

An Analysis on Effectiveness of Watershed Development Programmes in Selected Districts of Assam

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Abstract

The study provides a compilation of major processes covered and the important observations made at the field level during the process & progress under IWMP projects in assigned districts namely Darrang, Dhemaji, Dibrugarh, Lakhimpur, Sivasagar, Sonitpur & Tinsukia up to the financial year 2020-21. It also sums up the various activities carried out from the inception to the period of study. Implementation of EPA, NRM works like land-based activities such as land development, soil and water conservation, gully control, field bundh, water harvesting, plantation (horticulture and forestry), production enhancement activities and livelihood upliftment activities are taken up. Implementations of such activities are briefly studied. The total fund received by PIAs of 20 batch projects up to 31.03.2020 stands at Rs 3659.45 lakhs. The total fund spent up to 31.03.2020 by PIAs of all 20 batch projects was around Rs.3641.66 lakhs. Thus, financial progress up to 31.03.2020 is recorded at 32.31 % of the total allocation. The participation of beneficiaries in the planning and execution of the watershed was seen not up to the mark and motivation required. It is observed that the impact of the watershed is more focused on physical and biological achievement, but the focus on social aspects is limited. The participation of beneficiaries in the planning and execution of the watershed was seen not up to the mark.

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I. Introduction

Effective use of land and water is fundamental for growth and sustainable development. The concept of watershed management has evolved to ensure the effective use of both natural and social capital. Thus, the watershed development programs include land, water and human resources as essential components. The watershed program is primarily a land-based program, which is increasingly being focused on water, with its main objective being to enhance agricultural productivity through increased in situ moisture conservation and protective irrigation for the socio-economic development of rural people (Joshi, et al. 2004, 2006). It has been essential in a country like India where the majority of the population depends on agriculture and about 60 per cent of total arable land (142 million ha) in the country is rain-fed. A large portion of the rain-fed areas (65% of arable land) in India is characterized by low productivity, high risk and uncertainty, low level of technological change and vulnerability to degradation of natural resources (Joshi, et al, 2004). Over the years, the sustainable use of land and water has received wider attention among policymakers, administrators, scientists and researchers. Almost all major international developmental agencies like World Commission on Environment and Development (WCED), Food and Agricultural Organisation (FAO), and Consultative Group on International Agricultural Research (CGIAR) and its allied agencies amongst others have emphasized sustainable use of water and other natural resources.

It was realized that sustainable development is synonymous with the maintenance of productivity of natural resources and the maintenance of ecological equilibrium. Kushwaha and et al. (2010, p.1479) noted that the concept of sustainable development has received much-needed impetus after the Rio Conference in June 1992, mainly through the 27 principles on sustainable development and the action plan called Agenda 21 (UNCED, United Nations Conference on Environment and Development, Rio de Janeiro, 3–14 June 1992). The approach was followed up in a big way during the World Summit on Sustainable Development in 2002 at Johannesburg. The Summit re-emphasized the need for strengthening the three pillars of sustainable development, viz. economy, society and the environment. The watershed forms an appropriate unit that links all these three components and has a direct bearing on human lives. A watershed approach is a system-based approach that facilitates the holistic development of agriculture, forestry and allied activities in the proposed watershed.

Watershed Development Programmes (WDPs) has been accorded high priority in India's development plans (Singh, 1991). These programs have been initiated in India to improve and sustain productivity and the production potential of the dry and semi-arid regions of the country through the adoption of appropriate

production and conservation techniques. The WDP approach seeks to improve and develop all types of lands- government, forest, community and private lands- that fall within a particular watershed. It is a holistic approach to improving and developing the economic and natural resource base of dry and semi-arid regions (Ninan and Lakshmikanthamma, 2001). The programs have stressed the improvement of wasteland, runoff reduction, water conservation and protective irrigation, the mechanism in all areas including desert prone areas and drought-prone areas Development programs, envisaged under its purview include almost every activity that concerns land, water and biomass production. MoRD has been implementing watershed development projects only since the late 1980s. It deals with non-forest wastelands and poverty alleviation programs having components of soil and water conservation.

Components of Watershed Development Programme

The components of the watershed development program would include; (i) soil and land management (ii) water management (iii) crop management (iv) afforestation (v) pasture or fodder development (vi) livestock management (vii) rural energy management (viii) other farm and non-farm activities (ix) and development of community skills and resources. All these components are interdependent and interactive.

II. Review Of Literature

There are several pieces of literature available on watershed management programs covering a wide range of issues. However, we have only attempted to review selected literature from the vast sources of literature available in the context of understanding major issues, impact and effectiveness of the program. Studies by Farrington, et al (1999), Deshpande and Narayanamoorthy (1999), Kerr et al (2000), Vaidyanathan (1999, 2006), Reddy and Dev (2006), Biswas, et al (2005), Pascual, et al (2009) and others have discussed several issues in watershed development programs. They have covered policy-related issues, institutional drawbacks,

implementation issues, community and participation issues, etc. Although there are large numbers of issues already covered, the research scope in the issue of watershed management is tremendous. Over the years, with the attention shifted from a more centralized to a decentralized system of governance, watershed development programs have equally emphasized decentralized approaches such as more community and people's participation and involvement of PRIs in planning, executing and monitoring of the projects, etc. Deshpande and Reddy (1991), Shah (2001), Joshi (2004) and others have reviewed different dimensions of watershed management. These studies while addressing several issues have also focused on the positive impact of watershed management on cropping, agricultural productivity, employment generation and increase in income amongst others. The Kothapally study by Wani et al (2001) has shown significant impact of watershed management on crop production, increase in groundwater level, reduction in runoff water, increase in income, etc. Similarly, ICRISAT has reported various benefits of the watershed development programs in the country.

Studies by Deshpande & Narayanamoorthy (1999), Kshirsagar, K.G., S. Chavan, M.P. Madhusoodhanan, and R. Rathod (2003) and many others have acknowledged that the watershed development programs are potential to augment income and reduce poverty among the watershed communities. These studies have focused that there is a positive change in crop yielding and productivity, cropping intensity and optimum use of farm implements despite some odds

Objectives of the study

1. To examine various performance indicators that contribute towards the effective implementation of the program
2. To assess the overall impact of the program on the Groundwater level condition, Reduction in soil erosion, increase in surface water and other physical conditions in watershed management
3. To assess socioeconomic and livelihood conditions of the communities
4. To identify existing issues and deficiencies (if any) in the implementation of the Programs

III. Methodology

The Department of Soil Conservation, Govt. of Assam, has been implementing Integrated Watershed Management Program (IWMP) since 2009-10 presently known as Pradhan Mantri Krishi Sinchayee Yojana (PMKSY). This is a centrally sponsored scheme being managed by the Department of Land Resources (DoLR), a department under the Ministry of Rural Development, Govt. of India. Seven (7) out of 27 districts of the state namely Darrang, Sonitpur, Lakhimpur, Dhemaji, Dibrugarh, Tinsukia and Sivsagar for 68 projects had been covered for study covering a total treatable area of 3,01,677 Ha have been covered.

IV. Data analysis

A. Entry point activity: Entry point activities (EPA) had been implemented in all seven districts of the project area. This is adopted as a pre-project to introduce the project among the community. The stress is on the creation of awareness or spread effect among the community than the activity itself. The works are physically 100% completed with the involvement of 100% financial expenditure against the target.

B. Awareness Programme: As of 31.03.2020, for 20 nos. projects are a concerned total of 263 awareness meetings were conducted covering 659 villages. Details are presented in Table 1.01

Table 1.01: Physical Achievement in respect of Awareness Programmers

SL. no	District	No of Village Covered	No. of Program Conducted
1	Darrang	112	69
2	Dhemaji	106	19
3	Dibrugarh	76	12
4	Lakhimpur	112	50
5	Sivasagar	79	66
6	Sonitpur	123	41
7	Tinsukia	51	6
	Total	659	263

B. Formation of Self-Help Group: The status of Self-Help Group formation during the year 2019-20 was as follows:

- The total number of SHGs formed till 31.03.2020 is 531 numbers, on an average of 27 per project.
- Achievement on an average of SHGs formation against MWS in case of projects is 5.

C. Capacity Building: Achievement for this capacity building has been evaluated under two sub-indicators namely, number of training programs conducted and the number of people trained. Till 31.03.2020 overall achievement of projects in respect of the number of trainings conducted 221 numbers. The overall achievement of persons trained 28%. The following table 1.02 indicate physical progress in respect of the number of trainings conducted and the number of people trained.

Table 1.02: Physical Progress in Respect of No. of Trainings Conducted Under Capacity Building Program.

Sl No	District	Total No. of Projects	Targeted		Physical Achievement		% Achievement	
			No. of Training	Persons to be Trained	No. of Training	Persons Trained	No. of Training	Persons Trained
1	Darrang	3	162	4057	78	1952	48%	48%
2	Dhemaji	2	33	812	21	524	65%	65%
3	Dibrugarh	2	67	800	42	500	63%	63%
4	Lakhimpur	3	23	2096	10	893	43%	43%
5	Sivasagar	4	84	2096	21	521	25%	25%
6	Sonitpur	4	297	9722	32	1046	11%	11%
7	Tinsukia	2	72	1055	17	250	24%	24%
	Total	20	739	20638	221	5686	30%	28%

D. Watershed Works:

Watershed works have been undertaken in five categories namely, Land development, Water harvesting structure, Drainage line treatment, Marshy land development, Plantation, etc. District wise variability in respect of relative importance for different categories of works is well evidenced. In the case of Physical progress, 634 number of works were completed. Following Tables 1.03 presents district-wise physical achievements of NRM works.

Table 1.03: Physical Progress of Projects Under Watershed Works

1. DARRANG DISTRICT

Name of the Activity	Unit	Target	Achievement	Percentage
Boulder pitching	Cum	446	446	100
Boulder spur	Cum	192	192	100
Brick drainage channel	Ha	62.08	62.08	100
Distillation of traditional pond	Cum	34610	34610	100
Earthen Agri bunnndh	RM	30,152	30,152	100
Earthen drainage channel	RM	29,155	29,155	100
Earthen farm pond	Cum	36,146	36,146	100
Hume pipe culvert	No	7	7	100
Plantation	Ha	277.31	277.31	100
Renovation of drainage channel	RM	15,255	15,255	100
Earthen check dam	Ha	7	7	100
Gully control	Ha	130	130	100
Riverbank protection	Ha	20	20	100

2. DHEMAJI DISTRICT

Name of the Activity	Unit	Target	Achievement	Percentage
Boulder spur	Cum	467	467	100
Earthen Agri bund	RM	8225	8225	100
Earthen drainage channel	RM	8580	8580	100
Earthen farm pond	Cum	41569	41569	100
Earthen check dam	Ha	8	8	100
Gully control	Ha	657	657	100
Earthen farm pond	Cum	36,146	36,146	100
Earthen guide bund	RM	6181	6181	100

3. DIBRUGARH DISTRICT

Name of the Activity	Unit	Target	Achievement	Percentage
Brick Drainage channel	RM	2500	2500	100
Distillation of traditional pond	Cum	1160	1160	100
Earthen drainage channel	RM	40550	40550	100
Earthen farm pond	Cum	49763	49763	100
Earthen Agri Bund	Rm	9926	9926	100
Hume pipe Culvert	No	9	9	100
Plantation	Ha	15.54	15.54	100
Eradication of ipomia	Ha	45	45	100
Renovation of Drainage Channel	RM	38192	38192	100
RCC Box Culvert	No	1	1	100
Hume Pipe Culvert	No	1	1	100
Renovation of Field bund	RM	6860	6860	100

4. LAKHIMPUR DISTRICT

Name of the Activity	Unit	Target	Achievement	Percentage
Boulder retaining wall	RM	930	930	100
Earthen Agri Bund	RM	23745	23745	100
Earthen Check Dam	Cum	4212	4212	100
Earthen Drainage Channel	Rm	15500	15500	100
Earthen farm pond	Cum	48182	48182	100
Gully Control Projects/ RCC Check Dam	Cum	421	421	100
Construction of ring wall	No	2	2	100
Boulder pitching	Cum	447	447	100

5. SIVASAGAR DISTRICT

Name of the Activity	Unit	Target	Achievement	Percentage
Distillation of traditional pond	Cum	22475.67	22475.67	100
Earthen Agri fund	RM	18705	18705	100
Earthen Embankment	RM	20607	20607	100
Earthen Farm Pond	Cum	37227	37227	100
Excavated Drainage Channel	RM	46077	46077	100
Plantation	Ha	6.86	6.86	100
Eradication of ipomia	Ha	88.8	88.8	100
Renovation of Drainage Channel	RM	43266	43266	100
Sandbag spur	RM	30	30	100
Hume Pipe Culvert	No	4	4	100
Ring bund	RM	3300	3300	100
Bamboo spur	RM	50	50	100

6. SONITPUR DISTRICT

Name of the Activity	Unit	Target	Achievement	Percentage
Boulder pitching	Cum	441	441	100
Earthen Agri bund	RM	51039	51039	100
Earthen Drainage Channel	RM	48495	48495	100
Earthen Farm Pond	Cum	70328	70328	100
Gully control project/ RCC check Dam	Cum	319	319	100
Plantation	Ha	7.89	7.89	100
Eradication of ipomia	Ha	12	12	100
River trainee project	Ha	50	50	100
Renovation of pond	Cum	1471	1471	100
Hume Pipe Culvert	No	5	5	100
Boulder retaining wall	RM	460	460	100
Brick drainage channel	RM	909	909	100

7. TINSUKIA DISTRICT

Name of the Activity	Unit	Target	Achievement	Percentage
Earthen Agri bund	RM	12982	12982	100
Earthen Drainage Channel	RM	16957	16957	100
Earthen embankment	RM	9152	9152	100
Earthen Farm Pond	Cum	51965	51965	100
Eradication of ipomia	Ha	141	141	100
Plantation	Ha	35	35	100
Hume Pipe Culvert	No	9	9	100
Renovation of drainage channel	RM	1748	1748	100
Renovation of field bund	RM	3610	3610	100
Bamboo spur	RM	193	193	100

F. Production Enhancement Activities and Micro Enterprises:

As of 31.03.2020, a total of 1028 number activities have been undertaken and overall financial achievement against target has been recorded at 32.11%. District wise physical & financial progress expressed in terms of a per cent against target has been depicted in following Tables 1.04

Table 1.04: Physical Progress of Projects Under Production System Activities

Sl No	District	Physical Target	Physical Progress		
			Up to 31.03.2019	Till 31.03.2020	Achievement %
1	Darrang	1279	119	296	23%
2	Dhemaji	263	25	26	10%
3	Dibrugarh	100	10	12	12%
4	Lakhimpur	5932	577	577	10%
5	Sivasagar	920	79	81	9%
6	Sonitpur	216	21	24	11%
7	Tinsukia	95	9	12	13%
	Total	8805	840	1028	12%

E. Livelihood Support Activity

Under Livelihood activities as of 31.03.2020 total of 478 number activities have been undertaken and overall financial achievement against target has been recorded at 12%. District wise physical & financial progress in terms of a per cent against target has been depicted in the following tables below (Table 1.05)

Table 1.05: Physical Progress of Projects Under Livelihood Support Activities

Sl No	District	Physical Target	Physical Progress		
			Up to 31.03.2019	Till 31.03.2020	Achievement %
1	Darrang	599	57	70	12%
2	Dhemaji	247	26	26	11%
3	Dibrugarh	237	28	28	12%
4	Lakhimpur	667	72	87	13%
5	Sivasagar	599	58	61	10%
6	Sonitpur	1358	151	151	11%
7	Tinsukia	454	55	55	12%
	Total	4161	447	478	11%

Financial Progress during 2020-21: As of 31.03.2020 cumulative financial progress is as follows:

➤ The total fund received by PIAs of 20 projects up to 31.03.2020 remained at Rs 3659.45 lakhs i.e., 32.31 % of the total allocation as compared to Rs. 2705.81 lakhs i.e., 23.91% respectively in the last year i.e., 31.04.2019

➤ The total fund spent up to 31.03.2020 by PIAs of all 20 projects remained at Rs. 3641.66 lakhs as against Rs. 2636.24 lakhs up to 31.03.2019. Thus, financial progress up to 31.03.2020 is recorded at 32.31 % of the total allocation.

- PIAs of 20 projects utilized 99.51% of the fund they have received up to 31.03.2020. In the last year, i.e., 31.03.2019 utilization against actual receipt of the fund remained at 97.79%
- The closing balance with PIAs (including closing balance with WCs) has been reduced from Rs. 69.57 lakhs as of 31.03.2019 to Rs. 17.899 lakhs as of 31.03.2020.

Table 1.06: District Wise Progress in Respect of Fund Spent by PIAs of Projects till 31.03.2020

District	Amount Spent (Rs. In Lakhs)		Amount Spent Against Allocation		Amount Spent Against Actual Receipt	
	Up to 31.03. 2019	Up to 31.03. 2020	Up to 31.03. 2019	Up to 31.03. 2020	Up to 31.03. 2019	Up to 31.03. 2020
Darrang	396.51	537.21	23.84%	32.30	99.73%	98.79%
Dhemaji	302.40	420.73	24.00%	33.40	99.98%	99.70%
Dibrugarh	314.07	472.29	23.86%	35.90	99.70%	100.00%
Lakhimpur	400.52	573.47	22.51%	32.22	94.06%	98.26%
Sivasagar	430.07	513.25	22.26%	26.57	93.24%	100.00%
Sonitpur	490.37	685.10	23.22%	32.44	97.80%	100.00%
Tinsukia	302.30	439.61	23.99%	34.90	99.99%	100.00%
Total	2636.24	3641.66	23.38%	32.16	97.79%	99.51%

V. Findings and Discussion

Data compiled and systematically analyzed the major findings based on common measurable and attributable indicators highlighted in the study

1. Status of water harvesting structures

Harvesting the rain and runoff water is the prime objective of the watershed development program. To do this, many structures of various types like check dams, nala bunds, farm ponds, etc. need to be constructed across the gullies of various orders. The quality and current status of water harvesting structures play a crucial role in generating impacts in a post-project scenario. It helps us assess the nature of project implementation. These structures are expected to withstand rough conditions. Maintenance of water harvesting structures is significant to enhance storage capacity and also in certain cases the infiltration capacity. The structures also require periodical maintenance like plastering, pointing, and repairing to prevent cracks and leakages. Maintenance of storage capacity and infiltration capacity is essential to avoid water flow as a runoff.

The better performing districts to maintain the quality of harvesting structure are Darrang and Sonitpur. Districts like Sivasagar, Dibrugarh and Lakhimpur are mostly good and have average performance in this regard. In Dhemaji and Tinsukia, the quality of WHS is not up to the mark. It was found that in Sonitpur district more than 82% of watersheds structures can be placed in either good or satisfactory category and hardly any watershed was found to be under the "poor" category. This reflects the good quality of construction in terms of selecting a technically appropriate site, technical specificity of construction (wing wall, apron, pitching and core wall in case of earthen structures, spillway, inlet and outlet, etc), good quality of material used, and effective community consultation amongst others.

The quality of water harvesting structures revealed that out of the 20 watersheds taken for evaluation, the quality was found to be very good in 16%, good in 62%, satisfactory in 9% and poor in 13%. For the construction of a check dam in the Darrang and Sonitpur districts, timber shuttering technology was used. It is a simple and cost-effective technique. The gully control measures were also made with locally available materials and earthwork was also found to be appreciable. However, some of the assets had been damaged owing to the flood in 2018.

Major issues identified:

A major issue identified was the lack of clarity in the mechanism with regards to the maintenance of structures during and post-implementation phase. As a result, the siltation/ weed/ water hyacinth was found to be common in most of the watersheds. Damage without proper maintenance, lack of adequate institutional mechanism and poor community involvement are some of the issues identified by the studies. No proper management of WDF is another issue. Lack of awareness among various stakeholders about usages of WHS is noticed in some districts.

2. PIA wise performance in different Districts

One of the objectives of the study is to assess the performance of the project implementing agencies (PIA) concerning the implementation of the program. In this regard, some reports have shown the impact of

watershed development programs in both government and non-government PIAs. It was found that in some districts like Darrang, Sonitpur PIAs are doing better. Further, in some districts like Sivasagar, Dibrugarh PIAs are performing well. Therefore, there is no proper correlation found between PIA and WDP impact on physical, biological or social factors.

Impact Assessment

1. Increase in groundwater level

An increase in groundwater tables in watershed areas is one of the important measurable indicators of a successful watershed program. Various factors are accountable for the increase in groundwater. The water harvesting structures play a key role by storing water and allowing sufficient time for water to percolate into the ground. Land development activities such as contour bunding, land levelling and cultivation practices also contribute towards the accumulation of groundwater. The increased water levels also render some respite in the drinking water situation/ irrigation in the project villages. As observed from the data furnished by the districts, the groundwater level experienced a marginal increase in Assam after the implementation of the project.

2. Increase in surface water and streamflow

An increase in surface water or stream flow is another indicator that can help establish the positive impact of watershed development programs on physical factors. Both surface water and streamflow have increased during the post-watershed development programs in many districts.

3. Soil erosion reduction

The best performing watersheds are those where soil erosion was reduced by more than 50 per cent and the worst-performing are the ones where there is an increase in soil erosion or the implementation failed in arresting soil erosion. The soil of Assam is of high clay texture hence high erosion occurs due to rainfall in the barren land. The vegetative barrier with “Murta” (a local species of cane bamboo) was used to check soil erosion. This has resulted in a reduction in soil erosion.

The general understanding is that in watersheds where area treatments were undertaken, the community reported a reduction in soil erosion as compared to the pre-watershed situation. Soil erosion is also prominent in districts with low rainfall. However, the variation in the percentage of reduction depended on soil and moisture conservation activities in the respective districts. Activities like afforestation, pasture development, horticulture can directly check soil erosion but these activities are scanty and executed works are also not satisfactory. It is expected that soil losses would be substantially reduced if community or cooperative action is taken.

4. Runoff reduction

With regards to runoff reduction, it was observed that the program is successful in achieving this goal. Runoff is indicating a positive impact in most of the project areas. According to the beneficiaries, this has been possible because of the contour bunding or field bunding which has also helped in checking the runoff of rainwater resulting in soil moisture retention.

5. Land use pattern, cropping pattern and agricultural productivity

There is an attempt here to understand how the WDPs have helped improve land use patterns and agricultural productivity across different watershed regions. To give a general picture of the scenario, the central government schemes of IWMP are taken into consideration for review and analysis.

(a). Change in land use pattern

Better land use pattern is one of the important objectives of watershed management. With the increase in surface water conservation and increase in the availability of water in the watershed regions, it is expected that there will be a more positive change in land-use patterns.

In Darrang district, the change in land use is in a positive direction due to the watershed development program. The report indicates about 35% to 70% changes in land use in all the districts of the state. This is especially due to the initiation of vegetable cultivation especially in fields close to the development of irrigation structures. There is also a decrease in cultivable wastelands due to WDP in the districts. On an average, about 60% of the cultivable wastelands especially those that are nearby the newly developed irrigation structures are put into use i.e., cultivation started in these wastelands due to IWMPs.

Darrang has shown a very positive change in land use patterns after the implementation of the watershed management program. For example, positive change is observed in all watershed areas. The average net sown area increased from 274.8 Ha to 309.65 Ha after the watershed program. In Sonitpur, the average net sown area has increased from 333.29 Ha to 346.71 Ha. However, the distribution is much skewed. In all the districts almost all watershed areas have an increase in area under both kharif and rabi crops. Dhemaji district

has undergone a phase of transformation with more areas from an average of 426 Ha during the pre-watershed period to 490.22 Ha in the post-watershed period in are being covered under cultivation with better irrigation facilities, an increase of 41.67 Ha in the average area irrigated during the post-watershed period. Similarly, the other districts too, have a positive impact on land use patterns in the post-watershed period.

(b). Cropping pattern and agricultural productivity

Since water is essential for agricultural production, the provision of adequate water using increasing groundwater levels and conservation of surface water is instrumental. With an available water harvesting structure, farmers are inclined to new cropping patterns and agricultural diversification. Both agricultural diversification and intensification lead to an increase in agricultural productivity in the regions where watershed programs are effective.

(c). Crop diversification

Crop diversification is also an important outcome of the watershed program. In Assam, the districts covered under study such as Darrang, Sonitpur, Lakhimpur have resulted in better adoption of commercial crops especially among the small and medium farmers. In most places, the farmers tend to move towards growing summer paddy, mustard and in some places, the farmers are slowly moving towards growing fruits and vegetables. Vegetable cultivation is popular where there is adequate water or irrigation facility available. However, very few people are interested so far to take up micro-enterprise initiatives. Crop diversification in Sivasagar has not received any substantial attention from the farmers even after the implementation of the watershed programs.

(d). Cropping intensity

The change in cropping intensity is one of the major indicators to assess the impact of the watershed development programs. Out of the districts covered under the study, in Sonitpur it was reported that out of 4 sample watersheds almost all watersheds have noticed an increase in cropping intensity. Five watersheds in Sonitpur and Darrang have noticed more than 100% in cropping intensity

These reasons include Increase in residual moisture content due to contour bunding helping in crop growth and yield. Loosening the hard strata increase in infiltration of water and easy penetration of roots due to land development activities like levelling and tillage.

(e). Increase in agricultural productivity

Assam, there was an increase in cash crop production (an increase from 185 Ha to 232 Ha), milk production and paddy production. Cash crops are not pre-dominant in many watersheds except for watersheds in Darrang and Sonitpur. The increase reported is higher in the case of IWDM projects than other central govt. projects.

The impact of watershed development programs (WDPs) on crop yield is reported to be positive in Assam. It is noticed that the yield of cereals has increased between 20 and 40% in 53% of watersheds, in 47% of watersheds it is between 10 and 20%. The yield of pulses has not been so good as cereals but certainly, there is improvement in yield after the watershed program. The less increase in yield is reported with oilseeds, an increase between 15 to 20%.

(f). Debt reduction position

Assessment of debt reduction position is one of the important objectives of the study. The reduction of debt has many social and economic implications. This can help in reducing poverty and improving livelihood. With the absence of a proper irrigation facility, crop loss is frequent. The crop loss after huge investment in agriculture makes the farmers dependent on moneylenders and intermediaries. Many studies on farmer's debt have reported that the farmers are victims of money lending. They fall under a huge debt trap after investing a large chunk of money in fertilizer, hybrid seed, cultivation operations, etc. In such a scenario, WDPs has helped a lot in providing irrigation facilities for better agricultural operation.

(g). People's Participation

A participatory approach is essential in the planning and development of the watershed management program so that it becomes the people's program with the government participating in it as a facilitator only. Active people's participation is, therefore, highly critical in the success of the watershed program (Kerr et al. 2002, Sreedevi et al. 2004; and Joshi et al. 2005). The available pieces of evidence confirm that there existed a positive relationship between people's participation and benefits from the watershed program. The results of this study showed that the benefits were the highest from the watersheds where people's participation was high. In

the majority of the places, it was moderate and in a few it was conspicuous by absence. The other impact indicators were also far ahead in watersheds having greater people's participation.

(h). Management of Common Property Resources (CPR)

Common Property Resources refer to the resources in which all the villagers have equal rights. The villagers maintain, protect and enjoy the usufructs with equal rights and responsibility. They however do not have any legal right over the resources. Several common property resources are developed under watershed development programs such as pastures, development or renovation of water bodies, plantations in common land. While these resources are being developed, they provide employment to the folks and once it is developed it contributes directly towards livestock management and non-farm activities besides agricultural production

(i). Reduced migration

The latent aim of this project was also to reduce migration and generate sufficient employment opportunities. Migration had substantially stopped during the project have provided some employment opportunities. Tree-based farming or agroforestry and horticulture can also form a major source to provide employment opportunities and reduce migration. But the projects attempted it on a meagre scale. Attempt to mitigate migration is required on a major scale. implementation stage. Since employment opportunities in form of labour were available. But after implementation, though productivity and income have increased to some extent, it was unable to reduce or stop migration altogether. The project was not able to provide alternative employment opportunities to the villagers. The promotion of non-farm sector activities like dairy, poultry, goatry was found to be negligible.

(j). Women empowerment

Empowerment is a multi-faceted, multi-dimensional and multi-layered concept. Women empowerment is a process in which women gain a greater share of control over resources such as material resources, human and intellectual resources, information, and financial resources amongst others. According to the Country Report of the Government of India, "*Empowerment means moving from a position of enforced powerlessness to one of power*". Since empowerment is a latent phenomenon and cannot be measured directly so aspects like participation, mobility, a voice in decision making in the home, community, society were taken into consideration.

The analysis of this aspect reveals that women's participation was not adequate. They were part of SHGs, UGs, WCs, WAs also but it was nothing more than mere presence. The mere presence of women members on the watershed committee had no real impact as they were not effective in the decision-making process in the committee (Seeley et al. 2000). Women in SHG did not feel confident to interact with people, officers, panchayats, bank

(k). Impact on landless community and livelihood improvement

The landless community should not be ignored in the developmental process. These marginal families can be part of indirect benefits and can be included in the user's groups, SHGs and other institutions. Most of them are part of SHGs but do not include the user's groups in the project area. It seems that watershed activities have not improved the conditions of the landless community significantly. Apart from some minor labour work, there has not been much to improve their livelihood. According to the watershed guidelines, livelihood promotion is a very important outcome of the project. Under this study, additional employment as labour days is considered as a parameter for livelihood promotion. In Assam, the watershed project did not maintain the record for employment generation. The muster roll was not maintained as the works are executed by the watershed committees.

(l). Improvement in Standard of living

Successful implementation of the watershed program is realized in the fact that it brings more lands under cultivation, improves the quality of the land thereby the productivity. All the positive impacts of WSD are expected to culminate in an improved standard of living at the household level. People can get some regular income perhaps some additional income which leads to additional expenditure. Raised income enables a better life in terms of better food, clothes, education, health, more spending at the time of festivals and marriages, physical assets and amenities acquired.

Findings of the study revealed that the majority of the households across all the study areas have reported only slight improvement in the standard of living. The benefits of WSD have not fully translated into disposable income or net gains to improve the standard of living.

(m). Other impacts: Impact on SMF and LMF

Watershed Development being a land-based activity affects all categories of farmers. Mostly it has been seen to benefit the large and medium farmers more than that of small and marginal farmers. This could be attributed to the fact that large and medium farmers have more land in terms of quantity as well as quality and can make an investment towards irrigation equipment etc.

To gauge the differential impact between small and marginal farmers (SMF) and large and medium farmers (LMF), a study performed in Darrang and Sonitpur can throw some light. It was examined for bio-physical or environmental indicators. SMF seems to have performed better with regards to soil erosion, runoff reduction, accruing benefits of drinking water facilities whereas large farmers can gain more from the irrigation impact of WSD because of their better investment capabilities. The benefit of the availability of fodder was found to be neutral. Whereas, the benefits accrued in terms of fuel and manure were seen to be more to SMF than LMF.

The study in other districts has noticed that the impact of WSD is neither in favour nor against any particular group though variations can be observed across the districts.

VI. Conclusion

Watershed Development Programme (WDP) is one of the most popular development programs implemented across the State. It is widely admitted that WDP is seen as the panacea. This program has been directed towards the promotion of overall economic development and improvement of the socio-economic conditions of the resource-poor sections of people inhabiting the program areas through natural resource enhancement (GoI, 2001b). Over the years there is much visible impact of watershed development programs among different communities across various districts. The general conclusions derived from the studies are as follows:

I) It was found that there was a good quality water harvesting structure in some watershed areas, but in some other watershed areas, it requires further attention. Maintenance of WHS during the post-implementation phase is poor in many districts. Micro watersheds in DDP areas perform better in this regard. Contribution to WDF is as per norm practised in some districts while in some other districts there is variation in terms of contribution to WDF.

II) There was a reduction in soil erosion in the watershed areas. However, the variation in the percentage of reduction primarily depended on the quality of soil and moisture conservation activities in the respective regions.

III) There was a marginal increase in groundwater level in some districts but some other districts exhibit a better increase in groundwater level.

IV) It was observed that the program is most successful in maintaining runoff reduction.

V) There is a positive change in the land use pattern reported in most of the WDP regions. In these regions, more wasteland was converted for productive use by the farmers. This resulted in an increase in net sown area in the majority of the districts. Further, a better land use pattern has helped increase agricultural intensification and thus enhance agricultural production.

VI) Crop diversification has resulted from more irrigation facilities available in the watershed areas. However, the concern is that the people invest more in a good class of land. The investment in low-quality land has not received much attention.

VII) Watershed program resulted positively in reducing the workload of women in terms of fetching drinking water, collecting fuelwood and fodder for livestock in almost all the study areas.

VIII) The income of the community members has increased to some extent but watershed activities have been unable to make much visible impact in enhancing employment opportunities.

IX) The Watershed Committees had been actively involved in the implementation of the watershed program in the majority of projects. User groups are formed in all the projects, but their degree of involvement varies. The user groups are hardly visible in watershed activities after the completion of the project. Very few CBOs seem to have survived after the withdrawal of the project.

X) The position about common property resources leaves much to be desired and, therefore, it calls for concerted efforts from the authorities concerned.

XI) Migration was marginally reduced during the project implementation stage. But a further attempt is necessary to stop migration completely.

XII) The analysis of women's empowerment shows that women's participation was not adequate. Mostly, women lack mobility, a voice in decision-making at home or in the community. The same is the case with landless members. It seems that the livelihood conditions of landless communities have not been significantly improved. Apart from some minor labour work, there was nothing much to improve their livelihood.

XIII) It was realized that the position about the flow of funds and social audit is limited to some watershed areas. It was realized that the participation of local community members is key to the success of the watershed projects. Participation also enhances community empowerment. The participation of beneficiaries in the

planning and execution of the watershed was seen more from the LMF group. Poor rural households were less involved in planning and decision-making processes in the watersheds.

XIV) Economic impacts across the schemes reveal that the performance of DPAP watersheds is relatively as good as that of IWDP watersheds. DDP watersheds have scored better under some activities like the quality of water harvesting structure but in some areas like reduction in soil erosion, runoff reduction, etc DDP has scored less. However, it must be considered that this scheme is implemented in extreme environmental conditions. Hence, even this limited impact can be judged as positive. Nevertheless, there is a need to find out the gaps and reasons to make it even more effective and realize the full benefits of the program.

XV) It was also found that the majority of the households across all the study areas had reported a slight improvement in their standard of living. The benefits of WSD have not been fully translated into disposable income or net gains to improve the standard of living.

XVI) The study also suggests that the impact of a watershed is more focused on physical and biological achievement, but the focus on social aspects is limited. There are certain positive trends towards the growth of water level, soil regeneration capacity, land use pattern, cropping pattern, livestock production, etc. However, social achievements have not been properly addressed with the implementation of WDPs. The majority of the reports suggest that the positive effect of watershed development on the lives of the community is greatly limited.

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