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Impact of Watershed Project on the Land-use; Resource-use; Cropping Patterns and Productivity of the Crops

Dr. Th. Motilal Singh
Subject Matter Specialist, ICAR-KVK, Imphal West, ICAR-RC for NEH Region, Manipur Centre, Lamphelpat, Imphal

ABSTRACT
The implementation of the watershed project provide better avenues to the marginal and landless farmers in crop production activities thereby leased-in land from the landlords and large farmers have changed significantly. The arable land area has been increased significantly from 139.72 ha to 192.38 ha (37.70 percent). Also the area under afforestation which was 8.5 ha before the project has been significantly increases to 21.09 ha and the percentage change of 148.11 has been marked. The per hectare use of seed which was found to be 330/-before the project has marginally increased to Rs. 343/-after the project with a percentage change of 3.4 only. Also, the different level of manure and fertilizer use has been slightly increased from Rs. 2133/- to Rs. 2400/- during the two study period accounting for 12.5 percent change. The use of per hectare amount of labour reveals that there is a marginal increased from Rs. 15860/- to 16200/- respectively during the pre- and post period of the project with only 2.1 perent change. The overall gross cropped area from both the irrigated and rainfed area before and after the project are found to be 127.55 ha and 150.78 ha respectively with a significant percentage change of 18.21. Thus, the overall cropping intensity of the Sagolkhong watershed project area is marginally increased from 105.81 to 114.83 during the pre- and post- period of the study. However the productivity of all the crops has not changed much except on some major crops.
KEYWORDS: Sagolkhong; afforestation; rainfed

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I. INTRODUCTION:

Land and water are the most vital natural resources of the nation and these resources are under tremendous stress due to ever increasing biotic pressures. The optimal management of these resources with minimal adverse environmental impact is essential not only for sustainable development but also for human survival. So, watershed is an ideal unit calling for multi-disciplinary approach to the natural resource management for ensuring continuous benefit on sustainable basis. In fact, watershed approach is the basis for sustainable management of the farming system. It emphasizes the planning of natural resources, specially land, water, vegetations and the socio-economic need of the certain ecosystem and community concerned. On this basis, watershed has been the area of concerned in the recent Five Year Plans in both the rainfed and shifting cultivated agro-ecosystem. Different implementing agencies have been managing watershed in the recent Five Year Plans and in Manipur too, Watershed development project has been operating through different implementing agencies of both the valley and hilly region. Although, the impact analysis of such watershed project has done in many states of India, little work has recorded for the states of the Manipur regarding the socio-economic aspects of the watershed areas. Thus, the present investigation is an attempt to assess the impact of watershed development project on the overall socio-economic status of the beneficiaries in the particular project area with the following objectives.

II. OBJECTIVES:

1. To study the impact of on land-use pattern, resource use pattern, cropping pattern and
2. To assess the technological adoption and the productivity of crops

III. METHODOLOGY:

Sagolkhong watershed project was one of the model watershed project sponsored by the Ministry of Agriculture, Govt. of India under Central sponsored project viz., National Watershed Development Project for Rainfed Areas (NWDPRA) and was implemented by the department of Horticulture and Soil Conservation, Govt. of Manipur. The project was purposively selected for the study so as to assess the impact of the watershed project in the socio-economic aspects of the farm families in watershed area. For this, a two-stage-stratified

random sampling method was used for the selection of three villages and 100 sample households from the Sagolkhong watershed using proportionate allocation random sampling technique. The study is based on the two types of data *viz*., "Before and After" the project. The preliminary survey was preceded by discussing with the project authority, watershed development committee of the village and other agricultural and horticultural officials to frame the schedule for farm level enquiry in its proper perspectives. Secondary data were collected from various reports of the project and published and unpublished record of the Government of Manipur. Information pertaining to the land use; resource use; cropping pattern; technological adoption and productivity of the crops has been collected from the watershed beneficiaries. Analytical tools such as averages, percentages and frequency distribution and t-test were used to arrive at the results related to the studied objectives.

LIMITATIONS:

As there are no records of the farm activities by the beneficiaries in the watershed area, the information on the use of resources and productivity of all the crops in the studied area are collected based on the memory of the beneficiaries. Hence, the findings of this study may not be generalized with the actual scientific recommendations.

IV. REVIEW OF LITERATURES:

Alemayehu et al. (2009) opined that the Integrated watershed management (IWSM) was implemented to address issues of poverty and land resource degradation in the 14,500 ha upper Agula watershed, in semi-arid Eastern Tigray (Ethiopia), an area known for poverty and resource degradation caused by natural and man-made calamities. The results reveal significant modification and conversion of land use and cover of the watershed over the last four decades (1965-2005). A significant portion of the watershed was continuously under intensively cultivated (tainted) land. The area under irrigation increased from 7 ha to 222.4 ha post-intervention. The area under dense forest increased from 32.4 ha to 98 ha. His study reconfirms the importance of IWSM as a key to improve the land cover of watersheds, as a contribution to poverty alleviation and sustainable livelihood.

Bhalla et al. (2013) stated that the Watershed development (WSD) is an important and expensive rural development initiative in India. Proponents of the approach contend that treating watersheds will increase agricultural and overall biomass productivity, which in turn will reduce rural poverty. Their findings show that WSD has not resulted in a significant increase in productivity in treated micro-watersheds at any grouping, when compared to adjacent untreated micro-watershed or the same micro-watershed prior to treatment. He revealed that with the large investment of financial resources in the watershed program, it is important that the program becomes successful. Hence the challenges in watershed impact assessment should be given due importance in the future planning and development programs. The results had indicated that watershed development activities have been found to have significant impact on groundwater recharge, access to groundwater and hence the expansion in irrigated area. In addition to these public investments, private investments through construction of farm ponds may be encouraged as these structures help in a big way to harvest the available rainwater and hence groundwater recharge.

Implementation of the project maize wheat accounted for about 85 per cent of the total cropped area of the sample households which decreased by about 6 per cent with the implementation of the project. Due to the creation of irrigation facilities under the project, the area under vegetables was increased from 3 to 9 per cent of total cropped area. The pattern of other crops during the two periods was found to be unchanged. 11. The cropping intensity was estimated at about 200 per cent in both periods, despite the increase in the area under vegetable crops after the implementation of the project. A slight reduction in the cropping intensity by 1 per cent as compared to pre-project period was due to introduction of fruits crops on irrigated lands.

Palanisamia and Kumar (2009) concluded that the overall performance of watershed development programmes has been examined in the state of Tamil Nadu. The impacts of major watershed development programmes have been outlined in terms of biophysical impacts, environmental impacts, socio-economic impacts and overall economic impacts. It is pointed out that the watershed development activities have made significant positive impacts on various biophysical aspects such as soil and water conservation, soil fertility, soil and water erosion in cropped area, changes in cropping pattern, cropping intensity, production and productivity of crops.

Thakur *et al.,* (2014) revealed that the land holding and land utilization are the basic resource that the farming households get in inheritance from the ancestors and pass on to next generation. However, over the period of time land holdings are becoming smaller in size due to increase in population and sub-division of farm families. Therefore, the per capita land-man ratio is decreasing constantly putting more pressure on land. Agriculture is a land based avocation and, as such land resources are the basic requirements for farming around which economy of farmer revolves. On an average total land holding was found same in all the locations in two periods i.e. 2006-07 and 2013-14. The total land holding in upper, middle and lower area was 0.93, 1.49 and 1.05 ha/ household respectively. On overall situation total land holding was 1.16 ha/ household. However, area

under irrigation has changed during two periods due to project intervention. Sea change in irrigated area has been noticed in upper area, 0.14 ha to 0.26 ha (86 per cent increase)/ household. Minor change has been noticed in middle area, 0.60 to 0.62 ha per household. No change was recorded in lower location of the sub-watershed on sample households. On an average situation irrigated area has increased from 0.42 to 0.47 ha/households, showed 12 per cent addition of irrigated area over the prior to project implementation activities. Overall irrigated area has increased from 36 per cent to 41 per cent of the total land holdings and farmers had shifted their land for orchard. Overall increase in orchard was recorded 0.01 ha to 0.02 ha. per households over the seven years which showed 50 per cent increase in area under orchard.

The cropping pattern of the farmers in previous period (2006-07) before implementation of the project and post implementation period (2013-14) showed higher proportion of arable land was under food crops in both the season (Kharif and rabi) as compared to 2013- 14. Maize in Kharif and wheat in rabi seasons were the most important crops grown by the farmers in both the period. Also, the farmers allocated higher proportion of total cropped area to HYVs maize in Kharif season in both the period. The total area accounted under maize in Kharif season was (87%) in upper area followed by middle (85%) and lower area (81%) per households in 2006-07, which was accounted for about 43, 42 and 41 per cent of the total cropped area of upper, middle and lower area respectively. However, in 2013-14 the proportion of area under maize in Kharif season was 80 per cent in upper area followed by lower area (77%) and middle area (76%). On overall situation area under maize has reduced 84 per cent in 2006-07 to 78 per cent in 2013-14 in Kharif season, constituting 42 per cent in 2006-07 to 39 per cent in 2013-14 to their respective total cropped area. There was no major change in the cropping pattern of pulses, oilseeds and fodder crops etc.

Productivity of horticultural crops of the Swan River catchment area showed increase over previous period as 93 q/ha to 109q/ha in mango and no change in yield (20q/ha) in lemon as sole crop/ orchard on overall situation. However, there was decrease in yield of orange from 185 to 77 q/ha. This decrease was noticed due to non- bearing of new area under orange. Whereas in mixed crop, all the fruit crops have shown increase in productivity. The increase was recorded 147 to 201 q/ha in mango, 72 to 85 q/ha in orange and 115 to 122 q/ha in lemon. However, slight decrease 17q/ha to 16q/ha was recorded in other fruit crops like, guava, papaya, pomegranate, litchi, kinnow, etc. on an average farm situation. Almost similar trend was observed in different locations of the sub-watershed of the project area.

V. RESULTS AND DISCUSSIONS:

1. Changes in the Demographic Features of Sagolkhong Watershed Development Project

The inclusion of various components for the overall development of the watershed areas has made a significant change in the demographic features. Population of children below 14 years declined marginally from before the project from 37.3 per cent to 35.5 per cent after the project. Awareness of the watershed households in family planning programmes restricted the children population in the area.

Table No 1: Demographic Features of Sagolkhong Watershed Development Project

Sample Size: 100

A. **Population (%)**	**BP**	**AP**
Below 14 Years	37.30	35.50
Between 15 to 60 Years	48.60	52.00
Above 60 Years	14.10	12.50
Family Size	7.16	8.62
B. Literacy Rate (%)		
Illiterate	61.77	50.83
Primary & Middle	33.65	43.85
Matric	4.18	4.98
Graduate & Above	0.40	0.34
Literate	38.23	49.17
C. Work Force (%)		
Agriculture	90.10	87.40
Service as Primary	1.10	0.90
Business as Primary	0.60	0.40
Business & Agriculture	0.60	0.40
Agriculture & Service	0.30	0.20
Small Scale Industry	7.20	10.70
Casual Labour	0.10	-

BP= Before Project

AP= After Project

It is found that 48.6 per cent and 52 per cent of the total population are fall within the age-group of 15 to 60 years during the period and also form the major proportion of the total population. Likewise, the aged-group i.e. greater than 60 year is recorded as 14.1 and 12.5 per cents respectively. Finally the average family size is found to be 7.16 and 8.62 respectively during the pre- and post period of the project indicating a slight increase.

The overall literacy rate for the total population size is found to be 38.23 and 49.17 respectively as before and after the project. Of these, 33.65 and 43.85 percents are meant for Primary & Middle; 4.18 & 4.98 for Matric; and 0.4 & 0.34 represents Graduate and above. On the other hand, the total illiterate rates are 61.87 and 50.83 per cents respectively as ex-ante and ex-post project life which is significant. A moderate increase in literacy rate resulted from better schooling facilitates and increasing households earning after the watershed project.

The whole population comprises of different occupation or work force for their livelihood support system. Accordingly, it has been found recorded that agriculture sector dominated the entire work forces and accounted for 90.1 and 87.4 per cents respectively during the pre and post period. The decrease in the number of work-force after the project is due to the population explosion and the reduction in the operation holding and diversification of economic activity towards the other profitable enterprises. Other primary occupation such as Service; Business; Business with agriculture and Agriculture along with Service are not mark upto the significant level. Again, Small Scale Industries which accounted for 7.2 per cent of the total work force before the project has come-up to 10.7 after the project. Interestingly 0.1 percent of the total working forces which were acting as casual labourers are now vanished after the project. This is due to the fact that watershed project has provided direct opportunities for becoming an entrepreneur which can be considered as a positive impact.

2. Changes in Land-Use Pattern

The total operated area of the sample households are 382.15 ha and 388.45 ha respectively during the study period (i.e., 1.64 percent increased). The percentage changes in the area remain more or less stagnant after the project. Out of these, 286 ha were owned land and it was significantly decreased to 240 ha (-15.83 percent) in the post period of the project. Contrary to this, the leased-in area which was 96.15 ha during the pre-project has been increased to 147.73 ha. This shows that 53.64 percent of the leased-in area has increased significantly. The implementation of the watershed project provide better avenues to the marginal and landless farmers in crop production activities thereby leased-in land from the landlords and large farmers.

Table No 2: Changes in land-Use Pattern of Sample Farm in the Sagolkhong Watershed Area (Area in hectare)

	BP	**AP**	
Sample Size	**100**	**100**	**Percentage change**
Total Operated Area	382.15	388.45	1.64 (NS)
Owned Land	286.00	240.72	(-) 15.83**
Leased –in	96.15	147.73	53.64**
Arable Land			
Wet land cultivation	48.25	54.50	12.95**
Upland/Contour Cultivation	14.90	16.28	9.26 (NS)
Jhum cultivation	55.50	58.50	5.40 (NS)
Orchard/Fruit	11.82	40.94	246.36**
Afforested area	8.50	21.09	148.11**
Fish pond/Aquaculture	0.75	1.07	42.34
Sub-total	**139.72**	**192.38**	**37.70****
Non-Arable land			
Current fallow	242.43	196.07	19.10**
Irrigated area	48.25	54.50	12.95**

*** = 5% level of significance*
**** = 1% level of significance*

BP = Before project
AP = After project
NS = Non-significant

The arable land area has been increased significantly from 139.72 ha to 192.38 ha (37.70 percent) changes have been taken place. This increased percentage is contributed by the wet land cultivation; upland or contour cultivation; *jhum* cultivation; orchard or fruits; afforested area and fish pond or aqua-culture areas. Among these, wet land cultivation accounted for 12.95 percent which is also significant. This may be due to the increased supply of irrigation thereby converting or utilizing waste land or non-arable land to arable land areas. These changes have been taken place in the valley area only where assured and possibility of partial irrigation exist. However, the effort to convert the *jhum* areas to permanent cultivation are not marked upto the significant level. It may be due to the lack of awareness, traditional bound system, poor institutional support and lack of suitable technology in the hilly region. These areas and point is to be discussed further more.

On the other hand, the area under horticulture has been increased visibly with orchard/ fruit crops comprising of banana, pineapple and tree bean plantation in the tribal inhabited areas which is found to be 246.36 percent change and is highly significant. Also the area under afforestation which was 8.5 ha before the project has been significantly increases to 21.09 ha and the percentage change of 148.11 has been marked. The reasons behind the increase in the area of fruit plantation and afforestation are the willingness of the farmers to work more for better income generation and their positive attitude towards the environment i.e., towards sustainability.

Further, the number of fish pond/ aqua-culture has been increased from 0.75 ha to 1.07 ha showing 42.34 percent changes. Interestingly, the significant increased in the number of such pond is benefitted mainly to the valley region but not to the hilly region. It is due to the non-availability of the water in the dugged ponds and also lack of technology on fish production. Due to these, the investment made on aqua-culture/ fish pond in the hilly region is in vain which must be taken into consideration of the policy makers.

Over and above, the current fallow or the natural forest areas in the hilly region have been reduced from 242.43 ha to 196.0 ha with a percentage change of 19.10 and is found significant. It is attributed to the use of more land from private or village chief in the implementation of the project. This used land area has been under different components of the Sagolkhong Watershed Development Project such as forest plantation, natural regeneration etc. in the valley region, the wet land area has been increased from 48.25 ha to 54.50 ha as partial irrigated area after the project. This may be due to the increased in irrigation and utilization of wasteland to the arable land.

3. Changes in the Resource - Use Pattern

Resource-use pattern of the study area revealed that the per hectare use of seed which was found to be 330/-before the project has marginally increased to Rs. 343/-after the project with a percentage change of 3.4 only. Also, the different level of manure and fertilizer use has been slightly increased from Rs. 2133/- to Rs. 2400/- during the two study period accounting for 12.5 percent change. This is due to the fact that farmers have aware that without the application of manure and fertilizers, it is very difficult to increase the yield of their growing crops. With these, the productivity of such crops has increased. However, the application of the manures and fertilizers are not marked upto the recommended doses. If use, the yield of all the crops can be boost-up provided there is timely availability of irrigation water.

Table No 3: Changes in Average Resource-Use Pattern of Main Enterprises in the Sample Households (per hectare)

Particulars	**BP** (Rs.)	**AP** (Rs.)	**Percentage Change**
Seed	330(1.79)	343(1.82)	3.4 (NS)
Manures & Fertilizers	2133 (11.57)	2400 (12.64)	12.5**
Plant Protection Chemicals	100 (0.54)	100 (0.54)	-
Labours	15860 (86.10)	16200 (85.02)	2.1 (NS)

Figures inside the parentheses indicate percentage contribution
*** = 5% level of significance* *BP = Before project*
AP = After project *NS = Non-significant*

But the attitude of the farmers towards the use of plant protection and management practices do not show any significant result. The reason may be their traditional bound agricultural system and the health aspects too. Over and above, these enterprises are considered to be the most labour intensive. The use of per hectare amount of labour reveals that there is a marginal increased from Rs. 15860/- to 16200/- respectively during the pre- and post period of the project with only 2.1 *perent* change. The reason may be due to the existing land

features and cropping pattern of the area and the lack of proper transport and communication system prevailing in the watershed area.

4. Changes in Cropping Pattern

The cropping pattern of the Sagolkhong Watershed Project shows that the cropping pattern is distributed over irrigated and rainfed area. Due to the increased in irrigated area from 48.25 ha to 54.5 ha, mainly during the *kharif* paddy occupies 100 percent of the available area which is significant in per cent changes. The reason for non-adoption of the other crops may be due to the lack of technical know-how, high risk in marketing and un-awareness of the farmers in the dynamic environment. Also, the traditional system of rice-based consumption can also be one of the factors.

Table No 4: Changes in Cropping Pattern of Sample Farm (Area in hectare)

A. Irrigated Area	**BP**	**AP**	**Percentage change**
i. Kharif			
Wetland Paddy	48.25	54.50	12.95**
ii. Rabi/ Zaid			
Potato	0.01	6.00	5900**
Rapeseed	4.50	9.25	105.60**
Sub-total	4.51	15.25	238.90
Gross Cropped Area	52.75	69.75	32.22**
Cropping Intensity	109.32	127.98	17.06**
B. Rainfed Area			
i. Kharif			
Upland Paddy	9.25	3.50	-62.16**
Maize	1.03	1.78	72.83 (NS)
Soybean	0.47	1.32	180.85 (NS)
Colocasia	1.81	4.13	128.17**
Turmeric	0.80	1.86	132.50 (NS)
Ginger	1.54	3.68	138.96***
Jhum Paddy	55.50	58.50	5.40 (NS)
Chilli	1.02	1.34	31.37 (NS)
Bean	0.68	0.77	13.23 (NS)
Others	0.19	0.26	36.84 (NS)
Sub-total	72.29	77.15	6.72 (NS)
ii. Rabi			
Potato	0.80	1.32	65.00 (NS)
Cabbage & Cauliflower	0.75	1.03	37.30 (NS)
Pea & Broad-bean	0.50	0.86	70.00 (NS)
Mustard	0.46	0.68	47.82 (NS)
Sub-total	2.51	3.88	54.58 (NS)
Gross Cropped Area	74.80	81.03	8.32 (NS)
Cropping Intensity	103.47	105.02	1.50 (NS)
Total Gross Cropped Area	**127.55**	**150.78**	**18.21****
Overall Cropping Intensity	**105.81**	**114.53**	**8.24****

*** = 5% level of significance*
**** = 1% level of significance*
BP = Before project
AP = After project
NS = Non-significant

During the *rabi* season, only potato and rapeseed contributed to the crop area of the valley region. More interestingly, potato which was hardly grown on irrigated farms before the project has been introduced to 6 ha of crop area and accounted for 59000 percent which is highly significant. This idea is to intensify the cropping system so as to earn more income and secured vegetable production from the crop. Also, the area under rapeseed, 4.5 ha during the pre-project period has been increased to 9.25 after the project with 105.6 percent change. The reason will be for the income generation and production of oilseed crops. Thus, the gross cropped area during the kharif season is found to be 52.75 ha before the project and 69.75 ha after the project. It shows a significant percentage change of 32.22. Ultimately, the cropping intensity of the area increased from

109.22 to 127.98 with significant percentage change of 17.06 after the project. The increased in the area of potato, mustard and the area of the wet-land paddy is attributed to assure supply of irrigation water during the *rabi* and *kharif* seasons and the intensive extension efforts on the cultivation of these crops.

However, the cropping pattern prevailing in the rainfed areas contributes more in diversification acreage. The crops during the *kharif* include upland paddy*;* maize, soybean, colocasia, turmeric, ginger, *jhum* paddy, chilli, bean and others. Of these, the area under upland paddy has reduced insignificantly after the project. Maize crops which was grown on 1.03 ha before the project has increased to 1.78 ha (72.83 percent change) and is marked significant. Likewise, the area under soybean (0.47ha); colocasia (1.81ha) turmeric (0.8ha); ginger (1.54ha); chilli (1.02ha); beans (0.68ha) and others (0.19ha) have been increased to 1.32ha; 4.13ha; 1.86 ha; 3.68ha;1.34ha;0.77 ha and 0.26ha respectively. But the *jhum paddy* occupied 55.5ha to 58.5ha during the pre and post project cannot account for the significant changes. The reason behind may be due to the non-availability of flat lands and irrigation water and lack of suitable technology; land tenureship system and low socio-economic status of the farmers couple with low rate of literacy. Then, the sub-total of the cropped area during the *kharif* season has increased from 72.29ha before the project to 77.15 ha after the project.

During the *rabi* season, the crop area under potato (0.8ha); cabbage & cauliflower (0.75ha) peas and beans (0.5ha) and mustard (0.46ha) has increased to 1.32; 1.03; 0.85 and 0.68 with a significant percent changes of 65; 37.30; 70.0 and 47.82 during the pre- and post period respectively. Thus the sub-total of the crop area and rainfed area during the *rabi* season increased from 2.51 ha to 3.88 ha with a significant change of 54.38 after the project. Consequently, the gross cropped area has increased to 81.03 from 74.8 ha respectively after and before the project. Also, the cropping intensity has marginally increased from 103.47 to 105.02 during the pre and post period of the project.

So, the overall gross cropped area from both the irrigated and rainfed area before and after the project are found to be 127.55 ha and 150.78 ha respectively with a significant percentage change of 18.21. Thus, the overall cropping intensity of the sagolkhong watershed project area is marginally increased from 105.81 to 114.83 during the *pre-* and *post-* period of the project.

5. Changes in Technological Adoption

The level of technological adoption refers to the extent of the use of recommended package of agricultural practices on the farms. The category of the farmers; level of adoption; number of farmers and percentage changes were analyzed and classified into *very low adopters; medium adopters and relatively high adopters* with the adoption level of below 10 percent; 10 to 20 percent; 20 to 30 percent and 30 to 40 percent respectively. The percentage change of the number of farmers on the adoption level shows that most of the sample households did not change much from their original status. Based on the adoption indices of the sample farmers, it is found that the number of farmer with very low adoption level don't change much from before and is still 15 percent of the total population. The reason for low adoption may be due to the marginality and landless nature couple with low income and illiterate. In addition, most of the farmers in the hilly regions are neither the owner nor they cannot use the land when required. The overall power and authority lies in the hand of village chief who is the actual owner of the whole village land in the hill.

Table No 5: Changes in the Technical Adoption of Sample Farm Households

Farmers Categories	**Adoption levels**	**No. of Farmers**		
		Percentage Change		
		BP	**AP**	
Very Low Adopters	< 10%	15	15	-
Low Adopters	(10-20)%	62	61	1.61 (NS)
Medium Adopters	(20-30)%	21	9	(-) 57.14**
Relatively High Adopters	(30-40)%	2	15	650**

*** = 5% level of significance*

BP = Before project

AP = After project *NS = Non-significant*

Also the number of low adopter groups does not change from before the project i.e., 62 to 61 respectively before and after the project. The percentage change of the low adopters is still 1.61. Although these groups form the majority of the farmers in the watershed, their benefits from adoption of the new technology do not change much from before. These farmers comprises of marginal and mostly the small farmers with very low income groups, low literacy and large family size. 50 percent of them face the problems of absence of land use rights being faced by the very low adopters. They are helpless to adopt the new technology in spite of being

aware of the package of practices, there land holding nature still form as a major constraint. 50 *percent* of farmers in the valley area remain idle due to the non-availability of irrigation water and lack of credit policy.
But 21 percent of the farmers with 20 to 30 percent adoption level have benefitted the most. Their number decreased from 21 to 9 as recorded from before and after the project period. This category mainly comprises of farmers with relatively larger land holding size generating some level of income with near and dear one, loyal to the chief, higher literacy rate and medium aged farmers. The reason in decreased of their numbers is due to the divergence of their adoption level from medium to the higher adoption level. Interestingly the number of farmers in the relatively high level i.e., 30 to 40 percent has been increased from 2 to 15 (65 percent). They are marked by high literacy rate, high income groups, large land holding, near and dear one or loyal to the chief particularly in the hilly areas and progressive farmers in the valley area wherein the possibility of every new package of practices are digested and adopted. Thus, the impact of the Sagolkhong watershed project to the farmers of the areas towards the new technology is benefitted mostly to the medium and high income group which is to be addressed.

6. Changes in Productivity of the Principle Crops of the Farm Households

The analysis of the various principle crops grown and their productivities during the two study periods i.e. Before and After the project shows that most of the crops do not change much. Even after the project where stress had been given for intensifying the agricultural practices with the use of improved and HYVs of seeds, the yield of all the crops are not marked upto the significant level. This is due to the existing topography and other physical constraints and also the irrigation facility is not available throughout the year.

Table No 6: Changes in the productivity of Principle Crops of the Sample Households in the Watershed Area (in tons/ha)

Crops	**Productivity**		
	BP	**AP**	**Percentage Change**
Irrigated Paddy	2.80	3.10	10.70**
Jhum Paddy	1.50	1.70	14.00 (NS)
Maize (Jhum)	2.68	2.71	1.12 (NS)
Soybean	0.80	0.80	-
Colocasia	12.50	14.50	16.00 **
Turmeric	4.50	5.20	6.70 (NS)
Ginger	8.50	9.10	7.05 (NS)
Potato	8.50	9.50	11.76 (NS)
Mustard & rapeseed	0.80	1.10	37.50**
Chilli	5.30	5.70	7.54 (NS)
Banana	7.80	7.50	- 3.84 (NS)
Pineapple	-	6.40	640.00***

*** = 5% level of significance*
**** = 1% level of significance*
BP = Before project
AP = After project
NS = Non-significant

However, crops grown during the kharif season with the application of little or more manures and fertilizers have slightly changed in their productivity levels. But those crops grown during the rabi season are still facing water constraints. Thus, irrigated paddy; jhum paddy, maize (jhum); soybean; colocasia; turmeric; ginger; potato; mustard and rapeseed; chilli and banana have change their productivity level from 2.8; 1.5; 2.68; 8.0; 12.5; 4.5; 8.5; 8.5; 8.0; 15.30 and 7.8 to 3.1; 1.7; 2.71; 8.0; 14.50; 5.2; 9.10; 9.50; 1.10; 5.7; 7.5; and 6.4 tonnes respectively during the pre- and post period of the study. Of these, rapeseed and colocasia account for higher productivity with a per cent change of 37.5 and 16 respectively. The yield of the ginger crop also increases from 8.5 tons to 9.1 tons. The yield of banana plants has decreased due to the incidence of various disease and pest problems. However, fruit crop like pineapple which were grown before the project occupies some pockets in the hilly areas yielded 6.4 tons/ha. Also tuber crop like potato which was grown in the less area has been expanded to more areas in the irrigated farms has slightly increased to 11.76.

VI. POLICY IMPLICATIONS:

With excellent planning and formulation of the objective through proper methodology, the faith of the project will be in dilemma without the actual owners. Indeed, there should be an actual owner of the project whom it will manage even after the project period. So, the formation of the SHGs with membership equity will ensure it. But even after the formations of Self Help Groups (SHGs), sagolkhong watershed development project remain an orphan like deities. This is due to the fact that the SHGs so-form is now functionless. In fact, effective

SHGs with membership's equity must be formed both during the project implementing period and post project period with sufficient funds in their account.

Sometimes watershed area is composed of both homogeneous and heterogeneous community. When such features happen to co-exist, the success of effective implementation of the project is less because there are lots of communities having differences in their ideology. So, watershed project must be developed separately for homogeneous and heterogeneous community.

Watershed development project is doing for sustainability. In other words, they work for poverty elevation and eco-restoration for future generation. If it is blindly done, without the consent and knowledge of the people residing in the watershed area, the whole investment will be unproductive. So, in order to get the better return from each project, greater emphasis should be made to develop the human resources of the people in the watershed area which will be the key factor in the whole project. Thus, a sound watershed management education is necessary as abroad-base-line treatment.

VII. CONCLUSION:

Implementation of watershed project in the hill and plain areas has resulted in the change in land-use; resource-use; cropping patterns of the farm families which in turns leads to the change in the technological adoption and productivity of the crops grown in the watershed areas. Ultimately, the cropping intensity also increases from before after the implementations of the various inputs for development of watershed areas. Watershed project must be developed separately for homogeneous and heterogeneous community. In fact, effective Self-Help Groups with membership's equity must be form both during the project implementing period and post-project period with sufficient fund in their common account.

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