selected. Gadhinglaj block from Kolhapur district, Kuhi block from Nagpur District, Himayatnagar block from Nanded district and Murud block from Raigarh district have been selected. Households being the unit of enquiry for the study, 80 households, 40 from beneficiaries and 40 from non-beneficiaries groups, have been selected following the technique of stratified random sampling without replacement. Thus finally a sample of 320 households has been selected for the purpose of the study.

1.3 Main Findings

1.3.1 West Bengal

It is evident that there is no uniformity in family size in between the selected watersheds. The literacy rate is higher among males (82.29 per cent) than females (64.47 per cent). In non-watershed (NWP) area literacy rate is lower for both male and female at 71.41 per cent and 55.38 per cent, respectively. The size of land holding is 1.02 hectares and 0.77 hectares in WP and NWP, respectively. It

has been found that the farmers in NWP are somehow well equipped with tractor and sprayer than WP.

The average size of holdings in WP is 1.02 hectares comprising of cultivated (operational), cultivable fallow, permanent fallow, home stead, irrigated and non-irrigated area. In NWP, the average size of holding is 0.77 hectares. It indicates that the size of holdings is lower in WP than NWP. Total cultivated area of the sample farms in watershed area is 100.96 hectares, out of which 22.14 per cent is under pond irrigation followed by 1.88 per cent under canal irrigation, 8.40 per cent under STW, 1.23 per cent under other wells and 3.41 per cent under other sources. The non-irrigated area in WP is 62.95 per cent. In NWP, the total cultivated area is 87.42 hectares of which 26.66 per cent of area is irrigated under different irrigational sources followed by 73.34 per cent under non-irrigation. It indicates that the WP area is well irrigated in comparison to NWP area. This could be attributed to impact of watershed on groundwater augmentation in watershed area.

It has been observed that there is no difference in adoption of other recommended technologies in between WP and NWP farmers. It has been worked out that the overall adoption ratio of recommended watershed/agronomic technologies by WP and NWP farmers are 32.95 per cent and 27.68, respectively. It is evident that the quality of land available in WP area is suitable for agro-forestry and perennials and farmers are relatively more responsive to adoption agro-forestry and perennials.

The contribution of watershed as reflected in gross returns from rainfed crops was considered as the dependent variables, since the watershed impact is direct and implicit. Accordingly, gross returns from rainfed field crops in 2007 was regressed on dry land cropped area in hectares (X_1), human labour (X_2), bullock labour (X_3), seeds in Rs. (X_4) and fertiliser in Rs. (X_5). The adjusted R^2 for

the watershed and non-watershed area was 87 per cent and 94 per cent which indicate adequacy of fit of the model.

The regression coefficients are the estimates of the elasticity of production with respect to the independent variables. In WP, elasticity coefficient for human labour, bullock labour and fertiliser are 0.02, -0.01 and -0.03, respectively, and are statistically significant at 5 per cent. For land, the elasticity coefficient is 1.01 and significant at 5 per cent. The coefficient for seed is -0.03 and is not significant.

In NWP, variables land and seed are significant and their elasticities are 0.93and 0.07. For human labour, bullock labour and fertiliser, the elasticity coefficients are 0.06, -0.03 and 0.01, respectively and significant at 5 per cent. The returns to scale are 1.01 and 1.04 in WP and NWP areas, implying constant returns to scale. This shows that the production technology used in watershed and non-watershed is scale neutral.

The geometric mean levels of gross returns for WP and NWP sample farms are Rs. 11500.83/- and Rs. 11764.65/-, respectively. The geometric level of inputs land, human labour and bullock, seed, fertilisers are computed both watershed and non-watershed sample farms as 0.49, Rs. 2300.87/-, Rs. 413.75/-, Rs. 172.43/- Rs. 612.60 and 0.48, Rs. 2302.69/-, Rs. 418.49/-, Rs. 163.07/- and Rs. 617.26/-, respectively in that order.

In watershed area, the major source of irrigation is groundwater from tank/ponds. All tanks were excavated before watershed development programme. The impact of WDP is assessed based on number of irrigation ponds. Another measure of impact of WDP is the increased water yield in the ponds. However, the average yield of ponds is not available. Out of the 65 total ponds in the selected watersheds, only 4 ponds are non-functional, whereas in NWP area 3 ponds are non-functional out of the 29 ponds. Average water area of the pond in WP area is 0.12 hectare, whereas it is 0.17 hectare in NWP area. The average command area and average depth of the tank in WP area is higher than that of NWP area.

Average age of pond is 38.75 and 45.75 years in case of WP and NWP area, respectively. The shorter life of pond in WP could be attributed to water harvesting structures. The impact of WDP on groundwater recharge enabled farmers to take advantage of the increased life and age in the selected watershed areas to extract higher volume of groundwater. This may result in reduced investment on additional irrigation structures and the associated investment in irrigation.

Most of the soil and water conservation measures serve the purpose of conserving rain or runoff water and it is difficult to separate them and analyse their contribution to groundwater recharge. However, we can broadly divided them into (1) measures that increase in-situ water availability and (2) measures that increase availability of applied water stored off-farm or below the ground. The ubiquitous check dams and nala bunds, diversion channels and all their variants store water on surface or enhance subsurface storage. However, the use of farm ponds is for protective irrigation. The total investment on soil and water conservation structures in the selected watersheds is Rs. 35,52,403/- . The increased availability of groundwater due to WDP manifests in decreased irrigation cost. The net returns per farm has been observed to be Rs. 189.68/-, Rs. 518.48/- and Rs. 1057.91/- for marginal, small and medium farms, respectively. It has been observed that the cropping intensity decreases with the increase in size of holdings. This may be due to less irrigated area in higher holdings. It has been observed that the decrease in cost of irrigation and corresponding increase in net returns in WP is due to impact of WDP.

A large number of farmers in WP are rearing livestock on a small scale after the WDP. Farmers expressed during the discussion that due to availability of fodder on farm and common lands, the number of bullocks, cows, buffaloes, sheep, goat has increased. The net return from livestock per farm and per acre are

Rs. 24.12/- and Rs. 38.22/-, respectively in WP area and Rs. 21.42/- and Rs. 5.15/- in NWP area.

The equity in the distribution of income among different categories of farmers due to WDP has been analysed using Gini coefficients. Gini coefficients are computed for marginal, small and medium farms. Gini coefficients for WP and NWP areas are 0.44 and 0.41 for all farms, respectively. This indicates a fairly equitable distribution of income in WP area than that of NWP area.

1.3.2 Rajasthan

In 2006-07, compared to base year 2001-02, beneficiary as well as non-beneficiary households recorded marginal increase in respect of area under Kharif crops and area allocation to different crops in Kirap watershed. The area under rabi crops has also increased. Similarly, beneficiary and non-beneficiary have also registered increase in GCA. The beneficiary households increased the irrigation area by 2.59 hectares as against 3.43 hectares by non-beneficiary households. This gives clear indication of no role of NWDPRA in expanding irrigation area in this watershed.

Compared to base year, beneficiary households increased the area allocation to more remunerative and higher moisture/water demanding crops such as soyabean and groundnut in 2006-07 in Sakariya watershed. Whereas, in case of non-beneficiary, it remained nearly stable for soyabean and declined to a few extent for groundnut. In 2006-07, beneficiary households increased area under rabi crops and GCA by about 9 percent. The increase in rabi area and GCA for non-beneficiary households was meagre. Beneficiary households were able to put additional area under irrigated wheat and rapeseed in 2006-07. This clearly indicates that NWDPRA intervention impacted positively on shifting of crop-pattern and crop-diversification.

In crop-pattern, soyabean and maize among Kharif crops and coriander and wheat among rabi crops occupied the dominant position in Modak-VI watershed. As compared to 2001-02, for beneficiary households, increase in area under rabi crops and GCA was by 13.60 ha and 18.60 ha, respectively. Whereas for non-beneficiary households, it was only 3.24 ha for rabi crops and 3.56 ha. for GCA. The beneficiary households recorded 91 percent increase in area under irrigation, whereas, it was only 22.04 percent for non-beneficiary households. Compared to non-beneficiary households, higher quantum of incremental area under irrigation and GCA for beneficiaries clearly demonstrates positive impact of NWDPR activities on irrigation and crop-pattern.

As compared to pre-project year, beneficiary households increased area under rabi crops by 5.26 ha. in 2006-07 as against 1.51 ha. by non-beneficiary households in Dhar watershed. A similar trend was witnessed in respect of GCA. In 2006-07, 20.13 percent of Kharif crop area was irrigated by beneficiary households as against only 3.03 percent by non-beneficiary households. This indicates positive impact of NWDPRA intervention on irrigation and cropped area.

In all 4 watersheds, compared to base year 2001-02, cropping intensity recorded notable increase in 2006-07 for beneficiary as well as non-beneficiary households. However, this increase in percentage and absolute term was much higher for beneficiary households. The NWDPRA intervention improved the ground water aquifers and soil-moisture which subsequently helped beneficiary households to increase double cropped areas and supplemental irrigation. This helped beneficiary households in enhancing cropping intensity.

As compared to 2001-02, the overall average cost of cultivation per hectare in 2006-07 for beneficiary shows an increase of 58.80 percent in Kirap, 43.56 percent in Sakariya, 48.29 percent in Modak-VI and 81.97 percent in Dhar watershed. For non-beneficiary, it ranged between 43.25 percent for Kirap and

86.10 percent for Dhar. The increase in cost of cultivation was mainly due to higher use of costly inputs such as HYV seeds, fertilizers, higher rate of application of inputs and increase in input prices. Thus, watershed treatments brought changes in use pattern of inputs and also enhanced cost of cultivation. In total cost of cultivation, most important items were human labour, bullock labour and machine labour.

In all the 4 watersheds, compared to base year, beneficiary and non-beneficiary farmers achieved higher yield for all crops (barring few cases) in 2006-07. In Sakariya, the incremental yields achieved by beneficiary farmers varied from 35.96 percent for gram to 188.46 percent for Isabgul. And for non-beneficiary, it varied from 3.98 percent for gram to 100 percent for Isabgul. In Kirap, for beneficiary farmers, it varied from 23.07 percent for Bajra to 58.18 percent for Udad. And for non-beneficiary, it varied from -22.50 percent for gram to 38.74 percent for Jowar. In Modak-VI, yield increment for beneficiary households varied from 15.01 percent for Soyabean to 90.02 percent for Jowar. In Dhar also, increment in yields of different crops (except gram) obtained by beneficiary households were far superior as compared to same for non-beneficiary. Thus, in all 4 watersheds, NWDPRA had noticeable positive impact on crop-yields. However, scale of impact varied across watersheds due to variation in soil-climatic conditions, soil-moisture level, terrain, rainfall, inputs of pattern etc.

In all 4 selected watersheds, as compared to base year, value of gross produce per hectare of cropped area shoot up sharply for both, beneficiary and non-beneficiary households. Overall, for beneficiary farmers, it went up by 73.45 percent in Kirap, 111.21 percent in Sakariya, 175.62 percent in Modak-VI and 63.92 percent in Dhar watershed. For non-beneficiary households, it ranged from 51.92 percent in Kirap to 117.76 percent in Modak-VI. The significant upsurge in the value of gross produce was mainly due to higher farm harvest prices and higher yield achievement.

In all 4 sample watersheds, net farm income per hectare of GCA and output-input ratio (except Dhar) for beneficiary and non-beneficiary households in 2006-07 were found much higher than those in 2001-02. Further, net farm income and output input ratio for beneficiary households was found substantially higher than those for non-beneficiary households. This suggests quite positive impact of NWDPRA on net return from farm enterprise.

In selected watersheds, as compared to 2001-02, the average annual net income per household from various sources recorded impressive upsurge in 2006-07, for both, beneficiary and non-beneficiary households. For beneficiary, increase was Rs. 25427 in Kirap, Rs. 16068 in Sakariya, Rs. 37270 in Modak-VI and Rs. 13819 in Dhar. The corresponding numbers for non-beneficiary were Rs. 14489, Rs. 11144, Rs. 25745 and Rs. 10196 respectively. The sharp increase in the net annual income per beneficiary households shows positive impact of NWDPRA on livelihood security of different stakeholders of the watersheds.

As compared to non-beneficiary, assets investment per beneficiary household during 2001-02 to 2006-07 was found higher by Rs. 27260 in Kirap, Rs. 12638 in Sakariya, Rs. 18281 in Modak-VI and Rs. 20035 in Dhar watershed.

As compared to base year 2001-02, the average rise in water level in wells during Kharif-2006-07 recorded by beneficiary households ranged from 7.03 feet in Dhar watershed to 8.55 feet in Kirap watershed. During summer, it ranged from 1.88 feet in Dhar to 2.66 feet in Sakariya watershed. As compared to non-beneficiary, net increase in water table for beneficiary households was more than 4.43 feet in Kharif, 1.88 feet in rabi and 0.62 feet in summer season. This clearly indicates that water conservation technology adopted under NWDPRA is effective. This improvement in water table situation eased the drinking water problems of watershed community to some extent.

Mango, Lemon and Amala (Anola) were main horticulture plants and Ratanjyot, Neem, Bamboo were important agro-forestry trees. The survival rate of

horticulture plants was found below 50 percent in Dhar, Sakariya and Kirap. For Neem, Bamboo survival rate was found 47 percent or less.

In all 4 selected watersheds, as compared to base year, the proportion of beneficiaries as well as non-beneficiaries who adopted various improved farming practices is found higher in 2006-07. As compared to non-beneficiary households, the adoption rate was found moderately higher for beneficiary households which indicates positive impact of NWDPRA on adoption of improved farm technology.

As expected, in all selected watersheds, number of milch animals and total number of livestock increased moderately in 2006-07.

In selected watersheds, requirement of human labour for farming sector shows noticeable upsurge in 2006-07. Compared to 2001-02, beneficiary households in 2006-07 generated per ha./annum additional farm employment of 42 mandays in Kirap and Sakariya, 36 mandays in Modak-VI and 56 mandays in Dhar watershed. Additional farm employment generation was observed relatively very low for non-beneficiary households.

In majority cases, the out-migration was of short duration. In selected watersheds, average period of out-migration in 2006-07 was somewhat lower for beneficiary as compared to non-beneficiary households.

The perceptions of beneficiaries indicates that most of the indicators determining the quality of life are showing positive changes in all the selected watersheds. Beneficiaries reported moderate improvement in transportation, communication, educational facilities. They also reported moderate to high positive changes in respect of farming aspects, irrigation and household income. The impact has been found positive but somewhat below the expectation in respect of out-migration, availability of drinking water etc.

In selected watersheds, bunding activities, soil-conservation measures on farm, creation of structures for run off management, water storage and harvesting

and drainage line, testing and demonstration of new technology, livestock management, planting of horticulture/agro forestry trees etc. were considered as most relevant and sustainable activities by more than 85 percent of sample beneficiaries. Further, all watershed farmers found bunding activities on arable land as most effective in increasing soil-moisture and recharge of water, reducing soil-erosion and conservation of rain-water. However, due to average / poor quality of structures, 30 to 40 percent beneficiaries feared that created structures will be less effective in the years to come. Therefore, proper financial and administrative arrangement for timely repair and maintenance of these structures is most important. With regards to different activities of the NWDPRA, 35-50 percent beneficiaries were found lacking awareness on some of the components of the programme. Majority farmers believes that role of UGs is not so effective. All beneficiaries participated/ contributed by way of "Shramdan" in project activities and avoided financial contribution. Majority of beneficiaries did not get the chance of participating in training programme, subject tours etc. Nearly 26 percent beneficiaries believed that selection of participants for training programme, subject tours, visit to KVK, Krishi Mela etc. is not free from personal favour and bias. Almost all sample beneficiaries/ non-beneficiaries believed that NWDPRA is a most effective multi sectoral programme for developing rainfed areas and after effecting suitable corrections it should be replicated on a larger scale in other untreated rainfed areas too.

Using 10 percent discount rate, BCR, IRR and NPV have been worked out for 10 and 20 years time horizon. For 10 years horizon, Benefit Cost Ratio (BCR) was 3.50 for Kirap, 3.82 for Sakariya, 9.02 for Modak-VI and 1.17 for Dhar watershed. And the Net Present Value (NPV) was Rs. 51.78 lakhs for Kirap, 60.05 lakhs for Sakariya, 83.11 lakhs for Modak-VI and 16.17 lakhs for Dhar watershed. The Internal Rate of Return (IRR) was 9 % for Kirap, 62% for Sakariya, 144% for Modak-VI and 23 % for Dhar. BCR, IRR and NPV worked out for 20 years

horizon are higher than 10 years time horizon. For each selected watershed, IRR are greater than opportunity cost of capital and BCR are greater than one which clearly indicates that investment on NWDPRA is economically very attractive and viable. A positive and high NPV for each sample watershed implies positive worth of project in generating returns in excess of all costs.

1.3.3 State: Bihar

In Bihar, the work activities commenced in 2002-03 and completed in 2006-07. Land and water resource development activities constitute the primary areas of intervention. The expenditure on management constitutes about 18.38 per cent whereas 81.62 per cent incurred on development components, which includes resource management (51.64%), farm production system for land owning families (20.58%) and livelihood support system for landless families (9.10%). The impact of the project on various items may be briefly seen as below:

In WS-I, the area under private wasteland decreased by 16.67 per cent indicating development of waste lands by way of plantation, etc. the benefits from which would also be available to the non-landholders. Similarly in WS-II, the area under govt. wasteland and private wasteland decreased by 15.00 per cent and 22.00 per cent respectively, which reveals that community as well as private waste land by 21.92 per cent and 21.43 per cent and 31.44 per cent respectively have been found, clearly indicating increase in community and private plantations.

The change in irrigational status of agricultural land in 2006-07 over 2001-02 of the watershed indicate marginal increase in irrigated area in all the selected watersheds and almost in all the crop seasons, which may be due to increase in number of water harvesting structures (tanks, check dams, ponds, etc.). The increase was mainly found to big farms, which showed that perceived benefits are concentrated on large farms. Of course it is not a new concern. In fact, it needs

group owned water harvesting structures in real sense rather jointly owned by own relatives/neighbours or raiyets. The approach to sharing the benefits of water harvesting structure among the resource poor farmers is to develop well, which has been found important sources of irrigation.

The land development and creation of new water harvesting structures in all the watershed areas have not much effectively brought some additional areas under the important crops both in kharif and rabi. The data indicate that there is increase in the area under paddy crops from 0.64 per cent to 4.37 per cent, maize 0.65 per cent to 3.37 per cent, pulses 0.99 per cent to 2.08 per cent and oilseeds up to 1.85 per cent. Of course, there is increase in area of important crops but it is not much appreciable. It is worth to mention here that almost similar increase has been indicated by the non-beneficiary respondents.

In regard to production, it increased from 1.11 per cent to 4.87 per cent in case of paddy, 1.25 per cent to 6.97 per cent in case of wheat, 2.28 per cent to 6.61 per cent in case of maize, 1.24 per cent to 3.97 per cent in case of pulses and oilseeds witnessed negative growth. The findings indicate that the production increase is higher in rabi season for wheat, pulses and oilseeds across all the watersheds and this indicates the overall effectiveness of the watershed activities. Similarly change was also indicated in case of non-beneficiary respondents, which related that benefits were not centered on the beneficiaries rather shared with non-beneficiaries also.

It is generally presumed that if the facilities are extended to farmers, the cost of the production of the crops will come down provided the prices of the inputs are constant. But things are different. Neither the cost fallen nor is the prices of any inputs constant. Among the beneficiary farmers, it rose at the overall level to 8.16 per cent in WS-I, 5.54 per cent in WS-II, 4.38 per cent in WS-III and 13.08 per cent in WS-IV. Among the non-beneficiary farmers, it increased to 8.53 per cent in WS-I, 12.36 per cent in WS-II, 12.39 per cent in WS-III and 5.16 per

cent in WS-IV. The reason for increase in cost of cultivation is mainly due to increase in prices of the inputs like fertilizer, irrigation, seeds, etc. The watershed development programme could not slash to the cost of production. The reason is obvious lesser the impact of the programme.

The disposal for all the crops level in WS-I is lower among the beneficiary households. However it is a bit higher among the non- beneficiary households. The reason behind low disposal may be lower production. Among the beneficiary households, the percentage of disposal is comparatively higher across all the three watersheds viz., 34.47 per cent in WS-II, 18.82 per cent in WS-III and 19.86 per cent in WS-IV. It is by 0.39 per cent in WS-I, 6.46 per cent in WS-II, 17.15 in WS-III and 21.93 per cent in WS-IV among the non- beneficiaries households. It revealed that the volume of disposal has increased, which may be due to distribution of benefits amongst the households or villagers.

The total average income of beneficiary group has increased in all the sample watersheds but it recorded higher in WS-III (25.24 per cent) followed by WS-II (19.22 per cent), WS-IV (11.30 per cent) and WS-I (0.31 per cent). Almost similar is the case of non- beneficiary group. It increased by 23.18 per cent in WS-IV followed by 14.72 per cent in WS-I, 5.13 per cent in WS-II and 2.56 per cent in WS-III.

The data suggest in all watersheds milk and meat generating animals/birds are kept by a large number of families to supplement their food items and cash resources, while cows and buffaloes are kept for sourcing domestic milk consumption of children and course for generating income. In all the selected watersheds the total number of livestock increased. It increased as much as 73.00 per cent in WS-I, 30.74 per cent in WS-IV, 21.32 per cent in WS-III and 10.78 per cent in WS-II. It reveals that the project has facilitated in keeping larger number of livestock. But in absence of clear and agreed livestock holding and grazing

practices there can not be favorable long term impact on conservation of common land resources.

The perception of beneficiary farmers indicate that positive changes have taken place in recharging of groundwater level and qualitative aspects of livelihoods by about 15.00 to 20.00 per cent across the watersheds. Irrigation, afforestation and availability of irrigation have changed positively to the tune of 17.50 per cent, absorption of women in various activities (7.50 to 15.00%), production (10.00 to 15.00%), cropping intensity (7.50 to 10.00%) etc. Non-beneficiary farmers also indicated positive change of the programme on improvement in groundwater conditions (7.50 to 15.00%), qualitative aspect of livelihood (5.00 to 12.50%), production (2.50 to 7.50), availability of irrigation (5.00 to 15.00%). The analysis reveals that there is a general improvement in quality of life but in overall sense, the impact of the programme in these watersheds has been somewhat lower.

In the initial years of the programme no UGs/SHGs could be formed in any of the sample districts, which may be due to delay in launching of the programme. These could be formed after 2003-04. SHGs formed by landless and women particularly of SCs received sewing machines, she-goats, leaf plate making machine, dhankutti machine, etc. for undertaking non-farm group activities. 3 to 4 training programmes relating to know-how of the programme and land management practices are organized across all the watersheds. But due to poor knowledge, skill and now level of maintenance of the assets substantial support to the livelihood has not been found.

The overall approaches of all the PIAs have been to implement the plan/activities within the prescribed budget limit with almost no planning for user groups. The WDT is not effective in the area of community organization. However, they all have performed well in terms of level of achievements of

physical (93% and above in number and 83% and above in overage) and financial (98% and above).

In fact, there is no single indicator of successful watershed development, so the most feasible approach is to compare the performance of a variety of indicators, which also reflect the diversity of project objectives. It is noteworthy that the cost per hectare is helpful in assessing their cost effectiveness. It is calculated at Rs. 8213/ha in WS-I, Rs. 8144/ha in WS-II, Rs. 7103/ha in WS-IV and Rs. 6561/ha in WS-III. The programme has significant positive impact on creation of employment opportunities. It has been created about 7142 man days in Ws-I to the highest of 8915 of man days in WS-III. The internal rate of return calculated on the basis of the additional income over and above the pre-project income from agriculture, micro-enterprises, wages etc. within the village, varies from 187.00 per cent to 202.00 per cent (average of 4^{th} &5^{th} year) across the sample watersheds. The cost and benefit ratio also varies from 1: 1.87 to 1: 202. The average employment generation per hectare works out to 12.75 man days in WS-I, 14.80 man days in WS-IV, 16.31mandays in WS-II and 17.58 man days in WS-III. The quantitative impact on productivity of the crops indicates that expect pulses (-2.55%) in WS-III, the productivity of major crops have noted positive change but in case of cereals, pulses (-) 2.55% to 10.44%, oilseeds from 0.59% to 6.78% and vegetables and others form 0.19% to 2.40% across the watersheds. The cropping intensity has fallen by 4.72 per cent in WS-I. No change has been found in WS-IV. As regards the income benefit it has increased from 8.22 per cent to 13.28 per cent per hectare per annum. Similarly annual per hectare family income has also increased from 5.45 per cent to 10.49 per cent across the sample watersheds. However, its equity depends on the magnitude of the households of the area. Positive change has also been found in case level of groundwater and coverage of green/ biomass in the villages.

1.3.4 State: Maharashtra

In Maharashtra, watershed changed the status of the rain fed agricultural land in to irrigated land and thus, paved the way for enhanced agricultural productivity, employment and income of the farmers in the villages covered the selected watershed. Enhanced irrigation potentiality has been created due to watershed and visible increase in the area of cultivation has taken place in all the watersheds. Watershed has positive impact in the beneficiary villages as it ensures assured sources of drinking water facilities to the stakeholders.

Among the four selected watershed, watershed-I (Kolhapur) manifest a remarkable progress do far as various live stock position is covered during the period 2001-02 to 2006-07, increase of cow calf is by 94.84% followed by Buffalo (74.43%), Goat (71.67%) and Sheep (70.83%). In the watershed-II (Nagpur) the increase of Goat in 138.23% followed by Buffalo calf (115.62%). In watershed-III (Raigarh) during the period 2001-02 to 2006-07, the increase of cow calf is by 100% followed by buffalo calf (50%). Similarly, in watershed –IV (Nanded) the number of cows has increased by 33.33% followed by bullock (25%).

Though the basic facilities of medical services and post offices are found in all most all beneficiary villages but it is deplorable that expect the watershed-1 (Kolhapur), we find that in all most all other watersheds there is conspicuous absence of latrines facilities.

It reveals from the observations that the watershed beneficiary villages have recorded impressive growth in terms of crop production recorded impressive growth in terms of cost of cultivation. In the watershed beneficiary villages the marginal farmers have impressive growth of marketable surplus during 2001-02 to 2006-07.

With regard to percentage change in the annual income in the ‘before’ the operation of watershed and ‘after’ its operation, it is reveled that the highest

percentage of (146.92%) increased in the annual income has occurred during the period 2001-02 to 2006-07 in the watershed–IV (Nanded) followed by the watershed-II (Nagpur) with 139.48%. the watershed-III (Raigarh) demonstrates a record increase of 192.06% in the annual income during the period 2001-02 to 2006-07, followed by the watershed-II (Nagpur) with 67.24%.

As per the performance indicator of the selected watershed in Maharashtra, it reveals that the highest area has been developed in the watershed-II (Nagpur) (91.01%), followed by the watershed-IV (Nanded) (77.44%). In all the watersheds there has been encouraging number of man days employment generated, the highest position in occupies by the watershed-I (Kolhapur) with 46765 man days, followed by the watershed-IV (Nanded) with 36907 man days. The additional area brought under cultivation also indicates a growing trend the highest position occupied by the watershed-IV (Nanded) with 65 ha., followed by the watershed-III (Raigarh) with 49 ha. There are also positive performance indicates with regard to additional area brought under supplemental irrigation. The watershed-I (Kolhapur) has 142.50 ha, the watershed–III (Raigarh) has 64 ha., and the watershed-IV (Nanded) has 34 ha. of additional area brought under supplemental irrigation. On the contrary, due to lack benefits accruing to the non-beneficiary big farmers, the productivity in agriculture, crop intensity, irrigation, quality of land, recharging of water, availability of irrigation, absorption of women in various activities, change forestry, literacy level and quality aspects of livelihood all remained standstill.

With regard to crops like cereals, pulses and oil seeds there has been positive co relationship so far as irrigated land and its productivity of these crops are concerned (x denote quantity of irrigated land (in hectare) cultivated, ‘y’ is the production in quintals). The crop-wise co relation shows positive correlation. Since fruits and sugar cane are in the category of cash crops, we have subtracted the figures and also found a positive correlation.

The foregone analysis in assessing the impact of NWDPRA on the rural agricultural economy of Maharashtra has concluded that watershed developments have greater potential to generate employment opportunities to the rural people. This is due to the increased availability of water resources, diversified cropping pattern including cultivation of labor-intensive vegetable crops and other horticultural crops. This additional employment generation from a watershed program varies across regions depending on the cropping intensity, and the labor-intensity crops grown in that region. This additional employment generation in the villages led to minimizing migration of landless and other labor. Thus, watershed programs also contributed towards checking migration of rural people to the urban areas. This migration has greater concern for planning and devising rural development strategies. Water shed approach has captured development as a strategy for raising agricultural productivity has been indispensable particularly in dry land areas- one that integrates sectors and provides the foundation for subsequent development. Thus, the impact evaluation has demonstrated that watershed development programme to large extent able to regenerate natural resources including land, forest and water and play a crucial role in augmenting agricultural growth, productivity, cropping intensity and cropping pattern.

1.4 Suggestions for Policy Implications

In view of the above, the following suggestions are made with regard to the selected states for policy implications.

1.4.1 West Bengal

(1) Watershed development programme intervention in natural resource conservation resulted in diversified land use and cover. Therefore, for sustainability of the programme other incentive augmenting rural

development programmes could be linked in watershed development programme in phased manner. In the aggregate, the watershed development programme can be considered as an appropriate rural development strategy by implementing all land based rural development programmes under the concept of watershed development programme.

(2) Dry land horticulture component increased and stabilised the net farm returns by improving the socio-economic conditions of marginal and small farmers. Hence, higher budgetary allocation in watershed development programme could be given to dry land horticulture development to maintain the environmental economic goal of maximized net farm income of marginal and small farmers together conserving the ecosystem.

(3) Promotion of local institutions through training and education of members for maintenance of water harvesting structures is crucial for sustainability of the watershed development programme.

(4) Construction of water harvesting structures through watershed development approach enhanced groundwater recharge. Proximity of irrigation ponds to water harvesting structures played a complimentary role in augmenting yield, age and life of ponds. Hence, a large proportion of water harvesting structures preferably located closer to cultivated lands to realize greater economic impact on irrigated farms.

(5) Policy guidelines for institutional mechanisms for management of groundwater as well as assets created under watershed need to be developed.

1.4.2 Rajasthan

Based on evaluation carried out in Rajasthan using field level data, it can be inferred that NWDPRA holds the key to the development of country's vast rainfed

areas. The programme improved the groundwater aquifers as well as in *situ* moisture level of soil. Further NWDPRA programme brought very positive changes in respect of irrigation, cropping intensity, crop-pattern, farm employment, fodder and bio-mass, out-migration, status of land less households etc. It boost the village economy. The NWDPRA is beneficial but it lacks certainty regarding its sustainability in future.

Though, it is very difficult to identify a single key factor, improvement in water availability for irrigation and in situ moisture lead to rise in crop-yields and farm income seem to be the driving force behind the noticeable performance of NWDPRA.

(1) The study in Rajasthan further reveals that quantum of benefits derived were below the expected level. By effecting necessary corrections to eliminate constraints discussed in forgoing analysis, benefit level of programme can be raised further. The participation of beneficiaries was low at the stages of planning, implementation and in village meetings. The awareness level about project activities was also low to moderate. This call for higher efforts to increase the people's participation at all the stages of programme, decision making process and particularly activities related to common property resources. Further, additional efforts are needed to raise the awareness level and building capacity of the stakeholders/ beneficiaries. Regular arrangement of meetings of WC/WA will bring more transparency. The regular interaction between PIA/WDT/WC and beneficiaries will be helpful in identify problems and evolving solution in a participatory ways. Though, NWDPRA have an essential component of institutional building, but most of the created institutions were found average/ weak in nature. On FPS, LSS and capacity building activities, WDT/PIA had paid little attention. Hence, there is a need for WDT, PIA and WC to give more emphasis on these aspects. The inclusion/ support of local NGOs in the programme will be helpful in reducing

implementation problems. The effective arrangement of timely repairs and maintenance of created structures also needed for sustainability of the impact of the programme.

(2) The NWDPRA is economically very attractive and viable and has succeeded in boosting people's empowerment. The goals of upliftment of farming communities of rainfed areas, equity, employment and food-security would not look distant, if NWDPRA is pursued in earnest. In the years to come, the NWDPRA deserves higher financial allocation and large scale replication in untreated rainfed areas of Rajasthan.

1.4.3 Bihar

The emerging issues in regard to NWDPRA in Bihar and the suggestions for improvement are presented below:

(1) People's participation in watershed activities is poor except in case of wage earners/subsidy beneficiaries. Most of the farmers expressed that improved, certified and guaranteed seeds in addition to enlarging water potential and providing market would usher agriculture in rainfed agro-eco-regions. In fact, people's participation is expected only when provisions of direct benefits to the farmers are made. So watershed activities should be taken up in such a way (PRA and action research) that majority of villagers could be encouraged/incentivized to participate

(2) It has found that although rainfed and water scarce areas have been chosen for the programme, the land areas developed are essentially private croplands. The community land development activities do not get much attention. As the target of PIA is to develop a total area of 500 ha, with no minimum expenditure or area earmarked for community land. PIAs usually opt for the easier course of developing only the flatter terrain of cropland areas, where

quick participation of land owning households is also possible. In such a situation land beneficiaries are deprived of any direct benefits. In order to avoid such problem and conflict between beneficiaries and non-beneficiaries, development of community land resources and introduction of income generating activities for the landless and other weaker sections should be considered.

(3) There should be a Detailed Project Report (DPR) of the selected micro watershed area in the initial year of project and get it known to all by displaying the list of activities to be undertaken during the project period. It should be prepared by a team of technical experts on the basis of felt needs of local people.

(4) The effectiveness of community organisation and sustaining watershed activities largely depend on the training and awareness of the members of WA, WC and WDT. The roles and responsibilities of these groups are defined but not in practice, which need to be activated by regular reviewing and monitoring of the programme.

(5) There is need to diversify the role of WDT to get associated in the post-project area activities for a minimum of 3-4 years after the project is completed to help various user groups. It requires re-validation of WDT as a professional body to render its services in the area.

(6) It has been found that high breed she-goats are given to SHG members under livelihood support system to landless families, which could not survive after a month or so in local conditions. Hence, the husbandry ability of the beneficiary members as well as suitability of the area must be considered before extending the assistance under the programme.

1.4.4 Maharashtra

Watershed management is essentially a resource based approach to livelihood enhancement. It ensures supply of water to every field, removes hunger and poverty from rural areas, restores ecological balances, provides green cover in the denuded areas, bring in more rains and improved environment. The suggestions for improvement of NWDPRA programme in Maharashtra are enumerated below:

(1) Watershed development needs to integrated into the main stream strategy for agricultural growth, if a large part of it is going to realised from the hitherto rainfed areas.

(2) Regular training at watershed committee, PAI/block and district level should continue all along the year. Training on innovative activities, local skills, improved technology etc. should be given priority. In fact, a training and community organisation activities calendar should be prepared and accordingly the programme be organised. Nursery is a vital need in all the watersheds. Provision of saplings of fuel and fodder plantation, fruit bearing trees, vegetable cultivation should be ensured either through individual nursery or from central nursery at every watershed area. Establishment of a medicinal/herbal plantation garden is felt essential in the watershed. Community based grain banks and seed banks should be established in the watershed and government support should be ensured at the beginning for food and seed security. Since the climate of Maharashtra is conducive for the cultivation of flowers and it has a high market value in the neighbouring state of Andhra Pradesh, floriculture should be promoted for the economic upliftment of the rural poor. In all the watershed projects, it is necessary to fix target and allocate fund for other activities like soil and moisture conservarion, development of non-arable land, drainage line treatment etc. are indispensable for the all round development of the watershed project.

(3) Promotion of sustainable livelihoods for marginal and small farmers in the rainfed regions, through tree based approach, plantation of cashew nut trees, adoption of soil and water conservation measures, development of plantation, intercropping and introducing new technologies for sustainable productivity in rainfed area emphasizing on soil-water-plant conservation seems more urgent as such areas are prone to degradation process in comparison with irrigated areas. Therefore, a developmental strategy based on integrated management of land, water and other production resources coupled with appropriate cropping and other agro-techniques has been justified for sustainable production.

(4) In order to check further depletion of the existing resources and bring about socio-economic changes in keeping a balance between the production and the environment , watershed approach has been taken up as comprehensive programme of action with a view to address some of the basic question of survival such as long term self reliance and sustainability in the livelihood system, regeneration of bio-mass and the degraded eco-system, entitlement and equitable control over community, and economic viability of a self managed resources system at the micro-level etc.

(5) There should be a holistic approach to rural agriculture development through watershed programme, primarily aiming at integration of several development activities such as soil conservation, land and water management, agriculture, afforestation and animal husbandry with special emphasis to relate these actions with human issues and to develop the capability of the target population at the micro level befitting to the local conditions.