

WATERSHED DEVELOPMENT IN NORTH-EAST: PROBLEMS AND OPPORTUNITIES*

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Abstract

The paper looks at some of the watershed development programs in the north eastern states of India. Given the unique topography, fertile land, abundant water resources, evergreen dense forests, high and dependable rainfall, mega biodiversity and agriculture friendly climate. It has various constraints such as uneven topography, soil erosion, small landholdings and jhuming practice of agriculture or shifting irrigation, which has lead to a number of environmental problems. To address the problems of the region government of India had initiated several watershed development programs to improve people's livelihoods and abolish the practice of jhum cultivation. Watershed programs have helped in raising income, generating employment and conserving the natural resource base as well as motivating people to abandon jhum practice. Watershed program can greatly help to alleviate poverty by raising farm productivity and generating employment opportunities in marginal and fragile environments. The scope for watershed development is even greater in given the region's problems and opportunities.

1. INTRODUCTION

North-Eastern Region (NER) comprising of eight states has remained far behind in the growth and development of the country. Agriculture being an important economic sector in the NE region contributes about 30% to gross domestic product and is the main source of livelihood for a majority of rural population. However, agriculture in the region is mainly subsistence, low input and technology laggard (Birthal *et al*, 2006). The geophysical conditions limit horizontal expansion of cultivable land. The percentage of cultivated area to total geographical area ranges from 2.2% in Arunachal Pradesh to 35.4% in Assam as compared to 43.3% at national level. High growth of population (varying from 2.01-5.22% per annum, except in Assam and Tripura) with a large proportion of small and marginal farm households, traditional and low input agricultural practices coupled with the problem of insurgency have affected the agricultural economies adversely in the region. The region has several unique features such as fertile land, abundant water resources, evergreen dense forests, high and dependable rainfall, mega biodiversity and agriculture friendly climate. Yet it has failed to convert its strengths optimally into growth opportunities for the well-being of the people (Barah, 2006).

Sustained supply of irrigation water is crucial to improving production and productivity of agricultural crops, but only about 10% of the total cropped area in the region is irrigated (FAI, 2003). The region has considerable surface and groundwater resources because of its location in the high rainfall zone varying from 1400 mm to 6000 mm across NE states, but remain untapped due to uneven topography and difficulty in construction of reservoirs.

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1.1 Jhum Cultivation

Jhum practice or shifting cultivation is regarded as the primitive step in transition from food gathering to hunting and food production. When this system emerged, it worked well and there was a balance of 20-30 years between fallow cycles. However, with increasing population pressure, the jhum cycle slowly reduced to 3-6 years, causing serious land degradation and ecological problems. Jhuming is practiced by tribals on the hill slopes ranging from steep to very steep. The jhumias do not own the lands and it belongs to the forest or revenue department. Generally, areas having good forest growth or dense bamboo forest are selected for jhuming as they give good burn; consequently, better crop yields. There is progressive degradation of the production base due to large-scale deforestation by shifting cultivation. Since the hill tops, particularly the catchment areas are the source of water, deforestation in the hills has led to elimination of sources of water while increasing run-off water. The system is labor intensive with low technology. The system leads to severe soil erosion; low crop production; and elimination of important tree species as well as genetic resources of the region; thereby causing a total degradation on the natural resources resulting in the ecological imbalance in the area.

2. ROLE OF WATERSHEDS

The role of watershed programs in the development of rainfed agriculture in India has been documented by a number of researchers (World Bank, 1990; Fernandez, 1994; Farrington and Lobo, 1997; Hinchcliffe et al., 1999; Kerr John, 2002; Kerr John et al., 2002; Joshi et al., 2005). These studies bring forth various issues related to watershed development programs, such as management of common property resources, sharing of benefits and costs, multiple and conflicting uses of common property resources within watersheds, multiple and overlapping property rights regimes in watersheds, difficulty of encouraging social groups to organize around a spatial unit defined by hydrology, upstream and downstream issues, equity and gender.

The north east region (NER) has problems of; uneven topography, soil erosion, small landholdings, *jhuming* practice, and opportunities of; fertile land, high and dependable rainfall and agricultural friendly climate. This can be a good bet for the development of watershed programs on large scale. The region is confronted with two major water related problems; (i) heavy and intense rainfall and surface run-off during monsoons leading to soil erosion and siltation or pollution of water bodies downstream; and (ii) drought situation in the months of February to April, leading to acute scarcity of water for spring season crops. These two extreme eventualities need to be managed for enhancing agricultural productivity, augmenting income and preventing degradation of soil and water, which can be best addressed by watershed programs.

Rainfed agriculture in India occupies an important place in the development initiative as 69% of 142 million hectare is rainfed, and productivity is low (> 1 ton per ha) although potential is quite high (Wani *et al.*, 2004). India achieved self-sufficiency for food through the green revolution. Integrated watershed management programs have shown the potential of doubling productivity of rainfed areas (Wani et al., 2003), an opportunity to maintain self-sufficiency for food while sustaining the natural resource base.

3. PROBLEM SPECIFICATION AND METHODOLOGY

A number of impact assessment studies have been done in past by various researchers and organizations on watershed development programs. However, no thorough study has been conducted on the impact of water-

⁴ Meta analysis is a statistical procedure that integrates and upscales numerous spatially and temporally distributed combinable micro-level studies to distil logical macro-level policy inferences. The inferences drawn, based on meta analysis, are often more objective and authentic.

⁵ A list of these studies is given at the end of paper. Moreover, four case studies were conducted in 2007 under which, four watershed projects were selected which were implemented by various departments and organizations under various watershed programs. The purpose was to see the performance of these different agencies in implementation of these programs and their effectiveness with respect to targeted objectives.

shed development programs carried out in the north eastern region, which has a peculiar geography and social system from the rest of the country. It is in this endeavor that the study was attempted. The study is based on the review of evaluation reports as well as the case studies carried out under the project. In this regard, various departmental reports were collected and studied to get broader conclusions from these reports. The study assessed the performance of watershed programs by employing meta analysis⁴. Based on an available review of 37 case studies on watershed programs in north east region, the study attempted to document efficiency, equity and sustainability benefits. Similar approach was followed by Joshi et. al. (2005) for Indian watersheds, which however excluded the north east states⁵.

4. HISTORY OF WATERSHED PROGRAMS IN NE REGION

The history of watershed management in India dates back to 1880 with the Famine Commission and then with Royal Commission of Agriculture in 1928. Both commissions laid the foundation for organized research in a watershed framework. After Independence, the Government supported programs started in mid-1950s, when the focus on watershed programs was sharpened with the establishment of the Soil Conservation Research, Demonstration and Training Centres at eight different locations of the country. The center started watershed activities in 42 locations mainly at small-scale to understand the technicalities of soil degradation and options that contribute to soil conservation (Samra, 1997).

As per the report of the Task Force on Development of Shifting Cultivation Areas, constituted by Ministry of Agriculture in 1983, the total area affected by *jhum* practice was 43.57 lakh hectares in the states of Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Orissa and Tripura. In the seven states of north east, (As per ICAR Research Complex for NEH Region) a total of 14.66 lac ha was affected with *jhum* problem involving 4.433 lac *jhumia* families. In order to address the problem of shifting cultivation, the Government of India took a major initiative by launching the Watershed Development Program for Shifting Cultivation Areas (WDPSCA). The WDPSCA program was taken up during the fifth five year plan as a pilot project with 100% financial assistance from the central government and was implemented through ministry of agriculture. The scheme was launched during 1976-77 covering all NE states, Andhra Pradesh and Orissa. After operation for 2 years, the scheme was transferred to state sector as per the decision of National Development Council (NDC). A total of 1700 *jhumia* families benefited with an expenditure of Rs.129.71 lac in its initial phase.

A similar scheme was launched during the VII Plan, in persuasion of the recommendation of the Task Force on Shifting Cultivation (1983), again with 100% central assistance to the State Plan Program from 1987-88 to 1990-91 in the same stages and later transferred to the State Sector and discontinued from 1991-92. During the VII Plan also the scheme was implemented through the ministry of agriculture on the basis of family development approach and 26512 *jhumia* families benefited under the program with an expenditure of Rs.60.72 crores. In 1994-95, on pressing demand from NE states, the Planning Commission agreed for revival of the scheme for NE region only as an additional central assistance to State Plan Scheme.

The Government of India (GOI) undertook strategic investments through watershed approach to develop rain-fed areas for sustainable management of natural resources in the region. The National Watershed Development Program for Rainfed Areas (NWDPA) introduced at national level in 1986-87, was started in NER by 1990-91. The funding pattern was 75% grant in aid and 25% as loan to the states. The NWDPA program which was launched in the VIII Plan, continued in IX and X five year plans as well. Apart from this, the Integrated Wasteland Development Project Scheme (IWDP) was taken up by the National Wasteland Development Board also aimed at developing wastelands on a watershed basis in the region.

5. BENEFITS OF WATERSHED PROGRAMS

Watershed programs have been specifically launched in the rainfed areas with the primary objective of

improving livelihoods of poor rural households that are afflicted by a disproportionate degree of risk with respect to agrarian activities. Their net income levels are low and uncertain and their plight is compounded by acute degradation of soil and water resources (Wani et al., 2003). The Government of India aggressively intensified watershed programs in fragile and high-risk ecosystems, where farm incomes drastically declined due to excessive soil erosion and moisture stress. It was anticipated that the watershed programs would augment farm incomes, raise agricultural production and conserve soil and water resources in rainfed areas through appropriate technical and financial support (Joshi et al., 2005).

Watershed programs were initiated over a wide range of “agro-ecoregions” and were planned, developed and implemented by various government agencies. A review of the available reports (37 in number for NE states) indicate that the past investment in watershed programs yielded positive results like raising incomes, generating employment opportunities and conserving the natural resource base. A summary of the multiple benefits derived from these programs is presented in Table 2.

It is worth mentioning that the watershed programs were launched in the region with four principal objectives, namely, improving production efficiency, equity, sustainability and abandonment of *jhumia* (shifting cultivation) practice in the NE region. To document these benefits proxy indicators were chosen and analyzed. The benefit-cost ratio (BCR) and the internal rate of return (IRR) were used as proxies from efficiency gains from the watershed programs. However, there is criticism of the way BC ratio and IRR are arrived at in the Indian context. All these evaluation reports have been prepared by different organizations and most probably may not have adopted the same procedure in calculating these figures. Moreover, the watershed programs generate substantial non-market benefits and costs, which cannot be quantified easily in monetary terms. Additional employment generation in agriculture as a consequence of watershed activities was assessed as an equity benefit. Four important indicators were identified to demonstrate sustainability benefits. These include (i) increased water storage capacity, which augments irrigation; (ii) increased cropping intensity; (iii) reduced run-off leading to reduced soil loss; and (iv) abandonment of *jhumia* practice, which conserves the natural resource base and makes the people of region settle down to farming. Similar approach was also used by the Joshi et al., (2005) in meta analysis of watersheds and their impacts in India.

The mean benefit cost ratio of watershed program was modest at 1.79 indicating that the investment in watershed programs in the North East region yielded near to double the initial investment. Similarly, the mean internal rate of return on watershed investments was approximately 19.40%, with a maximum of 39.25% (Table 2). These results suggested that the watershed programs performed reasonably well under these fragile and uncertain environments and the investments were justified as it raised income levels within the target domains.

Another important function of watershed programs was to generate employment opportunities. This would have the positive impact of alleviating rural poverty and reducing income disparities among households. The mean additional annual employment generation in the watershed area on various activities and operation was 164 person days/ha/year. In those watershed projects that included multiple activities, employment generation increased to 795 person days/ha/year. The generation of employment opportunities within these rural communities will invariably increase their purchasing power and a corresponding decline in rural poverty. Based on these observations, the watershed investments may be viewed as a poverty alleviation program in the fragile areas.

Rainfed areas are confronted with acute problems of land degradation through soil erosion, and high levels of risk associated with agriculture due to variable rainfall. Technological interventions through soil and water conservation can greatly reduce the risk in rainfed degraded systems. The watershed programs largely aimed to conserve soil and water as a means of raising farm productivity. The available evidences revealed that both these objectives were accomplished in the watershed programs. There is a mean reduction of 63% in soil loss due to watershed interventions (Table 2). This has a direct impact on expanding the irrigated area and increasing cropping intensity. On average the irrigated area increased by 60.25%, while the cropping intensity increased by 24.67% (Table 2).

Watershed programs such as the WDPSA Scheme were launched in the NE states for abolition of *jhumia* cultivation in a befitting way. Watersheds were taken as units of development in order to lead the *jhumias*

to the principles of proper scientific land use technique according to land capability and suitability. Seventh and eighth five year plans focused on conservation, management and development of land and water with village community as a whole on watershed basis instead of settlement and resettlement of *jhumia* families alone. Land and water conservation was carried out in an integrated manner with scientific land use planning in an eco-friendly system, which led to increase in productivity and employment generation. The summary results on this account reveal almost 40% reduction in the area under *jhumia* cultivation under these watershed projects with a maximum of 90% in area reduction. These benefits confirm that the watershed programs are a viable strategy to overcome several externalities arising from the degradation of soil and water resources. The above summary results of the reviewed watersheds clearly suggest that these programs successfully meted the objectives. These benefits have far reaching implications for rural populations in the rainfed environments. However, the benefits often vary depending upon the location, size, type, rainfall, implementing agency, and people's participation, among others (Joshi et al., 2005).

6. CAST STUDIES

The watershed programs in the country were undertaken with multiple objectives ranging from the rehabilitation of degraded areas to conservation of the resource base and improvement of productivity in agriculture (Joshi *et al.*, 2004). In recent years, the watershed programs have become more focused on poverty reduction and livelihood security. In order to get an onsite assessment of the watershed programs and its benefits to the community, case studies were conducted through PRA and discussions were held with the watershed committee members, SHGs, beneficiaries and landless along with the PIAs of the watersheds. In all, four watersheds were selected which were implemented by different agencies/organizations under different watershed development programs in the state of Meghalaya. The detailed case studies of these watersheds are documented in the following sections.

6.1 Umpling-Umrynjah Watershed (WDPSCA)

The Umpling-Umrynjah Watershed program was done under the Watershed Development Program for Shifting Cultivation Areas (WDPSCA) sponsored by Ministry of Agriculture (MoA), government of India and implemented by the Soil and Water Conservation Department, Shillong, East Khasi Hills District, Meghalaya. The watershed development program was started in the year 1999-2000. The watershed is located in the North Eastern direction on the Shillong Umroi Airport road at a distance of about 38 km under Myllem C&RD Block, East Khasi Hills District. The watershed lies geographically between 25° 39.6" to 25° 41.4" North Latitude and 91° 53.3" to 92° 0" East Longitude. It covers four villages; Umrynjah, Madan Mawkhar, Umphrew and Umjathang with a total number of 183 households. The total geographical area of watershed is 1300 ha with a net treatable area of 875 ha. The project cost is Rs.63.54 lac with a project period of five years.

6.1.1 Objectives of the program

The main objectives of the watershed development project were (i) to protect and develop hill slopes of *jhum* areas through different soil and water conservation measures on watershed basis and reduce further land degradation process, (ii) to encourage and assist *jhumia* families to develop *jhum* land for productive use with improved cultivation and suitable practices, (iii) to improve the socio-economic status of the people through household/land based activities; and (iv) to mitigate the ill effects of shifting cultivation by introducing appropriate land use and water management technologies. With this aim in mind, the project was formulated in the concept of watershed development and carried out in the organizational and committee set up.

6.1.2 Methodology

In order to make the project a people's program addressing their needs based on the priorities and

available resources, the PIA did a participatory rural appraisal (PRA) exercise using various techniques viz. participatory mapping, wealth ranking, matrix ranking, transect walk, and venn diagram with the villagers and beneficiaries to understand what the people have to say about the program.

6.1.3 Process

In order to empowerment people by the project, decentralization of decision making process was brought in by identifying existing village institutions namely, *durbar shnong* (village council). Umpling-Umrynjah Watershed Association (WA) was formed and registered as per the Society Registration Act. Members were made aware of their duties and responsibilities. The president and its members head the association. All the works taken up in the project were done in consultation with the WA.

Watershed Committee (WC) were constituted by the WA and comprises representatives of village elders, user groups, SHGs, youth and women's groups. All members have been imparted trainings and are made aware of their roles and responsibilities. The committee is headed by the chairman, and the secretary is drawn from the PIA. When the group matures, the secretary may be withdrawn. All works and day to day activities are supervised by WC and facilitators.

To gain confidence and enthuse the spirit of belongings among the WC, certain activities were identified by the committees and taken up with participation and labor contribution from people. Entry point activities such as drinking well, washing place, community water harvesting structure, repairs of community hall, school building including footpaths were taken up on priority in all the four villages falling under this watershed.

In the watershed villages, SHGs have been promoted and linked with financial institutions. A good number of SHGs have been promoted comprising of agricultural laborers, landless persons, women and youth. Separate groups were organized among women, as they have been found highly successful in management of credit and thrift activities. Each group has 10-15 members. Twelve SHGs have been formed under Umpling-Umrynjah Watershed among which 7 groups have already been graded by Myllem C&RD Block/Bank and DRDA have granted revolving fund of Rs.25000 each.

The watershed also witnessed the convergence of several R&D schemes through DRDA such as providing drinking water supply. Agriculture Department provided HYV seeds of paddy, maize, soyabean and conducted training programs on taking up specific crop production technologies in the watershed areas. Through horticulture department, Rs.30,000 was granted for taking up vermi composting under Technology Mission (TM) and Rs.40, 000 for green house to SHGs under Umrynjah (WDPSCA). Other departments such as veterinary, PWD, DIPR, State Council for Education and Training and ICAR were also involved in the watershed development program. Various training programs were held for different categories of farmers such as training of watershed association and watershed committee members on their roles and responsibilities in watershed committee development, SHGs formation and watershed volunteering. Field visits to developed watersheds like ICAR, RRTC, Umran, and Vocational Training Centre (VTC) were held to appraise the target groups of the new technologies in farm production and how to replicate those activities in their respective watershed areas.

6.1.4 Work carried out

The development activities carried out on arable land were in form of contour bunding, peripheral bunding, agro-horticulture, crop demonstration, improvement of existing paddy fields etc. Non-arable land treatment mainly included afforestation, dry land horticulture, improvement of existing natural forest and establishment of compost nursery. Furthermore, drainage line treatment in form of spurs or protection walls, small dug out ponds, check dams, diversion dams and water harvesting structures were taken up under the program.

6.1.5 Future Funding for Project

In an effort to make the project sustainable, community participation and contribution to the tune of 5%

was made mandatory and this was achieved through participatory approach. The fund generated through labor contributions, calculated in terms of monetary value was deposited in the fixed deposit with RRB, Mawlai Branch and the same is to be jointly operated by President of WA and Chairman of WC after the end of project for maintenance of assets created during the project period. The four WAs of four villages have a corpus fund of Rs.2, 04,804. Besides this, they have planned to collect a fixed amount from individual beneficiaries to maintain corpus fund for watershed activities. The respective WAs duly adopted a resolution that every household shall contribute 5% each time for every development activity to WDF which will be maintained by the Executive Committee (*Durbar Shnong*). Fund may also be used to provide loans to SHGs at nominal interest besides helping the poor and needy in times of emergencies or natural calamities. Moreover, they have community forests from which they can generate the funds for maintenance of watershed structures after project withdrawal which is scheduled in a short time period. The impact indicators of the Umpling-Umrynjah watershed are shown in Table 3.

6.1.6 Impact

In the watershed area, farmers have diversified their farming practices by switching over to double and mixed cropping systems instead of mono cropping system as practiced earlier. In areas with assured irrigation facility, they grow paddy as main crop followed by subsidiary crops like potato, tomato and french beans. Under rainfed conditions, the farmers take ginger and maize as main crop mixed with other subsidiary crops like yam, bitter gourd, cucumber, soybean, french beans and pumpkin.

During discussion with beneficiaries and members of WC, it was revealed that all farmers were practicing *jhum* cultivation previously, but have given it up (except 6-7 farmers) after watershed implementation. As per farmer's own assessment, with adoption of contour bunding, they were able to arrest about 95% of soil erosion. There has not been much change in the composition of crops, only change is that they improved existing cultivation of crops and have come to settled crop cultivation system. In terms of crop productivity, there has been increase of almost 40% which may mainly be attributed to HYV seeds and better irrigation. There is a 23% increase in household income from farming. About 399 ha area was brought under agro-horticulture system while 296 ha non-arable area was brought under dry land horticulture. Besides this, horticulture was introduced in watershed development program. Varieties of fruit plants such as guava, pear, lagoon pear, Khasi lemon, Assam lemon, mosambi, plum, peach, papaya, jack fruit, chest nut etc were distributed to beneficiaries and planted in their homestead/back yard garden. The survival rate of these fruit plants was about 85%, which is satisfactory. Once these fruit plants come in bearing stage, it will change the household economy of the beneficiaries.

In order to address the equity problem, watershed program also targeted poor and landless farmers in its developmental program through activities such as bee keeping, tailoring, piggery, pisciculture and vermi-composting, by formation of SHGs. Besides these special packages, landless people also benefited through labor work under watershed development program. Beneficiary card is also maintained for rehabilitation program of *jhumia* families containing basic information about the beneficiary, his family, current income, activities taken up, disbursement of funds, progress and benefits, which is being updated from time to time and for which separate funds have been earmarked (17.5% of the project cost).

6.2 Lyngiong Watershed (NWDPRA)

The Lyngiong Watershed was implemented by the State Agriculture Department under NWDPRA (Xth Plan). Presently, there are 78 watersheds under NWDPRA in Meghalaya State which are in the last phase of implementation and are expected to be completed by September, 2007. The Lyngiong Watershed was chosen for case study as almost 95% of the interventions were already over. It is located on Shillong-Mawsynram road about 36 km from capital city Shillong. The total geographical area of watershed is 515 hectares with 292 hectares arable area and 207 ha non-arable area. The total project cost is Rs.16.50 lac. It covers six villages.

6.2.1 Process

Before implementation of WS program, the PIAs made a meeting with the *Durbar Shnong* (village council) in which they were made aware of the proposed project. After few meetings, WC was formed which was selected by the general Durbar Committee members. With the formation and registration of WC, actual layout for developmental works was sorted out in consultation with the members. Watershed Associations (WAs) were formed at village levels. Each WAs comprise of 7-10 members. There are three women members in six WAs, however, they have a fair number of six in Watershed Committee (WC) out of total 15 members. Besides this, there are six women SHGs in the watershed area.

6.2.2 Works carried out

Developmental works carried out consisted construction of check dams and stabilization of stream bank in form of brush wood structures and boulders. There was considerable land reclamation in upper watershed area due to the developmental activities carried under watershed program. Besides this, a number of fishery ponds were constructed on private lands as well as community land. In case of private lands, 20% of the cost was shared by the beneficiary for making the fishery ponds and rest came from the watershed program. The other activities include piggery, poultry, goat rearing and vermi-composting.

6.2.3 Impact

There is a shift from traditional crops to high value vegetable crops in the area due to increase in water availability and better facilities provided under watershed program. The watershed villages were predominantly potato growing area with little paddy cultivation also. Under watershed development program, farmers started pea cultivation, which gave good results and better income. Quality seeds were provided by the department. There was a 18-20% increase in the yield levels of various crops. Pig rearing and poultry farming were very successful under the watershed development program⁶. Goat rearing and fisheries were also adopted with success. Good number of fish ponds were constructed under the watershed program, which will boost the beneficiary income after two-three harvests. The impact indicators for Lyngiong watershed are given in Table 4. These indicators show improvement in the livelihood opportunities of the beneficiaries.

6.3 Wah Umroi (ICAR Model Watershed)

Development of model watersheds in NE region under NWDPR scheme was entrusted to Engineering Division of ICAR Research Complex for NEH Region, Barapani, Meghalaya. These model watersheds were taken at Meghalaya (Wah Umroi WS), Nagaland (Peren-Jalukie WS) and Sikkim (Sajung WS). The geographical location of Wah Umroi watershed is 25° 41.5" N and 25° 45" N longitude and 91.5° 5.5" E to 91.5° 9.7" E latitude in Ri-Bhoi district. The total geographical area of watershed is about 1612.5 ha out of which 532.5 ha has been selected at five different locations namely, Umroi, Mawthai, Umeit, Mawpun-I and Mawpun-II. Umroi model watershed project started during 2003-04 for a period of five years. Out of the total selected 532.5 ha, an

⁶ Mr. Pranshon Jala was supplied 10 cross-bred piglets by the PIA under watershed program worth Rs.10, 000 on full subsidy in February, 2006. He started with these piglets and after every 7 months, he sells them. These are exclusively reared for pork purpose. Their litter is used as FYM in vegetable cultivation. He has now increased his piggery rearing scale and sells three batches of pigs every year. He has made three pig sheds and is now planning to construct further more. As per his own assessment, he gets a net income of Rs 65,000 per annum from the piggery farming. Looking to his success, other farmers are also now planning to go for pig rearing. Mrs Maygreen Kharbteng started poultry two years back with her own resources. She constructed a low cost poultry shed with Rs.6, 500 initial investments. The PIA under watershed program supplied her 200 broiler chicks with which she started her poultry farming. She sells five poultry batches in a year with 150-160 number of broilers per batch. One broiler on an average fetches Rs.120-130. She buys now chicks at a rate of Rs.14 per chick. She is very happy with her new enterprise and wants to increase her poultry farming scale.

area of 179.69 ha was developed till 2005-06.

6.3.1 Works carried out

The development works were carried out in form of constructing water storage tank tapped from spring water at Umeit village (upper reach). Drainage line treatments were made at upper, middle and lower reaches of watershed area. Activities on natural resource management have been carried out at Mawpun-I where 2 ha of land was taken up under soil and moisture conservation activities and 7 ha of land were developed for horticulture and agro-forestry. Other works included construction of diversion wall, spillway and rectangular weir of drainage line treatment.

To ensure people participation in the planning and development activities of the watershed, self help groups (SHGs) were involved and action plans were decided after regular discussions. A total of eleven SHGs are functioning at present in the watersheds. SHG meetings are generally held once in a month to collect the funds from the members and deposit in their respective bank accounts. The SHG⁷ members also discuss common problems and needs which are recorded in minute books and brought for discussion in the Watershed Development Committee meetings. During the work season of watershed development activities, the WC meetings are held monthly and in case of lag season, quarterly.

Initially private landowners were hesitant in allowing watershed development interventions on their lands due to certain apprehensions. This issue was addressed by the implementing agency through involving the secretary of the *Durbar Raj*. After realizing the true motive of the implementing agency, every farmer wants to have watershed interventions on his field. Thus it can be said that formation of institutions or involving the village/local institutions is a pre-requisite for successful implementation of watershed development programs, which can also maintain the system after the project withdrawal.

6.3.2 Impact

Only 34% of the proposed area has been treated by the implementing agency till now. The watershed development program will last until 2008. The changes in cropping pattern, crop yield and production are coming up and it is in transition phase. A number of enterprises are coming up in short period for which physical infrastructure has already been created. These enterprises are fish culture, vermi composting, mushroom cultivation and small processing units. Once these enterprises start their production process, more tangible benefits will accrue under this program. There is enough social capital formation in terms of SHGs and WDC. Results of impact assessment are presented in Table 5.

6.4 Nongpoh Watershed (NGO)

Nongpoh watershed is a micro watershed located at the border of Meghalaya and Assam. The watershed area consists of 12.5 ha out of which 3.5 ha have been developed. The whole area belongs to a missionary NGO known as the Mozarello Orphanage⁸ cum Training Centre. The center is basically an orphanage boarding school in which orphan girls from primary to high school level study. There are a total of 45 students from class-I to high school level. They work on field after school work. The watershed interventions were started in 2003 under the technical guidance of ICAR, Barapani. The funds came partly from ICAR institute and partly from externally funded schemes. A total of Rs.4.85 lac was invested in which, 75% was contributed by ICAR Barapani institute and rest by NGO in terms of labour component.

⁷ The interview with the chairperson of one of the women SHG revealed that they are involved in ginger cultivation. They have also been imparted training in processing and embroidery. The members take small loans in case of some domestic problem like illness or to meet other social obligation. No members till now had taken loan for starting any productive venture. Members make weekly contribution, which is deposited in the bank.

⁸ Many pass out students of the orphanage emerged successful and have now joined the Ri-Bhoi College. The NGO is run by Sister Linda who is a well-qualified and dedicated lady to her mission.

6.4.1 Works carried out

Only one acre of land was under cultivation before watershed interventions in which paddy was usually grown. With watershed interventions, they have started animal husbandry, which includes piggery, poultry, fishery, duckery and cattle rearing. Besides introduction of livestock enterprises, many plantations of fruit plants of pineapple, banana, beetle nut, pepper, guava and peach were done on steep slope areas.

6.4.2 Impacts

The results of watershed interventions are discussed enterprise-wise.

Fishery intervention: Seven different species of fishery seeds of more than 6000 fingerlings were supplied by ICAR, Barapani in August, 2004. In 2006, the yield was sold for Rs. 33,000. The average weight per fish was 3-4 kgs and sold at a very low rate of Rs.150 per fish due to market failure. Besides selling, they had also used 50-60 kgs of fish for their own consumption. This year, they are again going to harvest the fish.

Piggery: ICAR institute supplied eight piglets to start with. In two years, they have sold 37 pigs and earned Rs.50,000 from the sale. Pork is very popular and highly valued animal product in this area. On an average, they have incurred Rs.20, 000 to rear these 37 piglets on feed and also the leaves collected by girls from farms to feed them.

Poultry: Special poultry birds of Banraja were supplied by ICAR institute at subsidized rates. Hundred birds were supplied out of which 50-60 was sold at Rs.30, 000. Rest was used within orphanage center. They are now going to start with broiler chicks.

Duckery: Ducks are reared in the water pond from last three years. They had made about Rs.8000 from duckery. Mostly they use it for orphanage consumption.

Milk production: Orphanage has two jersey cows yielding about 20-24 kg/day out of which they sell 10 kgs of milk at the rate of Rs.20/kg. Rest of milk is used for orphanage consumption.

Rabbits: ICAR institute supplied the orphanage 3 rabbits (2 female and one male) in January 2007. After 4-5 month period, they increased their size to eight. They have not sold any rabbit. They first want to increase their population as well as size. After getting good number, they will sell them in the market. The average price of rabbit is Rs.150.

Goats: The orphanage started with a pair of goats in 2004. At present, they have 16 goats. They sold them at rate of Rs.1600 per goat for large sized and Rs.700 per goat for small ones.

Pineapple: This intervention was done under watershed by ICAR in which they spent almost Rs.10, 000. Till now they had two harvests. In first harvest, they sold for Rs.7000 and second harvest for Rs11, 000. They had planted more than 2500 plants on hill slopes. Apart from sale, children also consume these fruits. Besides pineapple, other fruit plants such as banana (100 numbers), beetlenut (200), pepper (50), guava (20), and peach (20 numbers) were also planted on steep slopes. Once these fruit tress come in full bearing stage, it will generate a huge income for the orphanage besides controlling soil erosion.

The impact assessment Table 6 of Nongpoh watershed shows 1100% increase in the income generated post watershed intervention from mere Rs.17,000 to Rs.2,04,000. Although, full benefits from the watershed interventions are yet to be realized, particularly from the horticultural plantation crops.

The overall performance ranking of these four case studied watersheds is shown in Table 7. It is revealed from the table that the Nongpoh micro watershed has performed superbly well followed by Umpling-Umrynjah and Lyngiong Watersheds. The Wah-Umroi ICAR Model Watershed has not yet realized its full potential benefits as the activities and interventions are not still over.

7. LESSONS DRAWN FROM THE CASE STUDIES

We conducted case studies on four watersheds implemented by different agencies under different watershed development programs. The lessons drawn for the success of watershed development program and how it can be scaled is discussed under different sections.

7.1 Sound Institutions

Traditionally, tribes and clans in the northeast were closely knit for security from external invasion but have now moved into other social activities. Social institutions have substantial impact on the decision making process and thus any watershed initiative will have to take these institutions and people into confidence and make them believe that the initiative will have a positive impact on their livelihoods. In all these case studies, the existing traditional village institutions, locally known as, *Durbar Shnong*, played a great role in motivating the villagers and initiation of watershed development program, besides reducing transaction costs. *Durbar Shnong* formed the social base for the implementing agencies to mobilize the people under these programs. All the studied watersheds except Nongpoh Watershed do have Watershed Committee's at apex level with Watershed Associations at village level besides SHGs and Voluntary groups. These institutions were successful in working together and bringing 'collective action' among participants to sustain watershed activities. There has been enough social capital formation under these selected watersheds whose role will be now more tested after the project withdrawal, which is in offing.

7.2 Equity

As watershed development programs are generally land and water based interventions, benefits are restricted to only land owners leaving aside land less poor classes of the society. However, there are examples of watershed programs (Sukhomajri WS) in which land less people of the watershed community were also given due rights to reap benefits from the watershed programs. In the case studies, the landless people benefited in terms of employment generated under the watershed development programs. Though the number of landless families in these watersheds was very less, efforts were made by the PIAs to target this group. In Umpling-Umrynaj Watershed women's SHGs were provided training in bee keeping, tailoring, piggery, pisciculture, vermi-composting to provide help to the poor landless people. However, there was some favouritism towards private lands in watershed interventions because of local village politics of traditional institutions.

7.3 Sustainability

The sustainability of the watershed project may be judged by identifying the activities and their outcome in: (i) protecting the natural resource base, specially land and soil from environmental and ecological hazard; (ii) improving availability of water in watersheds; (iii) improving the biomass production; (iv) developing and strengthening local institutions; and (v) developing mechanisms to maintain assets created during the watershed program and on sustained basis after the project withdrawal.

On all these indicators, the case studies fared well. However, some works carried out with locally available material like stream bank stabilization by brush wood treatment in case of Lyngiong watershed at the upper catchment is not going to remain for longer period due to heavy rainfall area of the watershed. Such fragile spots need to be treated by concrete structures. For maintenance of assets after the project withdrawal, the Umpling-Umrynjah and Lyngiong Watersheds have created corpus fund and also developed mechanism to generate resources for the maintenance of these structures after project withdrawal. Such mechanism were not developed in case of Wah-Umroi Watershed implemented by the ICAR, Barapani.

7.4 Sharing Costs and Benefits

One of the key determinants for the success of watershed activities is that the expected private benefits must substantially exceed the expected private costs (Joshi *et al.*, 2004). The costs of works carried on the private individual lands were shared between the PIAs and beneficiary. Beneficiaries mostly contributed in terms of labor. Proper consensus is needed among the community members or villagers to carry out watershed works on community lands, to work out the sharing of benefits generated by the community lands. However, in most cases, it was planned by the members of Watershed Committees that the revenue generated through these

community lands will be used to maintain corpus fund that may be in turn used to maintain assets after project withdrawal.

7.5 Gender Issues

More impetus is drawn now on the role of women in the watershed development programs. Meghalaya, which is dominated by the Khasi tribes, has matrilineal system of property rights. Women thus have an active role in agriculture. In case of studied watersheds, a good number of women were found to be members of watershed committees. Furthermore, a number of women SHGs were found working in different activities in capacity of entrepreneurs on new opportunities created under the watershed programs.

7.6 Market Linkages and Infrastructure

Most of the watersheds in NER region are located with poor connectivity and so was the case with the study area. The farmers were not getting the real price for their produce and they have to spend a lot to supply their products to markets. So, there is problem in input as well as output market linkages which need to be addressed by formation of village market cooperatives. Small-scale village processing industries may help in overcoming the problem of market failures and price fluctuations besides value addition of the produce. It will also be useful in considerable employment generation.

7.7 Technical Aspects

The guidelines provided under different watershed development programs have limitations in case of hilly areas of NE region. NER region has a tough terrain, poor road infrastructure and comes under high rainfall zone. Most of the works carried out for treating the prone areas have been done by locally available material as per guidelines. For example, brush wood treatment for stream bank stabilization in these watersheds is not going to last because of steep slope and high intensity of rainfall that will create havoc with these structures during monsoon season. Furthermore, the development cost per hectare as per guidelines should be more in case of hill regions where they have to transport the masonry material by head load or by employing ponies, which increase costs. It was also observed that there should be enough flexibility in the development component of watershed programs and activities should not be restricted as per guidelines but more demand driven as per local needs as well as suitable to biophysical base of the area. In fact, there is a need for a separate nation wide watershed development program for hill regions and guidelines need to be developed separately for such programs. Timely availability of funds was also mentioned by the PIAs as a constraint in effective implementation of watershed programs.

7.8 Watershed Ownership and Management

One important lesson drawn from the present case studies is that the programs carried at micro level and under one management protocol produce quick and more desired results, as was observed in case of Nongpoh watershed. This is because the benefits derived go to an individual or institution and decisions are taken at the same end, which has potential to give quick and tangible results.

8. CONCLUSIONS AND FUTURE DIRECTIONS

Watershed development projects have been taken up from time to time under different programs launched by the government of India in the north eastern region. The study concludes that the watershed programs have helped in raising income, generating employment and conserving the natural resource base as well as motivating people to abandon *jhum* practice. It is suggested that watershed program can be a vehicle of development to alleviate poverty by raising farm productivity and generating employment opportunities in marginal and fragile

environments. The peculiar nature of region and its problems and opportunities signifies an even greater scope for watershed programs at a larger scale with some modifications in the programs and guidelines.

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Table 1: Net sown and irrigated area in North Eastern States

Name of State	Net sown area (000' ha)	% of reported area (000' ha)	Net irrigated	NIA as % of NSA
Arunachal Pradesh	164	2.98	42	25.61
Assam	2774	35.34	172	6.20
Manipur	217	11.16	40	18.43
Meghalaya	227	10.19	60	26.43
Mizoram	98	4.70	16	16.33
Nagaland	305	19.27	67	21.97
Sikkim	110	16.37	9	8.18
Tripura	280	26.69	40	14.29
NE average		18.22		10.68
All India		46.06		39.11

Table 2: Impact indicators from the sampled watershed studies (N=37)

Indicator	Particulars	Unit	Mean	Minimum	Maximum
Efficiency	B/C ratio	Ratio	1.79	1	4.04
	IRR	Percentage	19.40	10.5	39.25
	Agricultural Productivity	Percentage	28.89	1.75	73
Equity	Employment	Person days/ha/year	164	21	795
Sustainability	Irrigated area	Percentage	60.25	11.5	122.72
	Cropping intensity	Percentage	24.67	1	65
	Reduction in <i>jhum</i> area	Percentage	33.69	2	90
	Reduction in soil loss	Percentage	63	32	97

Table 3: Impact of watershed development program in Umpling-Umrynjah WS

	Particulars/Indicators	Unit	Before	After	Change (%)
1.	Cropping pattern		Mono-cropping	Double and mixed cropping	
2.	Cropping intensity	%	138	213	75
	1. YIELD				
	(i) Rice	Kgs/acre	650	910	40.0
	(ii) Maize	Kgs/acre	300	380	26.6
	(iii) Ginger	Kgs/unit	200	295	47.5
	2. Change in livestock composition and yield				NO
3.	Farmers practicing <i>jhum</i> Cultivation	%	90	7	-92.00
4.	Area under <i>jhum</i> cultivation	acres	1325	72	-94.56
5.	Reduction in soil loss erosion	%			95.00
6.	Increase in House hold income	%			23.00

Table 4: Watershed performance in Lyngiong WS

	Particulars/Indicators	Unit	Before	After	Change (%)
1.	Cropping pattern		Mono-cropping	Double and mixed cropping	
2.	Cropping intensity	%	122	187	65
	1. YIELD				
	(i) Winter paddy	Kgs/ha	1945	2493	28.17
	(ii) Spring paddy	Kgs/ha	3448	4000	16.00
	(iii) Autumn paddy	Kgs/ha	1169	1482	26.77
	(iv) Maize	Kgs/ha	1465	1550	5.80
	(v) Pineapple	Tones/ha	4	6	50.00
	(vi) Ginger	Qtls/ha	4.2	6	45.00
2.	Change in livestock composition and yield			Piggery, goat, fishery, poultry	
5.	Reduction in soil loss erosion	%			17
6.	Increase in House hold income	%			20

Table 7. Performance ranking of watershed indicators.

Table 5: Watershed interventions and its impact in Wah Umroi WS

Particulars/Indicators	Unit	Before	After	Change (%)
1. Cropping pattern		Mono-cropping	Double and mixed cropping	
2. Cropping intensity	%	120	172	52
1. YIELD				
(i) Rice		632	850	34.5
(ii) Maize		287	368	28.22
(iii) Ginger		224	305	36.16
2. Change in livestock composition and yield				NO
5. Reduction in soil loss erosion	%			32
6. Increase in House hold income	%			60

Table 6: Impact of watershed interventions on the Nongpoh micro-WS

Particulars/Indicators	Unit	Before	After	Change (%)
1. Cropping pattern		Mono-cropping	Double and mixed cropping	
2. Crops grown		Rice only	Pineapple, Beetlenut Pepper, Guava, Peach	
2. Change in livestock composition and yield		Nil	Fishery, duckery, piggery, poultry, goats, cows, rabbits etc.	
5. Reduction in soil loss erosion	%			100
6. Increase in income	%	Rs.17,000	Rs. 2,04,000	1100%

Indicator	Parameters	Umpling- WS Umrynjah	Lyngiong WS	Wah Umroi WS	Nongpoh micro-WS
Efficiency	Agricultural productivity	****	****	***	*****
	Returns to investment	****	****	***	*****
Equity	Employment				
	Benefits to landless	****			
Sustainability	Corpus fund generation	****	***	**	
	Soil & water conservation	****	***	***	****
	Institutional development	****	****	****	
	Diversification of activities and enterprises	*****	*****	****	*****
Over all Rank		****	****	***	*****

Very Good *****, Good ****, Fair ***, Poor **