Sustainable Small Scale Irrigation Experiment in the Dry Zones: A Case Study on Happa (Small Tank) Model in the State of West Bengal, India.

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January 2011

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Presented in

APN Conference on " Innovation and Sustainability Transitions in Asia", at University of Malaya, Malaysia, during 9-11 January 2011

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Abstract:

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Indian economy is still an agrarian economy more than 50% of people in India are still dependent on agriculture for their livelihood. Rainfed areas without any source of irrigation in the country still accounts for 60% of the cultivated area and these areas are home to majority of rural poor and marginal farmers. Food security of small and marginal farmers in these regions are greatly jeopardized by the lack of assured irrigation. In this backdrop, there is an urgent need to explore the possibilities of sustainable and innovative forms of irrigation. One such innovative experiment is *happa* experiment which is viewed as Integrated Natural Resource Management(INRM) emphasizing both water and soil management. A *happa* is a mud-excavated small water harvesting structure with the average size of 50ft× 45ft×12 ft. The programme is going on in some dry zones where the happa is being excavated in the private land of the farmer wherefrom the farmer can irrigate his own agricultural land with average command area of happa being 0.6 – 0.75 acres. The construction cost one happa is being funded from NREGS scheme, the flagship programme of Government of India for employment generation. After the construction of *happa*, it is managed by the farmer himself and all the operational expenditure is being incurred by the farmer for mainataining these. This model has got success in some dry zones.

We have selected a village for our primary survey of households in the Bankura district which is located dry zone of West Bengal. There is specific geographical concentration of backwardness and poverty in these areas and these regions are affected by continuous degradation of natural resources. The main objectives of the study are as follows: (1) To judge the economic viability of the project using standard cost benefit analysis tools like NPV, BCR and IRR. (ii) Assessment of ecological and social impacts of the project, (iii) Identifying of different kinds of benefits accrued from the project, (iv) scope of upscaling of the project with the identification of problem areas in upscaling

Our analysis reveals that the small irrigation program like *happa* has made a strong impact on the livelihood of rural people. The environmental impacts include soil and moisture conservation of the watershed area. The economic benefits include incremental production from paddy production and vegetable production through irrigation. The success and upscaling of the programme depends very much on the system of planning, application, execution, monitoring and fund-flow.

Sustainable Small Scale Irrigation Experiment in the Dry Zones: A Case Study on *Happa* Model in the State of West Bengal, India.

1. Introduction:

Indian economy even after 60 years of independence is still an agrarian economy. Though the share of agriculture in GDP is about 20%, more than 50% of people in India are still dependent on agriculture for their livelihood. India at present faces a daunting challenge to provide food security to the burgeoning population. Rain fed areas in the country still accounts for 60% of the cultivated area and these areas are home to majority of rural poor and marginal farmers. Repeated draughts and erratic rainfall have severally affected the livelihood of rural people particularly those living in the dry zones where the irrigation facility is poor. It is found that in most states households with access to irrigation have only about half the poverty incidence compared to the households without irrigated land. The effect of irrigation facility even among the tribal households is worth mentioning (Roy 2006).

Irrigation in India is divided into 4 categories – canal irrigation, river lift irrigation, tube well irrigation and tank (water harvesting structure) irrigation. On the basis of cultivable command area (CCA) irrigation is divided into 3 categories in India – major (CCA above 10,000 hector) medium (CCA between 2000 and 10,000 hector) and minor (below 2000 hector). After the planning process started in India in 1951, initially there was emphasis on major irrigation in the form of construction of dams and barrages. After that India has increasingly depended on groundwater for irrigation. Groundwater presently provides 60% of net irrigated area in India. On the other hand, the area irrigated by tanks has fallen from 18% in 1950s to only about 4% presently. The proportion of critical districts for overexploitation of groundwater has increased from 9% to 31% during the period of 1995 -2004 (GOI 2010). The Fourth Assessment Report of IPCC has projected a rise in temperature in Indian region by 0.5^{0}C to 1.2 ^{0}C by 2020 which may affect agricultural production. The irrigation sector will also likely be strongly affected by climate change for the predicted increased variability in precipitation (Palansami 2010). In this backdrop, there is an urgent need to explore the possibilities of sustainable forms of irrigation. Sustainable irrigation may be promoted through the construction/renovation of tanks, check dams etc. Importance of tank irrigation has well documented in literature (Chandrasekaran et al 2009, Sivasubramaniyan 2006, Shah 2003, Narayanmoorthy and Deshpande 2005). Participatory Irrigation Management and Rehabilitation of tanks came as a strategy in India from 1995 onwards. The case for sustainable irrigation was strengthened with the introduction of NREGS (National Rural Employment Guarantee Scheme) in India in the year 2005. NREGS is a government flagship programme which aims at enhancing livelihood security by providing al least 100 days guaranteed employment in a financial year to every household whose adult members volunteer to do unskilled manual work. The NREGS works include water conservation and water harvesting; renovation of traditional water bodies etc which if effectively implemented will promote sustainable irrigation. For the effective intervention for rural poverty alleviation through enhancing agricultural income, INRM (Integrated Natural Resource Management) planning is very much essential which includes formation of village level association, baseline data collection, resource mapping, ownership mapping etc. The main component of INRM strategy includes the following : Harvesting rainwater water and using it judiciously, soil conservation, meeting livelihoods needs of people with planting trees, grow crops, rearing animals and transferring resources to the next generation safe and enriched.

2. Small Irrigation Technology: *Happa*

Water is a central issue for development in the rain-fed dry zones. The rainwater-harvesting tank can play a very vital role in conservation of water resource. The problem with large tank irrigation structures in India is that these are not well managed. The experiment with the formation of water users' association is not satisfactory at all in the state (Jana 2008). Some innovative experiments are going on in different parts of India in the irrigation sector. One such experiment in West Bengal *happa* where a small tank called is being excavated in the private land of the farmer wherefrom the farmer can irrigate his own agricultural land and the tank is managed by the farmer himself. A *happa* is a mud-excavated rain water harvesting structure and does not have any cement work or stone revetment. The sides of a *happa* are stepped with slope of 1:1 such that both livestock and human can access the water of *happa* easily. A *happa* is constructed by the side of agricultural field of a farmer with average length of 45 ft, breadth of 50 ft and depth of 12 ft. The total earth extraction of this *happa* is 17,360 cubic feet which requires 299 mandays. With existing NREGS wage rate of Rs. 100/day the average construction cost with the above specifications is about Rs. 29,900. The average command area of a *happa* is about 0.6 acre. The model is also called 5% model because it occupies 5% of the area of agricultural plot of the farmer. The construction cost of the *happa* is presently being financed from NREGS and all the operational expenditure is being incurred by the farmer for maintaining the happa. This model has become successful in some dry zones of West Bengal. It may be mentioned that there are two major cropping seasons in India, namely, Kharif and Rabi. The Kharif season is during the south-west monsoon (July-October). During this season, agricultural activities take place both in rain-fed areas and irrigated areas. The Rabi season is during the winter months (October to June) , when agricultural activities take place only in the irrigated areas. Khariff crop includes Aman paddy, maize, pulses etc. Rabi crop includes wheat, barley, oilseeds etc. Construction of water harvesting structures like *happa* have created a strong impact on their livelihood through generation of additional incomes in some dry areas because of the following reasons: (i) Farmers could provide life saving irrigation to paddy crop during this khariff season, (ii) They could grow vegetables around the bund of *happas* etc. It should be pointed out that in most of the dry zones the cropping intensity is poor. One extra crop will have perceptible impact on their standard of living.

A Happa in Biradihi Village (Primary Survey)

3. Study Area:

Our study area belongs to the Biradihi village in Musiaraha G.P. in Hirbandh block which is situated in the western part of Bankura district, West Bengal. The survey was conducted during 2010. In the district Human Development Report of Bankura, Hirbandh has been ranked last out of 22 blocks in the district of Bankura. About 54% of households in the block live below poverty line. There is specific geographical concentration of backwardness in these regions of the district. Only 30% of the agricultural land is irrigated in the block (Government of West Bengal 2007). The per capita annual food grain availability in the block is 230 kg whereas the requirement is 365 kg. The backwardness can be explained through the lack of access to natural resources like water. The land types in these districts are of three categories: (i) Fallow Uplands (called *Tarh* land): These are at the top of the terrain with very thin topsoil and very low water-holding capacity. (ii) Medium uplands (called *Baid* land): In these types of lands soils are sandy and sandy loam and shallow with low organic matter and low moisture holding capacity. (iii) Low Lands (called *Kanali / Sol* land): These lands are more loamy than baid and are most advantageously located in terms of water availability and these lands get additional water from seepage from upper catchment. In these regions 50% - 60% land is medium upland, 20%-30% is up land and 30% is low land. The water holding capacity of the barren upland is very low. There is high need for irrigation water in tar and *baid* lands as these possess inferior soil and low moisture. Season- wise paddy is classified into three types – Aus, Aman and Boro. Aman is the main paddy here which is grown in the Khariff season. In the state, September is flowering stage of aman paddy. If there is dry spell, then production of paddy in medium upland is badly affected. The moisture conservation of the soil is very important.

As already mentioned we have selected one village namely Biradihi for our primary survey. Area of the village is 289.9 hector with total households 106 and the total population of 600. The land use pattern of the village is as follows: Forest – 115.3 ha, cultivable waste – 54.6 ha, not available for cultivation – 48.7 ha, Irrigated land – 20 ha, unirrigated land – 61.20 ha (GOI 2001). So the major part of the agricultural land is unirrigated. Our selected village is in the baid land ie. medium upland. Agriculture is the main source of income in the village. There is no tube well in the village presently. The only other source of irrigation is *jorh (a water harvesting canal which is a common property of the village).* These regions are hotter compared to other regions in West Bengal. The temperature gradient reaches about 45 ^{o} C in the summer. Though average annual rainfall in the region is about 1400 mm per annum, there is huge run off because of rocky soil and terrain conditions. There is good scope of enhancing irrigation if thus huge run off is systematically tapped.

4. Household Characteristics

We have selected 20 households having *Happa* randomly from our sample village. Out of the 20 households selected our calculation reveals the following characteristics of the households:

i. The average family size of the sample households is calculated as 5.5 and the percentage of male members is 55%.
ii. The average educational class attained by the head of the household is 3.25 and 42% of the aggregate sample members (excluding child) is illiterate.
iii. Caste: 18 households are of scheduled caste (SC) category and 2 households are of Scheduled Tribe (ST) category. So all the households belong to backward castes.
iv. Poverty: 13 households are of BPL (Below Poverty Line) category. Poverty line in India is taken as monthly per capita expenditure of Rs. 356.30 for the rural sector.
v. Occupation pattern: Only two families have members who are employed in the service sector. The average employment generated per family is calculated as 485 mandays including family labour employed for own agricultural land. The average employment patterns are as follows: Agriculture – 74%, non agriculture – 5%, service – 8%, NREGS – 14%.
vi. 19 households possess NREGS job cards. Average employment from NREGS per family per year is 59.
vii. Dependency burden (the percentage of people below the age of 18 years and above 24 years) of the households is calculated as 45%.

viii. Number of households with different assets is as follows: Mobile phone -5, TV – 2, Cow - 13, Pumping machine – 11.

ix. Average landholding per family for different categories of land is presented in table-1. Average agricultural land holding is calculated as 0.88 acres per family of which irrigated land from *happa* is 0.35 acres.

x. Group formation under SGSY scheme is not so good here. Nine households have been reported to belong to Self Help Group.

xi. There is also the problem of rural indebtedness. 15 households have been observed to take loans from money-lenders. The average loan taken per family is calculated as Rs. 7,250.

xii. The average expenditure per month per family has been calculated as Rs. 4377. The percentage of expenditure on major items on an average has been calculated as follows: Rice – 31%, pulse – 4% spices – 14%, fish and meat – 8%, fruit -2%, medicine –13%, education -21%, cloth -6%, others-2%.

xiii. The average water level calculated from the household responses is 39.5 ft in the summer season and in the rainy season it is 8.75 ft.

xiv. Aman paddy is the main crop grown by the households. 16 households have reported that there is Aman crop failure in the current year because of poor rainfall.

xv. 14 households use other sources of irrigation (mainly *jorh*) except happa.

xvi. We have seen that aman paddy in the study area is generally grown during June to November; vegetables are grown during July to November. In other seasons limited amount of potato, wheat and mustard is grown because of the lack of irrigation facility. The average irrigation number for different crops are calculated as follows: Aman paddy : 3-5, Vegetables – 10-15, wheat - 3-4 times.

All the households have given their opinion that water is a great problem in the area and water scarcity is becoming acute in the recent years.

Table1: Average Land Holding per Family for the Sample Households

Land Type	Amount of land holding (acre)
Total Land	1.14
Total Agricultural Land	0.88
Total Non- Agricultural Land	0.26
Total Irrigated Land	0.70
Total Non-Irrigated Land	0.18
Irrigated land from Hapa	0.35
Irrigated land from sources other than happa	0.35

5. Strategy for Implementation

Any livelihood development strategy in the dry zones should focus on water as the central issue. In-situ conservation of soil and water along with checking the surface run-off, harvesting of rainwater on the surface, economizing the use of ground-water, rejuvenation of sub-surface water, livelihoods planning through participatory approach at village/hamlet level (based on micro-watershed level flow) have been considered to be at the core of the strategy. Working together with government departments to strengthen Farming system support services Influencing local governments to invest on Integrated Natural Resource Management (INRM) based livelihood activities for directly addressing poverty is the urgent need for promoting livelihood in these areas. Professional Assistance for Development Action (PRADAN) is an organization (NGO) -promoting livelihood in the backward regions. Under a new initiative by the Planning Commission PRADAN was selected as one of the technical resource agencies to facilitate district level planning in Purulia and Bankura districts of West Bengal. Implementing agency is Block level local body named Panchayat Samiti. PRADAN is acting as Project facilitating agency. PRADAN is working in two fronts – orienting the villagers in water conservation and providing the technical support in implementing the project. PRADAN work very closely with PRI system at Panchayat level. The cost of this support is provided through project management cost as allotted in the project. PRADAN has adopted different strategies for addressing poverty like organising women in Small Self Help Group (SHG), helping them in livelihood planning, enabling them to approach local body, administration and bank for getting fund and loan for implementation of the livelihood programme

As in other places of West Bengal Panchayati Raj Institution (PRI) plays a key developmental role in Bankura also. Panchaayati Raj is a system of governance in which gram panchayats are the basic units of administration. It has 3 levels: village (called Panchayat) , block (Panchayat Samiti.) and district (Zilla Parishad). Gram Samsad (Village Council), consisting of 1-2 villages, is the lowest level where village level plans are made. Elected members from Gram Samsad constitute Gram Panchayat (GP). These elected representatives, called Gram Panchayat members, are accountable for preparation and implementation of Annual Plan for the entire Gram Panchayat area (consisting of 12-15 villages). PRIs have different kinds of funds in the form of NREGS to finance the largely labour intensive activities leading to Integrated Natural Resource Management (INRM). The Village level INRM includes the following steps: (i) social mobilization and vision, (ii) delineation of the ridge line and drainage, (iii) mapping the resource, (iv) mapping the land ownership in each, (v) wealth ranking, (vi) preparing land use map, (vii) problem mapping and generating options for remedial, (viii) Checking whether all families are adequately addressed, (ix) prioritization and action plan preparation, (x) proposal preparation.

As revealed from the primary survey the steps followed are given below:

- Mobilising community and grooming of a pool of local Resource Persons (LRPs) through training on INRM plan and implementation. LRPs are selected by Gram Unnayan Committed.
- LRPs prepare village level INRM plan involving all the households and collect the

application forms for happa.

- LRPs place the plan in the Gram Samsad (GS) meeting/VDC (Village Development Council) and with recommendation of GS/VDC the plan is sent to GP.
- GP issues work order to LRP after getting sanction from block
- LRP supervises the work and prepares the muster roll of the workers and the Payment is made to the workers with the advice of SAE/Nirman Sahayak/GRS

It may be mentioned that in most of the areas self help groups are being involved in implementing the programme. In our study area this is not the case because self help groups are not so strong here.

6. Impacts of the Irrigation Experiment with Happa:

The environmental and economic impacts of Happa in the regions are reported to be very encouraging. Changes in the irrigated area have always positive impact on rural livelihood, particularly in these reasons where the opportunities for alternative livelihood are very little. Below we mention different kinds of benefits accrued from the programme in the study area.

Economic benefits include the following:

- 100 percent households surveyed have reported that the yield and cropping intensity of land has increased because of the construction of happa. Farmers could provide life saving irrigation to paddy crop during this kharif season. This has resulted in the improvement of yield. It has been reported that the yield of Aman paddy has increased from 3.5 tonnes to 4.5 tonnes per acre in poor rainfall year.
- They could grow vegetables around the bund of happas and diversify their cropping pattern. Our analysis reveals that cropping intensity has improved from 93% to 102% for the sample farmers inspite of the draught year.
- There is opportunity of generation of wage employment during the construction of Happa. The average number of persondays generated for construction of one happa is about 300.
- Involvement of local people in the planning and implementation of programme has led to developing more ownership of the programme.
- Out of 20 households surveyed 13 households have done fishery in happa. The annual average fishery income per happa is calculated as Rs. 1,152.
- Land value of land has increased because of the irrigation facility through happa. From the household data we have calculated that the price of the irrigated land is Rs. 1,25,250 per acre and the price of the unirrigated land is Rs. 87,450.
- The *happas* are also meeting the water needs of livestock.

In the following table we have presented the average productivity of different crops for the sample farmers. We see that after construction of *happa*, average productivity has improved for all the crops. This has happened despite the fact that the rainfall is poor compared to the normal this year.

Table 2: Average Productivity (Tonnes/hector): Before and After Construction of Happa

Crops	Before Construction Productivity	After Construction Productivity	Incremental Productivity
Aus Paddy	4.00	4.45	0.44
Aman Paddy	3.58	4.58	1.00
Potato	6.67	7.46	0.79
Wheat	-	2.04	-
Vegetable	6.34	8.46	2.12
Mustard	-	0.86	-

Source: Own Estimation from the Primary Data

We have prepared the following table for the aggregate of 20 farmer households that we have surveyed. In the table 2 we have presented crop-wise increase in gross cropped area after the construction of happa. In West Bengal Paddy is the main production. Paddy is grown in three seasons – Aus, Aman and Boro. As the rainfall was very poor in the surveyed year, paddy production was hampered very much. But the farmers shifted to different types of crops like vegetable (mainly cabbage) with the *happa* water. In table 3 we have presented the crop-wise area before and after construction of *happa*.

Table 3: Cropping Pattern: Before and after construction of *happa* for the aggregate sample households

	Before Construction		**After Construction**		
Crops	**Total Area (Acre)**	**Nos. of Family**	**Total Area (Acre)**	**Nos. of Family**	**Incremental Total Area**
Aus	1.16	04	0.25	02	-0.91
Aman	10.97	13	7.84	08	-3.14
Potato	0.69	06	0.92	07	0.23
Wheat	0.00	00	0.25	02	0.25
Vegetable	3.22	09	8.31	19	5.09
Mustard	0.00	00	0.63	03	0.63
Others	0.33	01	0.00	00	-0.33
Total	16.37		18.19		1.82

Source: Estimation Based on Primary Survey

Ecological benefits:

As we have already stated the sample happas have been constructed within 2009 and 2010. So the full impacts of ecological benefits are yet to be suggested. The soil and moisture conservation of the watershed area has improved in the village. Because of the enhanced moisture retention microbial activities and biomass deposition have increased. As a result local micro environment has improved. 80 % of the households surveyed have given their opinion that construction of happa has checked soil erosion and run-off. A major share of the households (70%) has opined improvement in land quality has improved. According to the villagers the colour of the soil has changed from red to yellowish and the soil has become more loamy. More herbs and shrubs are now found than before. 25% households have said that water table has improved. All the households are also in favour of NGO involvement in water management.

Social Benefits:

Households use water from *happa* for different purposes like bathing, washing clothes, cleaning of utensils. Before the construction of *happa* 45 households had to use only one dug well and one tube well for the purpose of bathing and drinking water. The tube-well is not operating recently. The distress migration in search of work has also been checked. In our survey results we see that number of migration for the sample households has fallen from 21persons to 15 persons. The process of *happa* construction has also lead to institutional development in terms of greater participation of poor and marginalized farmers, improvement in the relationship between different stakeholders like the farmers, traditional institutions like Panchayat and bureaucracy like block-level authorities.

7. Economic Viability of Happa: Cost Benefit Analysis

The purpose of this analysis is to have an idea about economic viability of *happa* for our sample which belongs to draught prone region. For this purpose, we have compared the costs of constructing *happa* and annual maintenance costs with the annual benefits generated from Happa. As we have already mentioned we have selected 20 *happas* for this analysis. The programme like this obviously generates social and environmental benefits other than economic benefits. We have avoided environmental and social benefits because of the complexity of estimation of these types of benefits. Here we have concentrated only on economic benefits in terms of incremental income from crop production. If the environmental and social benefits are added to the economic benefits, the incremental benefits would be much higher. For the long run viability of the programme we have to see whether the programme generates enough benefits to outweigh costs.

The construction cost of *Happa* is incurred for one time only. Annual costs of tank restoration are assumed to be Rs. 500/- per year for the analysis. The incremental returns have been calculated by net profit from increased production from happa. The main crops grown in the command are paddy and vegetables. We have calculated Net Present Value (NPV), Benefit Cost Ratio (BCR) and the Internal Rate of Return(IRR) for CBA using the standard cost benefit analysis technique (Reddy 2009). We have assumed that lifetime of the *happa* as 10 years and the discount rate as 15% which is taken as the long term lending rate. All the 20 *happas* in our sample have been constructed within the period 2008 and 2010. The year-wise numbers of *happa*s constructed are as follows: 2008 -1, 2009- - 24 and 2010- 1. For our sample the average length of the *happa* is

52 ft with maximum 60 ft and minimum 40ft, the average width of the *happa* is 36 ft with maximum 50 ft and minimum 30ft and the average depth of the happa is 11 ft with maximum 12 ft and minimum 10ft. The average construction cost of the *happa* is Rs. 25, 260 with the maximum being Rs. 33,600 and the minimum being Rs. 9,400. The average incremental profit per *happa* has been calculated as Rs. 11,241. Cost benefit analysis results are presented in the table 4. We have prepared this table by averaging data of the 20 sample happas under our consideration. The results reveal hat there is much economic justification for the construction of *happa*. Present Value of benefits of the incremental returns assumed to be accrued for the future 10 years is calculated as Rs. 64,682 and the Net Present Value (NPV) is calculated as Rs. 37,036. The Internal Rate of Return (IRR) is about 75.7% which is much higher than the market rate of interest.

Table 4: Cost Benefit Analysis Results for a *happa*

	Value (Rs.)
Present Value of Benefit	64,682
Present Value of Cost	27,646
Net Present value	37,036
Benefit Cost Ratio	2.3
IRR	75.71

Source: Own Estimation from the Primary Survey Data

The performance of happa depends very much on the rainfall. The current year in which we have done our survey has been declared as a drought in the district – the annual rainfall has been only 600 mm where the normal is about 1400 mm. The programme would have been more justified if the normal was normal. Though this analysis has been done for 20 households, the results will not differ very much if we include more households.

8. Scaling Up:

Scaling up means enhanced geographical cover. It could also be interpreted as the expansion of number of beneficiaries. Enhanced human resource development at local level is the key input of the viability and the scaling up of technology. The programme has strong potential as judged by sustainability indicators for the farmers like increasing market access, employment opportunites and more control over water resource. Farmers' beliefs and practices can be changed if a campaign is systematically planned and implemented. The key ingredient in participatory research is listening and understanding each other among the stakeholders. As most of the agricultural area is single cropped, there is huge scope of scaling up and out of this experiment in this area. As the reports come, there is huge demand for *happa* in these regions. Initially the farmers' interest were very low. But the success of the some *happas* has acted as impetus to other farmers to have *happa*. In fact some households have constructed more than one happa – in our sample 20 households have constructed 26 *happa*s in total. Presently the happa programme is going on in 3 G.P.s out of 5 G.P.s in Hirbandh block and the progrmme had started from 2008. In Hirbandh block the year wise numbers of *happas* constructed are as follows: 2008-09: 40, 2009-10: 950 and 2010-11: 1200. It has been reported that about 2,000 *happa*s can be constructed in a single G.P. It has been revealed in the survey that some people prefer *Indara* (dug well) to happa. But on sustainability ground it is less preferred because it is based on ground water instead of surface water harvesting. Also the cost of indara is high – with the same cost of one indara construction, 3 families could be provided with one *happa* each. The major hindrances of upscaling the programme in these regions are as follows: (i) Lack of awareness about the scheme (ii) Lack of efficient system to invest mainstream government fund for land husbandry and (iii) lack of political will.

10. Conclusion:

The small irrigation program like *happa* has strong impact on the livelihood security of the rural people. It has improved the productivity, intensity and diversity of crops. The diversification of production of farmers from a single khariff crop of paddy into other crops like vegetable production and fishery has reduced their vulnerability to climate shock they faced earlier before the construction of *happa*. The success and up scaling of the programme depends very much on the system of planning, application, execution, monitoring and fund-flow. As we have noted from the field survey, there should be more emphasis on crop diversification. Paddy cultivation is more risky compared to crops like maize and vegetables because in case of low rainfall paddy crop may suffer heavily. Our survey results reveal that 100% households have given their opinion that they fail to utilize the land because of the lack of water. There is huge demand for irrigation facility in these areas. Government should take more pro-active role in upscaling the experiment according to the needs. To make it success technological interventions are required in terms of new production techniques like SRI cultivation and new irrigation techniques like drip and sprinkler irrigation techniques for conserving water and also organic faring method. It must be pointed out that average annual rainfall in the district of Bankura, West Bengal is about 1400 mm. So, there is huge scope of enhancing irrigation if the run off water is systematically and properly tapped. Another big advantage of this model is that number of beneficiaries per unit expenditure spent is much higher in *happa* than the bigger irrigation model. As the *happa* is private property of the individual farmer, farmers have the incentive to maintain the structure and being low cost it is also affordable to them. The strong feature of the *happa* model is that it is both replicable and sustainable. There is enough scope of uplifting of the livelihood of the marginalized sections of the rural community through this programme. More innovations are required how this programme can be integrated with other watershed activities so that water can be more efficiently utilized.

Also there is a need to think how small farmers and farmers with scattered land and also landless farmers can avail the benefits of the progrmme. There is also high need of the political will to support the programme by creating awareness of the programme and also involving more women in the decision making process. There should be more emphasis on capacity building at the local level and the development of institutional arrangement. The success and upscaling of the programme depends very much on the system of planning, application, execution, monitoring and fund-flow.

Acknowledgement: I am grateful to Mr. Amit Das, Mr.Rajesh Mit and Mr. Prasenjit Mondal in various stages of the work.

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