

Women Agripreneurs Effort for Development of Minor Irrigation Structure: A Study in Single Crop Drought Area to Boost Farming Activities

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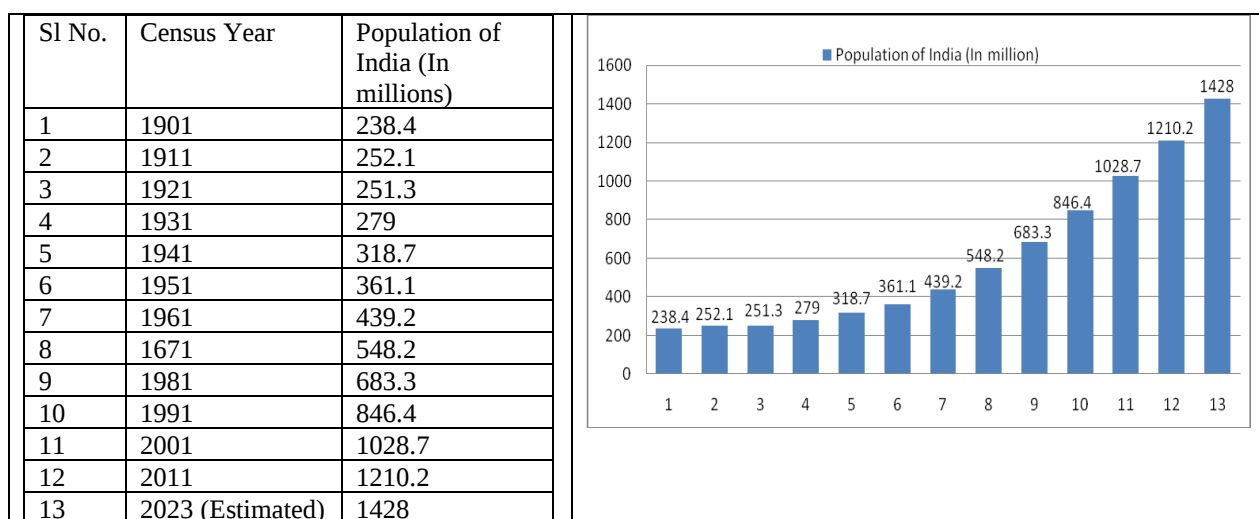
Abstract:

In a rain fed or single crop drought area where only Kharif crop are not assured at that place by the help of villagers as well as Women Agripreneurs the minor irrigation system developed by observing its benefit cost ratio in all respect. Because in this area the Women Agripreneurs are now thinking for alternative livelihood and it is very crucial situation for this crowded country like India. Now on the basis of the need of the farmers and considering hydro-geological features surface water based irrigation structure developed in rapid way by demarcating the relevant catchment area and command area for cultivation in Rabi & Pre-kharif season. Command Area based Women Agripreneurs Institution developed in each structure for operation, maintenance and to assure Agriculture Support Services from Government Departments. The agriculture and horticulture produce is collectively bring directly from field to market with the help of women agripreneur to get more profit and to know the customer taste. This mixed method study may show a ray of hope in Rain fed or Single cropped drought area related to how to utilizing natural resources in a sustainable comprehensive way for socio-economic development of the country.

Key Words: Rain fed or single crop drought Area, Geo-hydrological Unit, Farmers Institution, Management, Agripreneurship, Women Empowerment, Sustainability, Socio-economic Development

Introduction:

The main livelihood of the rural people is Agriculture which is continued as familial tradition. Naturally in India, Agriculture plays a vital role for socio-economic upliftment of the society and reduces poverty. Agriculture makes up approximately 18-19% of India's GDP at present. The most recent data from 2022-23 indicates that agriculture and allied sectors account for 18.3% of the total Gross Value Added (GVA) in the Indian economy. Starting from 1901 when the population was 238.4 million and in 2023 the total population is 1428.0 million. So population is growing rapidly and the agriculture land decreases day by day for multipurpose reason. To manage this situation and to utilize the women population, women based Agripreneurship development is essential for sustainable development of the country.



The main occupation in West Bengal is farming. Covering just 2.7% of India's land mass, it sustains around 8% of its people. Out of the total 71.23 lakh farm families, 96% are classified as small and marginal farmers. The mean land holding size is just 0.77 hectares. Nevertheless, the State benefits from a variety of natural resources and different agro-climatic conditions that allow for the growth of a wide variety of crops.. The most recent census of West Bengal took

place in 2011, and the upcoming census for 2021 has been delayed until 2024. The population is currently estimated to be around 10.42 Crores. As per 2011 census 72.03% of rural population lives in villages and total 48.69% population are female. So, it is clear that growth of West Bengal is lying in the development of villages and it is possible only when maximum females take part in the development process attentively.

The minor irrigation system i.e. development of Check Dam, Surface Flow Irrigation, Hybrid Pump Dug Well, Water Harvesting Tank etc. can irrigate the rain fed or single crop drought area where only Kharif crop are partially assured and in Rabi and Pre-kharif season where crop are not assured. As a result the huge amount of runoff water in time of rainy season can be tapped and may be utilized at the end of the Kharif, fully in Rabi and Pre-kharif season. Now if it is fully managed by the women member of farmer's family by forming institution then the comprehensive development in respect of irrigation, agriculture, horticulture, and fishery will be possible.

Literature review:

Very limited studies have been conducted in this sector in recent years. Mostly secondary data base are extended help for showing example. A advanced concept on "Hydrology project crucial for India - A initiatives by Ministry of Water Resources , Government of India, supported by World Bank Project is very much helpful and it can be accessed from website : <http://hydrology-project.gov.in>. The State of the World's Land and Water Resources for Food and Agriculture - Managing systems at risk published by "The Food and Agriculture Organization of the United Nations and Earth scan". This book deals primarily with the issue of land and water for crops related with production in light of demand. Shoji Lal Bairwa , Kerobim Lakra, S. Kushwaha , L. K. Meena and Pravin Kumar (2014) carried out a study carried out a study on "Agripreneurship Development as a Tool to Up liftmen of Agriculture" (www.ijsrp.org) . Garima Mishra, Dr. U. V. Kiran (2014) carried out a study on "Rural Women Entrepreneurs: Concerns & Importance" (www.ijsr.net). Here the author highlighted the necessity of rural women's economic and social development for overall economic development of society and nation.

Different Government programme running for more or less same purpose as are follows i.e. Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) under Ministry of Agriculture and Farmers Welfare Deptt. of Agri., Coopn. & Farmers Welfare, Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGA), Integrated Watershed Management Programme (IWMP), Jal Kranti Abhiyan (JKA), West Bengal Accelerated Development of Minor Irrigation Project (WBADMIP) . The entire above mentioned project untidily is also given a ray of hope of Agricultural Development.

On the other hand a lot of current research on women's empowerment delves into how it enhances various development results, like boosting agricultural productivity (Seymour, 2017), expanding production diversity (De Pinto et al., 2020), and enhancing food security and nutrition (Malapit and Quisumbing, 2015; Kassie et al., 2020). The literature on women's empowerment has mainly centered on Kabeer's (1999) definition, which views empowerment as an intricate process of transformation. This involves women gaining resources and taking action to enhance their well-being and achieve other successes. The concept of women's empowerment is multifaceted and intricate, with certain aspects being more quantifiable and visible, such as objective outcomes and achievements, while other aspects like agency are harder to measure due to their subjective nature. Additionally, official data regarding the scope of current private small-scale irrigation coverage and the prevalence of small-scale irrigation pumps nationwide is limited.

In regions with erratic rainfall and resources not fully utilized, irrigation systems are crucial for increasing productivity and decreasing susceptibility to climatic fluctuations (Awulachew et al., 2006). Using advanced irrigation technology helps farmers adapt and increase their ability to withstand challenges. It also encourages the use of modern resources, enables year-round harvesting, and provides employment for household members (Ayele, 2011; Hagos et al., 2009; Namara et al., 2005).

Insufficient precipitation like rain or snow leads to a drought, causing limited water availability, dry soil, and damage to crops. The start and finish of droughts are unpredictable, but long-lasting ones greatly impact water and food availability, and can lead to forced migration. A prolonged lack of rainfall causes drought, resulting in a significant water scarcity in the area. Water loss from the soil persists through evaporation and transpiration. If there is any rainfall or if the amount of rainfall is minimal for an extended period, the soil will become dry because the lost water is not replenished. Drought is a hazardous situation that reduces the quality of life. It is classified as a catastrophe with damaging consequences. A drought is typically the result of a lack of water in a specific area. This is primarily a result of decreased precipitation. Furthermore, droughts have been found to be deadly for both humans and animals.

Research Objectives:

The main objective to study the Rain fed or Single Crop Drought Area and probability of Irrigation structure to increase agriculture production along with to study the role of Farmer's / Woman's community based Institution to manage irrigation structure in Rural Bengal for agripreneurship sustainable development.

Research Methodology:

This problem solving research conducted on the basis of primary and secondary data. The maximum focus was given on literature review, Government Plans, Programmes, reports & case study of successful irrigation structure already developed. This is a mixed method study. An interview process also conducted to acquire the information needed for the improvement of socio economic and agriculture status of the farmers as well as women Agripreneurs. Only one rain fed drought Bankura district of West Bengal (India) is selected for collection of data and realization of the problem. An example is given based on Bhaktabandh Mouza under Gangajalghati Block.

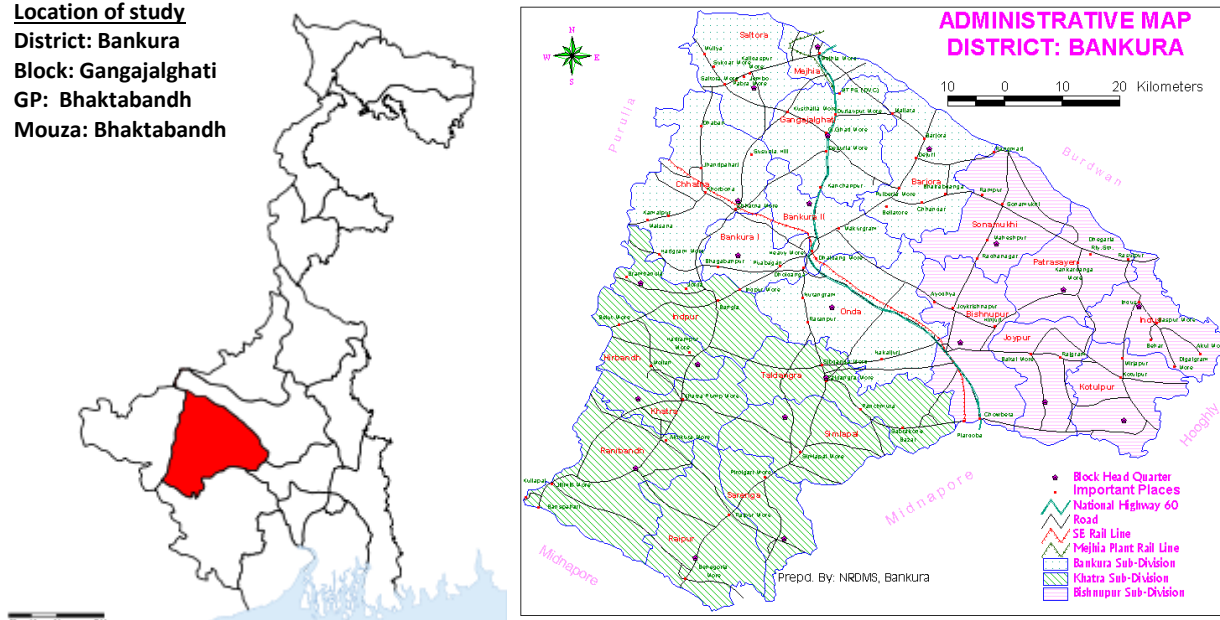
Importance of development of Micro Irrigation Structure:

West Bengal, locating on India's east coast, comprises 3% of India's land mass and 08% of the population taking population density above 900/sq. KM, being the highest in India. Irrigation infrastructure should necessarily be developed to reduce risks of climate and the full potential of agricultural sector in the country, taking West Bengal also. The majority of the population in West Bengal resides in rural areas depending on agriculture or other allied activities for their livelihood. So far available information is concerned, above 25% of population in the state lives below the poverty line. These people mostly belong to the rural agricultural sector. The major obstacles to their poverty alleviation are small land-holdings and rainfall uncertainties inclusive of periodic occurrence like dry spells, heavy cyclones and floods. During the non-monsoon season, agriculture is not possible without irrigation facilities. Average productivity is low in West Bengal comparing to that of advance agricultural states in the country. Enhancement of productivity is possible only when timely supply of "all inputs and adequate irrigation water" can be assured. Absence of assured irrigation supply inhibits use of improved seeds, fertilizers and other inputs which finally affects productivity levels. The water resource of West Bengal is relatively is good. The Ganga, the Brahmaputra, the Subarnarekha account for annual usable surface water of 58.8 billion cubic meter of surface water. Since the state has created little storage and potential to create major storage is limited, use of surface water is low. The state is relatively better comparing to other Indian states in reference to ground water with assessed annual renewable ground water resources in the state of 27.4 billion cubic meters. From the total annual replenishment of ground water, the state uses 42%, so there is big untapped potential.

For intensive study mostly a rain fed district Bankura is selected for assuming its current situation:-

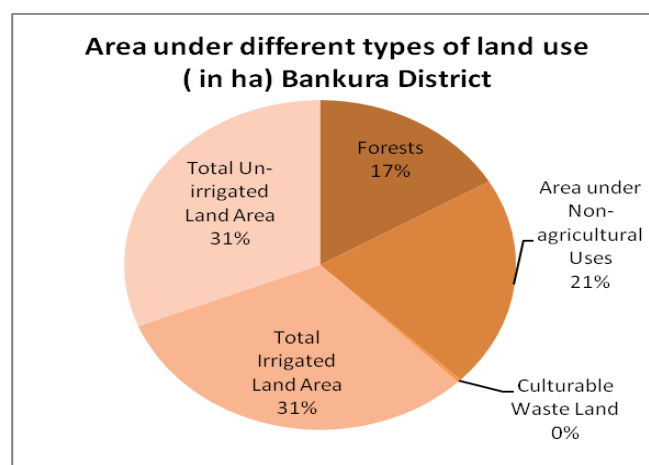
Location of study

District: Bankura
Block: Gangajalghati
GP: Bhaktabandh
Mouza: Bhaktabandh



The detailed information related to area of cultivation, net area sown, forests, non-agri- cultural uses, cultural able waste land, total irrigated land area in hector etc. is furnished to understand distribution of land profile.

Name of the District	Total area (in ha.)	Net Area Sown	Forests	Area under Non-agri-cultural Uses	Cultural able Waste Land	Total Irrigate d Land Area	Total Un-irrigated Land Area
Bankura (District)	678949.7	423992.1	112528.4	140253.8	2177	213231.8	210758.3



From the pie chart and the extract of Census data 2011 (since 2021 Census pending till date), it is clear that the Bankura District has large potential for development of Minor Irrigation Structure approx 31% in respect of the total area of this district. There is the high possibility of doubling the total production if the total un-irrigated land saturated with irrigation facilities by giving special focus on creation surface based irrigation system development.

How the scheme identified and developed irrigation system through people participation processes

Scheme identified in consultation with local villagers considering the demand of farmers land use criteria. The area must be rainfed (predominantly Kharif crop only as indicator of no irrigation source), villages predominated by small and marginal farmers and SC/ST, and more importantly community should be cooperative and supportive in nature and has the thrust to discover or innovative in nature.

On acquiring a firsthand view about the watershed both the implementer and beneficiary Women entrepreneur, a Focus Group Discussion (FGD) may be carried out with the community to understand the project concept and felt the need of irrigation facility after several discussions.

In this way after getting the social approval the irrigation project must be environmentally and technically verified along with latitude and longitude by taking support of GIS.

Now the after determining the said activities Scheme Development Management Plan (SDMP) may be developed. Accordingly an expert team consists of Institutional Development, Agriculture, Fishery, Horticulture, Social Development, Community Mobilization, GIS Specialist and Surveyor, Geologist, Hydrologist, Engineer (Civil & Mechanical) is required to consult the community/village to understand and develop detailed plan i.e. SDMP. A sensitization programme subsequently supported by one day orientation programme must be a part of the community understands about the essence of the project.

In detailed planning group activities, discussions, presentations by using Participatory Rural Appraisal (PRA) tool like resource and social mapping, hamlet meeting and focused group discussion with the participants. All primary data and information collected in those sessions. Mean time secondary socio economic data/information is to be collected from revenue/agriculture departments, district authorities, publications & studies, etc. Few targeted focused Group Discussion (FGD) also organized with different groups like women, youth and the limited tribal habitants trying to know their specific issues. The collected data from primary and secondary sources analyzed to understand the problem, its extent and opportunities and to define the plans for further action.

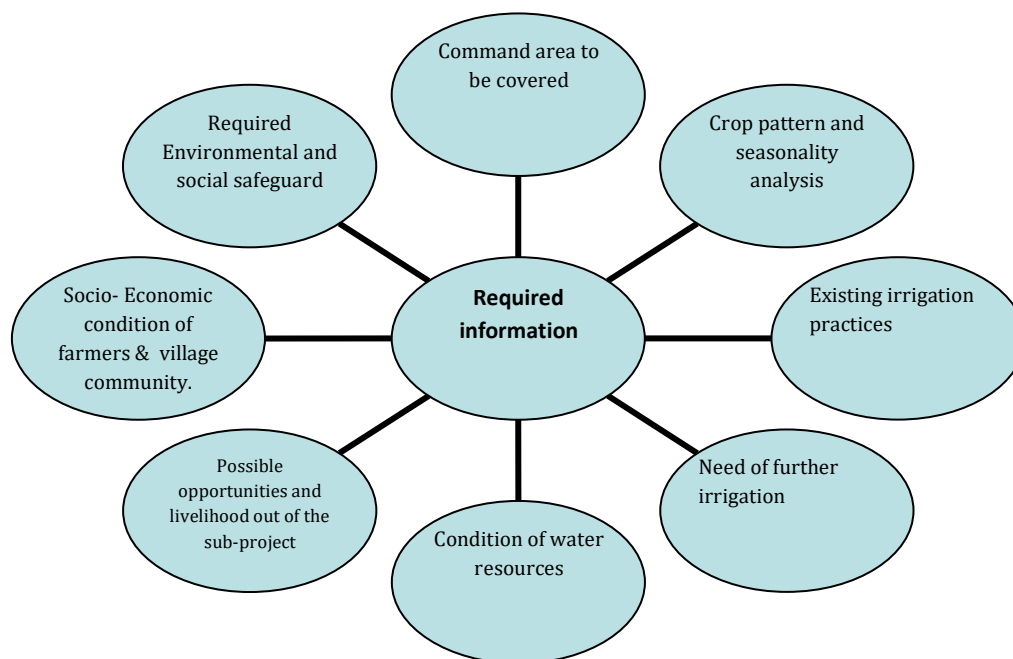
All these processes recorded and documented as the meeting resolution, Resource and Social Map, Village Profile, mass petition etc. All these proceedings resulted as the preparation of this document called SDMP.

At least five or six village level meetings required to in presence of farmers and women groups to understand the importance of information related to understand existing socio - economic conditions in the village with the emphasis on the socio-economic conditions of the targeted community, Existing practices of agriculture relating to cropping pattern, productivity, pest management, production and marketing, Water availability for irrigation and crop planning, Need of Community based systems for scheme management and maintenance, Need of donation of land etc. and participation for implementing the proposed sub-project and chalked out for an effective scheme plan.

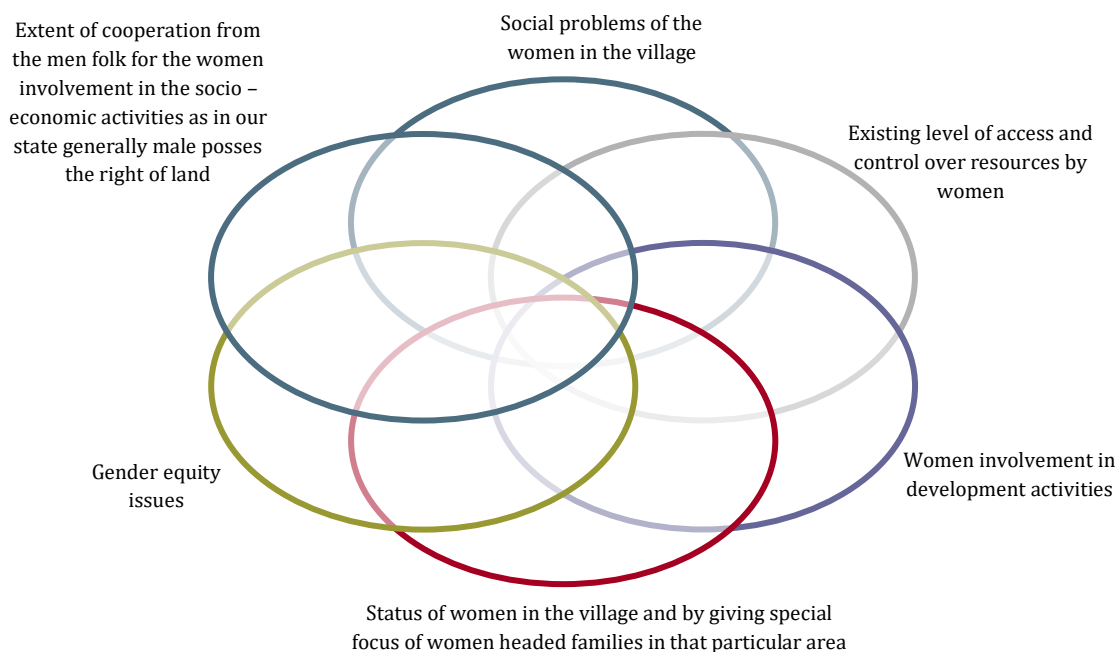
The meetings are generally followed by PRA exercise, focus group discussion and survey of the command area to collect the mentioned information.

A time schedule for building of local level institutions i.e Water users' Association also formed to chalk out for planned implementation of the scheme as well as for future operation, maintenance and management of the sub projects sustainably.

Following information collected through group discussion with the Farmers /women's under the proposed project Command Area:



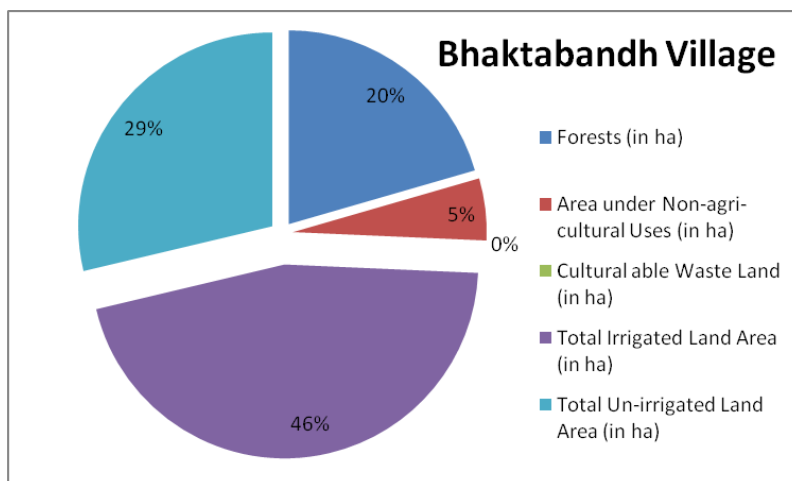
Issues discussed with the women



Village Profile

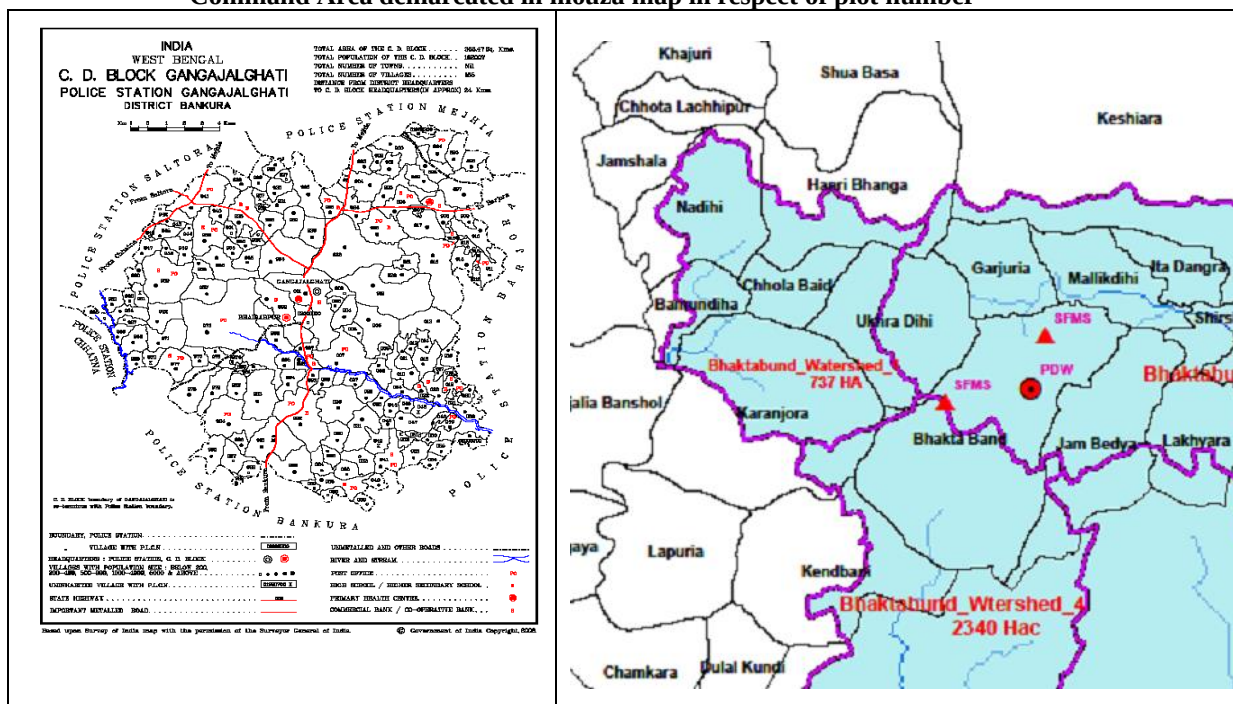
For analysis the village or mouza census data 2011 must be taken for consideration for implementation of any irrigation project / scheme. The primary data must be tallied with secondary data of census 2011 (since 2021 Census pending till date) for taking the decision.

Name of the Village	Total area (in ha.)	Net Area Sown	Forests	Area under Non-agri-cultural Uses	Cultural able Waste Land	Total Irrigated Land Area	Total Un-irrigated Land Area
Bhaktabandh	908.93	423992.1	186.56	46.94	0	414.55	260.88

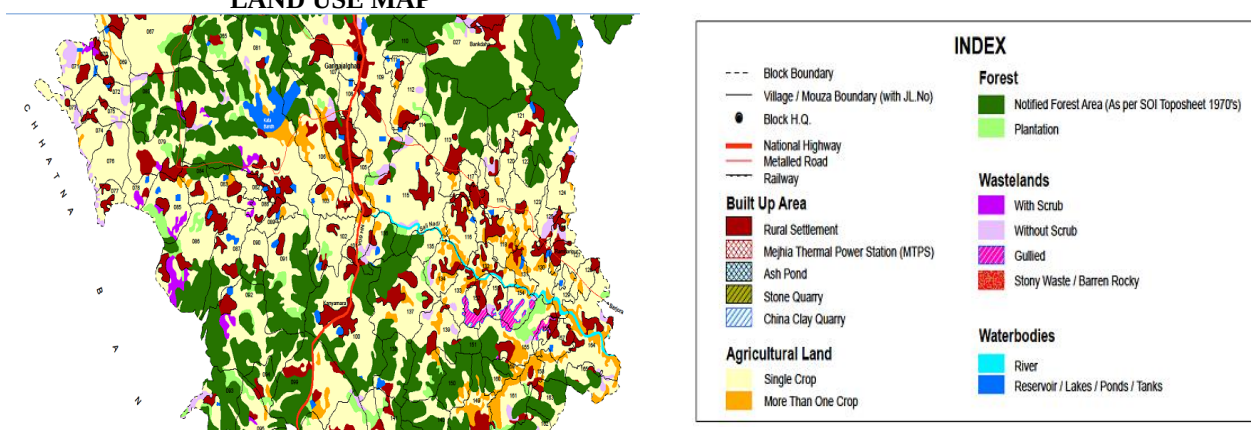


As per Census 2011(since 2021 Census pending till date) the total area is 908.93 ha out of which 260.88 ha (29 %) Un-irrigated Land and 414.55 ha (46%) Irrigated Land. So 29% un-irrigated land may be irrigated through development of the suitable surface based micro irrigation structure through watershed model. The command area map and land use map given hereunder which was prepared and give consent by the Women Water User Association

Command Area demarcated in mouza map in respect of plot number



Land Use Profile of Mouza(ha) LAND USE MAP



Hydrology and Water Budgeting

The micro watershed representing for this area at Bhaktabandh village is at latitude and longitude (Lat: N 23°22'41.38'', Long: E 87°4'26.60''). The watershed has a catchment area of 531 ha and covers three villages with first order and second order channels

The average rainfall in the catchment is 1425 mm which accounts for 3213 ham of water. It is estimated that 803 ha m (25%) is available as surface runoff. Existing surface development accounts 25 ha m through existing ponds (23 nos , 11.5ha) and lifting from the streams. The existing surface schemes provided by a private organization, which has no permanent storage. This 3213 ham water has a potential for further development of surface water schemes likes, ponds check dams etc.

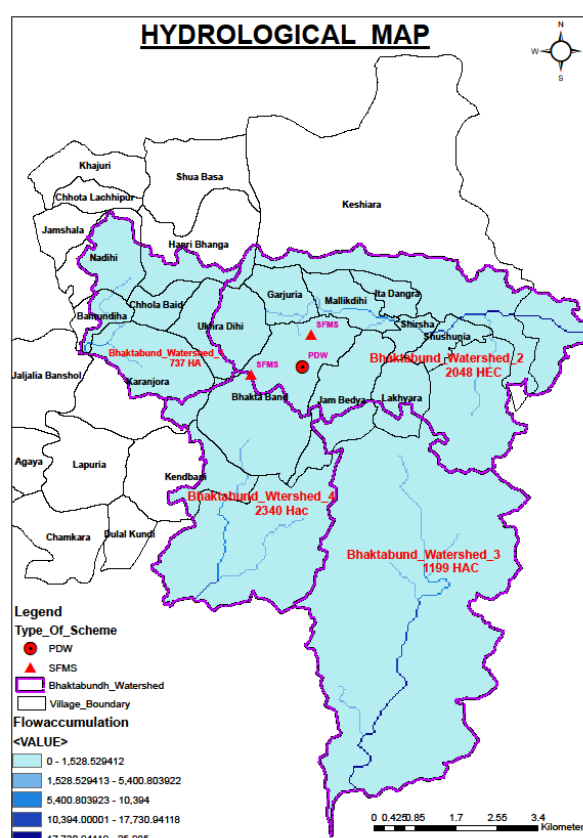
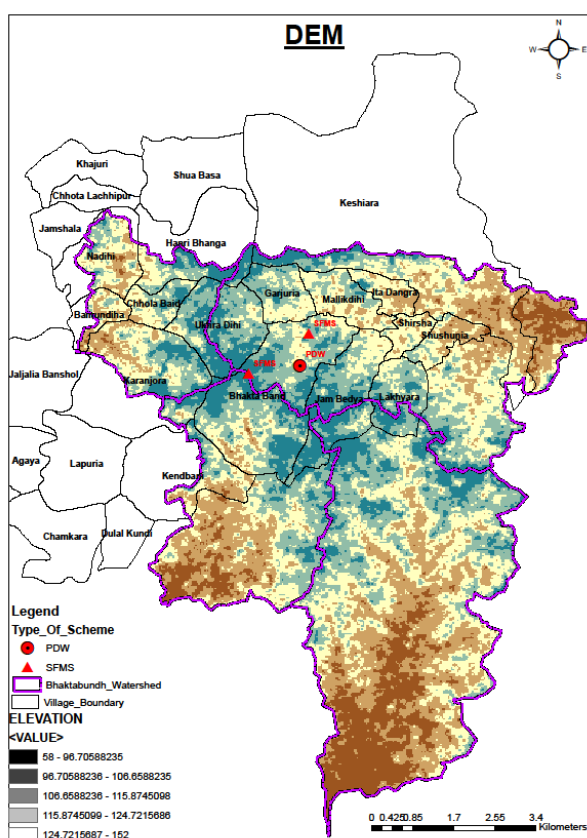
The watershed is not suitable for major groundwater development with hard rock region. Currently pump dug well and hand pumps are used for domestic purpose. The water level in these pump dug well varies from 4- 15 m below ground level. There are potential areas (valley fill) identified from DST maps for low capacity tube wells or dug wells.

Table 30: SW Monsoon and Annual Rainfall (2000-2022)

YEAR	SW – MONSOON RAINFALL (mm)		ANNUAL RAINFALL (mm)	
	RAINFALL	% DEPARTURE	RAINFALL	% DEPARTURE
2000	798.1	-10%	1035.4	-13%
2001	818.8	-8%	1100.7	-7%
2002	700.5	-21%	935.9	-21%
2003	902.9	2%	1187.3	0%
2004	807.1	-9%	1106.5	-7%
2005	874.3	-1%	1208.3	2%
2006	889.3	0%	1161.6	-2%
2007	943.0	6%	1179.3	-1%
2008	877.8	-1%	1118.0	-6%
2009	698.3	-21%	953.7	-20%
2010	911.1	3%	1215.5	2%
2011	901.3	2%	1116.3	-6%
2012	823.9	-7%	1054.7	-11%
2013	937.4	6%	1242.6	5%
2014	781.7	-12%	1044.7	-12%
2015	765.8	-14%	1085.0	-9%
2016	864.4	-3%	1083.2	-9%
2017	845.9	-5%	1127.1	-5%
2018	804.1	-9%	1020.8	-14%
2019	971.0	10%	1288.8	10%
2020	961.4	9%	1289.6	10%
2021	874.5	-1%	1236.4	5%
2022	924.8	6%	1257.0	8%

Rainfall statistics of India-2022, India Meteorological Department (Ministry of Earth Sciences)
Rain fall table for Bankura District

Month	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
Rainfall (mm)	184.44	340.58	306.80	278.54	126.39	16.32	23.92	12.11	27.44	23.27	60.79	143.60
4. (Table -3)	0.31	0.31	0.29	0.28	0.26	0.25	0.24	0.24	0.26	0.27	0.29	0.3
1. T _{max} (°C)	34.19	32.59	32.48	32.62	32.01	29.68	25.9	25.12	29.18	33.22	35.46	35.48
2. T _{min} (°C)	27.09	26.84	26.86	26.56	24.73	19.13	14.75	13.11	16.91	22.15	25.09	26.57



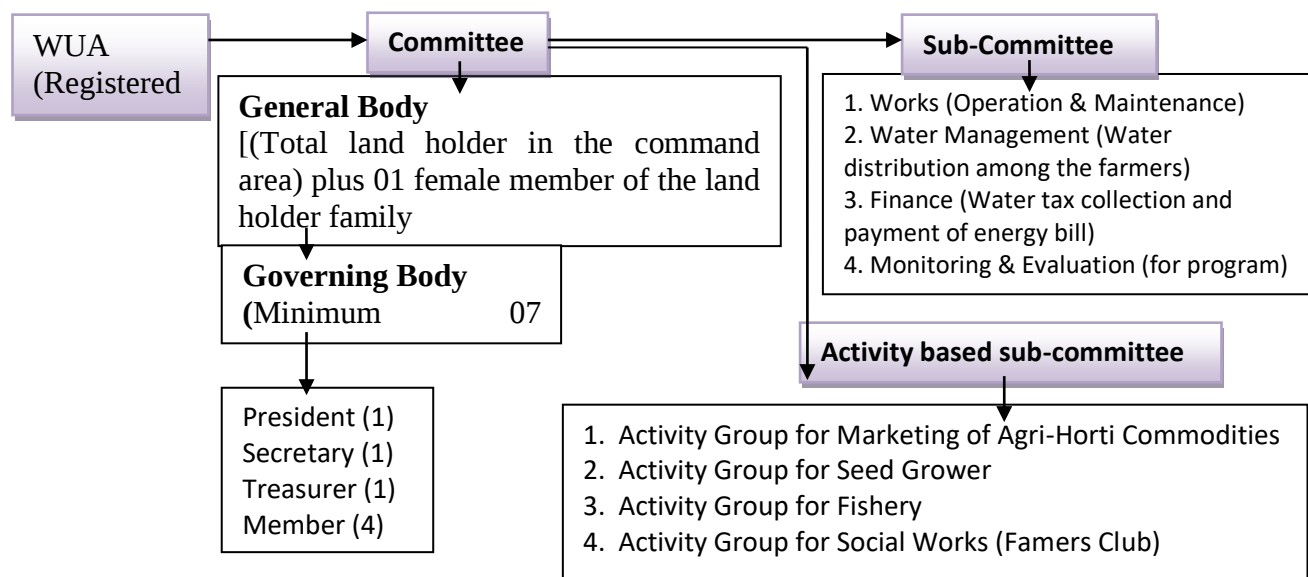
Water User Association (WUA) Profile:

After several discussions with the benefiting farmers whose land within the project / irrigated / command area a formal Water Users Association / Group formed for the Micro-irrigation structure / system. Representative of the benefiting households has become the members of the Water User Association / Group (WUA). All the members of the Association will elect the Governing Body member and four sub-committee members. An activity based-committee developed to gear up the livelihood based activities. All the committee, sub-committee, activity based committee must be maintained a uniform participation of the farmers and one female members of the farmers household in the ratio of 1:1 in case male dominated WUA. The participation of the women member increased because it will be helpful in future for sustainability of the project. On the other hand women Agripreneur based WUA there is no ratio related to male participation. The activity based committee generally assured the Agripreneurship among the men and women farmers and able to get direct benefit by avoiding middle man.

Depending upon the situation and performance of the WUA a grading or rating procedure also introduced and on that basis financial assistance under Agriculture Support Services (ASS) or Institutional Management and related capacity building training generally planned for sustainability of the project.

WUA generally maintained record (i) related to plot number wise benefited farmers and one of them women member list within the command area, (ii) Mass petition of the farmer of that particular scheme, (iii) Land Donation (Declaration of land owner) (iv) Total Budget Estimate (v) Handing Over Document (vi) Scheme Feasibility Report (vii) Resolution Register, Savings Bank Account, Audit Report etc,

Diagrammatic presentation of the association:-



After thread bare discussion with Water Users Association (WUA) beneficiaries it is appeared that WUA is managing the minor irrigation asset and regulate the use of irrigation water amongst so as to achieve full utilization of irrigation potential created under the scheme by forming registered organization under West Bengal Societies Registration Act (1961). Now WUA also is preparing cropping programme suitable to all its members along with demand and collection of water service charges. After completion of irrigation WUA also collect money from the WUA members for payment of energy charges, for repair, management of machines and conveyance system and make provision in the sinking fund for offsetting the depreciation of asset. The excess amount deposited in Nationalized Bank A/C for future use. WUA also keep in safe custody all assets under the scheme and to prevent theft or loss of assets. In the event of damage, theft of any asset the President of the Governing Body shall report the same in the Police Station and the implementing agency. WUA also resolve the disputes, if any between the WUA members on irrigation water distribution and sharing and also maintaining the accounts, audit and the records of the WUA mandated under the provisions of the West Bengal Societies Registration Act. For the purpose of proactive disclosure WUA also publish accounts at the end of the financial year as prescribed under the provisions of the West Bengal Societies Registration Act; and Conduct General Body meeting under the provisions of the West Bengal Societies Registration Act, 1961;

Scheme Profile

Considering the need of the farmers and hydro-geological conditions of the project area detailed design of the sub-project has been taken up by the experts. The economic viability should be considered without compromising the quality of the material to be used in consultation with beneficiaries. Before taking the proposal the command area must be observed carefully to assure that there is no irrigation structure in the command area. Overlapping of the command area must be avoided. The design of the scheme and investment must be observed carefully in light of the storage or discharge of water for irrigation in Rabi & Pre-kharif season and benefit cost ratio. The sub-project must be designed on the basis of the maximum water available as per hydro-Geological conditions, proposed cropping pattern suggested and crop water requirement. Technical feasibility Report or Scheme Feasibility Report (SFR) must be attached with the Detailed Project Report (DPR) as well as Scheme Development Management Plan (SDMP). The procurement must be made as per National Competitive Bidding (NCB). In time of issuance of work order the authority must be observed the credibility of the contractor in that specific work. In time of implementation of the scheme the Quality Control and Quality Assurance (QAQC) is also very essential for extending quality and durability of the infrastructure for long term. Following of Bureau of Indian Standards (BIS) is very much essential. Implementation span or mile stone must be followed carefully. The lined period in between season may be utilized for quick completion of work which will also minimize the loss of the farmer due to vehicle movement i.e earth mover, dumper etc.

Specifying the WUA participation of Construction Management Plan

The expected duration for installation & construction of the sub-project must be estimated. Necessary co-operation and support will be provided by the WUA for smooth and speedy execution of the sub-project. The quality control manual for WUA must be shared with WUA member and they must be trained to supervise the construction. There must be an “OK CARD” prepared that must be signed jointly by WUA, and engineers. After completion and successful test run, the scheme must be taken over by the WUA under specified standard rules and regulation. The WUA has agreed to take over the scheme for operation, maintenance and management after implementation.

WUAs committee, sub-committee and activity committee must be given guidance for operation, maintenance and management (MOM).

Water Management: The management would consist of monitoring the water availability and accordingly plan for water distribution and also for type of crop.

Monitoring: The Monitoring & Evaluation Sub-committee of WUA was monitor on regular basis. The monthly report will be generated on actual irrigation area, financial collection.

Hydrology and irrigated areas:

Groundwater monitoring: Not required. The WUAs shall be equipped with the manual water lever recorder and the operator shall monitor the water level on weekly basis. Based on the water level in pump dug wells, they would be able to determine the water availability and accordingly plan the crops.

Water meter reading: The operator shall record the volume of water pumped every day and as possible shall monitor the water used by each individual if only one irrigator was applying the irrigation.

Irrigated area: The operator shall also record number of hours taken in each plot. Based on this information, amount of water used by individual plots will be analyzed. This would make farmers understand the usage by individual farmers and perhaps have charges based on hourly or with number of irrigations instead of crop wise.

Operation: Operation will include the timing of irrigation to each field. The farmers jointly will prepare weekly plan for water distribution based on the demand of farmers. The farmers/operator will be taught about the process of opening the outlets. As required the WUA shall engage operators for one scheme or it can be worked out jointly for various schemes in the village.

Water distribution Pattern during Kharif and Rabi Season: Sometimes the irrigation is required during dry spell of rainfall events to save the crop damage. The WUA may even sell the water to non-members depending upon the availability of water. The WUAs need to arrange the water distribution system and agree upon the arrangements. The WUA were offered following options:

During Rabi season, all the members would plan in proportion to water availability.

Seasonal rotation: The members may agree on number of irrigations (or hours of irrigation) irrespective of season

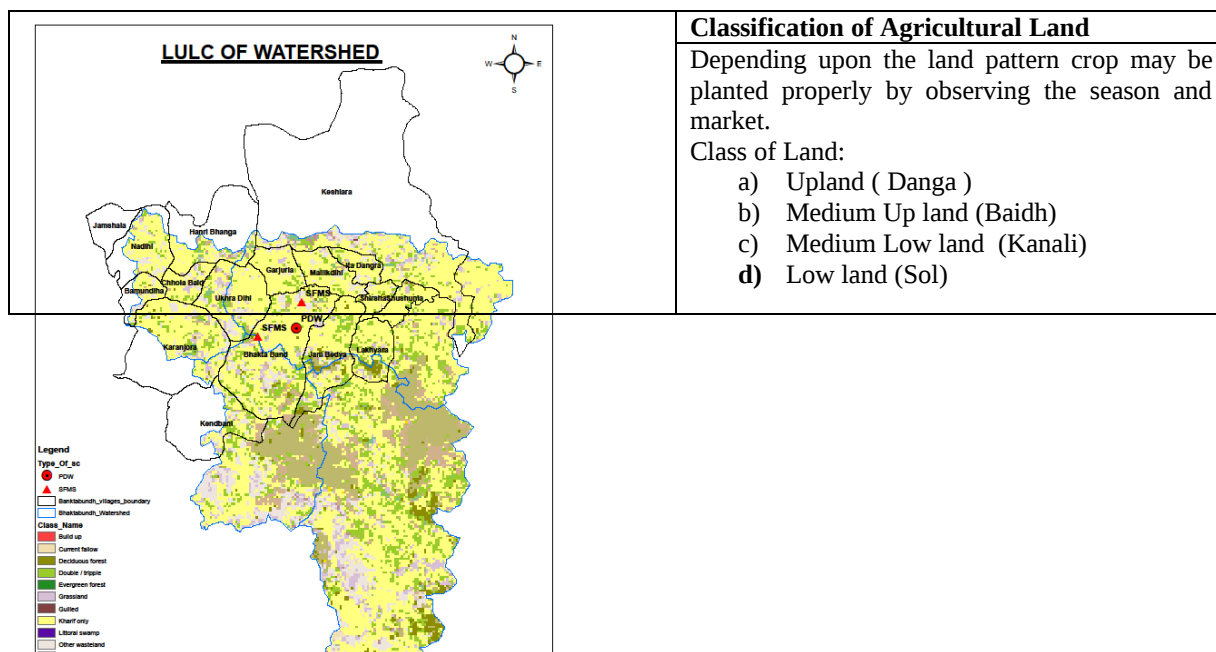
The WUA opted for option (i) where every farmer would crop in proportion to water availability during Rabi season.

The WUAs will be trained to determine the water availability and plan for Rabi irrigation.

Agriculture Support Services (ASS)

A cropping plan is very much essential to utilised the irrigated water in its full potentials. So a table may be prepared in presence of committee member related to present cropping pattern and proposed cropping pattern with introduction of:-

a) Introduction of good seed variety in Paddy / vegetables., b) Demonstrations for Vegetable crops in Rabi season, c) Soil health management practices such vermi-composting, d) Cultivation with DRIP or sprinkler to minimise the loss of water, e) Utilization of modernised tools and technique, f) Farmers Field School (FFS), g) Training to women men & women farmers etc.





Environmental Management Plan

Environmental safeguard must be adhered in time of Environment Screening at the Site Selection in the Planning Phase under Scheme Feasibility Report. A detailed survey may be carried out to understand the environmental situation of that particular village. Utilization of water shed in its full potential is required without overlapping the command area. A minimum distance from two scheme of from forest area or from international border or from local habitat must be maintained.

Surface water quality monitoring is required for surface water based subproject and ground water quality monitoring is required for ground water based subproject. Sample must be collected in pre & post monsoon time for testing. This will continue up to two years after commissioning the project. Monitoring report will ensure the quality of the water for irrigation. Soil quality must be examined after each season to determine the dose of fertilizer, selection of crop etc. WUA will ensure water resources must be managed by judicious use. WUA will avoid any use of WHO Class 1B and Class 2 pesticides & will try to use of bio pesticide in place of chemical or synthetic pesticide. Bio fertilizer will be used as much as possible. WUA must be taken active participation in tree plantation, water body conservation, building of environmental awareness among villagers etc. After completion of engineering work the site must be clean properly to assure environmental safe guard. In case any damage occurs in time of implementation that must be fill up as per norms.

Cost Benefit Analysis of scheme manage by Women Agripreneur as well as WUA

(Source: Data collected by author directly from intervening area)

In this data analysis section generally carried out to capture the expenditure & income analysis of cultivation before irrigation i.e before implementation of scheme. Before implementation of the scheme the respective 40 Acre land holders was cultivating Paddy -Local variety only in Kharif season and was generating net income Rs. 670/- per Acre. As a result total seasonal benefit was achieved Rs. 26,800/-only

Expenditure & Income analysis of cultivation before irrigation																	
A		Season	Crop	Area (Acre)	Expenditure/Acre							Income/Acre				Total seasonal benefit (Rs.)	
					Land preparation	seed	Fertilizer (28:14:14)	Manure & Micro Nutrients	Plant protection	Irrigation	labour	Expenditure	Yield	Straw	Income		Net income
1	Quantity (Kg)/nos.	Kharif	Paddy (local variety)	40		20					54		700				
					15					120		13					
	Amount(Rs.)				900	300		500	450	300	0	6480	8930	9100	500	9600	670
Total Annual benefit before irrigation																	26,800

Similarly under noted data analysis section generally carried out to capture the expenditure & income analysis of cultivation after irrigation i.e after implementation of scheme. After implementation of the scheme the respective 40 Acre land holders is now cultivating Paddy-High variety (25 Acre) plus Arhar (15 Acre) in Kharif season and is generating net income Rs. 5,235/- plus Rs 9940/- per Acre. Simultaneously in case Rabi season in combination of Tomato/ Beans (20Acre) plus Cabbage (15 Acre) is generating net income Rs. 11,200/- plus Rs 10,500/- per Acre. Similarly in case pre Kharif season in combination of Maize, Green Cob (15 Acre) plus Summer vegetable (10 Acre) is generating net income Rs. 24,800/- plus Rs 31,800/- per Acre. As a result total seasonal (i.e Kharif , Rabi, Pre Kharif) benefit is achieved Rs. 13,51,475/-only

Expenditure & Income analysis of cultivation after irrigation																		
B		Season	Crop	Area (Acre)	Expenditure/Acre							Income/Acre				Total seasonal benefit (Rs.)		
					Land preparation	seed	Fertilizer (28:14:14)	Manure & Micro Nutrients	Plant protection	Irrigation	labour	Expenditure	Yield	Straw	Income		Net income	
1	Quantity (Kg)/nos.	Kharif	Paddy (High Yield)	25		20					54		1650					
	Rate (Rs.)					25				150		10.8						
	Amount(Rs.)					1800	500	985	1000	600	600	8100	13585	17820	1000	18820	5,235	1,30,875
2	Quantity (Kg)/nos.	Rabi	Tomato / Beans	20		60							20450					
	Rate (Rs.)					50						2						
	Amount(Rs.)					2700	3000	4500	3000	2000	4500	10000	29700	40900		40900	11,200	2,24,000
3	Quantity (Kg)/nos.	Pre Kharif	Maize, Green Cob	15		15					54		40000					
	Rate (Rs.)					200				150		1						
	Amount(Rs.)					1000	3000	3000	1000	500	600	8100	17200	40000	2000	42000	24,800	3,72,000
4	Quantity (Kg)/nos.	Kharif	Arhar	15		10							450					
	Rate (Rs.)					80							45					
	Amount(Rs.)					1200	800	1010	1000	600	1200	4500	10310		20250		20250	9,940
5	Quantity (Kg)/nos.	Rabi	Cabbage	15									24000					
	Rate (Rs.)												1.75					
	Amount(Rs.)					2000	4000	4500	4000	2500	4500	10000	31500	42000		42000	10,500	1,57,500
6	Quantity (Kg)/nos.	Pre Kharif	Summer Vegetables	10							72		650					
	Rate (Rs.)										150		90					
	Amount(Rs.)					1800	3000	4100	2000	2000	3000	10800	26700	58500		58500	31,800	3,18,000
Total Annual benefit after irrigation																13,51,475		

As a result total Annual benefit after implementation of the scheme (B-A) is generating Rs. 13,51,475/- (-) 26,800/- = Rs. 13,24,675/-

The benefit-cost ratio (BCR) is an indicator showing the relationship between the relative costs and benefits of a proposed project, expressed in monetary or qualitative terms. As per under noted calculation it is found that the benefit-cost ratio is 1.85 that is higher than 1.0. Naturally, the project is expected to deliver a positive net present value to a firm and the women agripreneur.

Benefit /Cost ratio		
1	Capital cost of the scheme	Rs. 55,10,217.00
2	Life of the scheme (Year)	15
3		Rate Amount (Rs.)
(a)	Interest on capital cost	7% 3,85,715.19
(b)	Depreciation charges	2% 1,10,204.34
(c)	Operation & maintenance charges	4% 2,20,408.68
(d)	Total annual expenditure on capital cost (a+b+c)	7,16,328.21
4	Benefit /cost ratio	1.85

Sustainability: In a rain fed or single crop drought area where only Kharif crop are not assured at that place by the help of villagers as well as Women Agripreneurs the minor irrigation system developed by observing its benefit-cost ratio (BCR) more than 1.00. The agriculture and horticulture produce is collectively bring directly from field to market with the help of women agripreneur to get more profit by cultivating different types of economic crops in Kharif, Rabi, Pre Kharif . This collective activity carried out by Group of women agripreneur as well as Water User Association..

Findings of the study for scaling up Micro-irrigation Structure:

a) Community Based Institutional Aspects

Proper identification of the minor irrigation system and sustainable surface & ground water management active participation of communities as well as women's / farmer's institution is required. The entire minor irrigation scheme must be managed by the women's / farmers institution of that particular area where it will be developed.

The existing minor irrigation system may be come under Community based Institution Model to ensure its operation and maintenance in future or long term basis. The minor irrigation structure generally developed by the Gram Panchayat, Panchayat Samity, Zilla Parishad, Water Resources Investigation and Development Department, NABARD, Agriculture Department, Fishery Department, NABARD must be nurtured by creating a common platform by Involving the

Institutional / Social Development Specialist Cadre. Government may take initiatives to recruit this professional not only for sustainability of the irrigation structure but also assurance of convergence with other line department also like Agriculture, Fishery, Horticulture, SHG & SE etc. Community based & community managed institution can increase bio-farming, biological control of pests, seed production, increase the use of organic manure. Community based institution can able increase pulse production, commercial crop which has high return through Farmers Field School, DC etc. Combined community Institution based marketing in the nearby market may raised good profit to the farmers. Institutions can generate awareness related to crop insurance, farmers insurance, tie up with Sufal Bangla etc. for marketing ventures.

Breaking of middle-man chain is required who soft lifting the profit of the farmers in tricky way. Institutions can utilize as Bank to give loan to the farmers. Institution can purchase big volume of Seed & fertilizer directly from company as per need of the Institution. Institutions can procure essential agriculture equipments from government subsidized scheme to introduced new technologies. Institutional Development and organized capacity building for project management personnel including Community Service Providers, Community Workers, Field workers, Farmers, representatives of Water Users Associations, etc. Proper Empowerment of Water Users Associations is required to collect water charges in light of distribution water as per demand of the land holder in the command area. Women / Farmer based Water Users so much stable and sound Institutions for women agreepreneur. Association must be registered under law i.e Societies Registration Acts , must have valid PAN CARD, legal bank S/B or current a/c , Yearly Audited Account for maintaining transparency of the scheme. Participatory Irrigation Management (PIM) is essential in each scheme to encourage the adoption / utilization of traditional knowledge in water resources conservation and its management;

b) Irrigation System Management Aspects

Benefit cost ratio and people participation must be assured before taking the scheme in single cropped rain fed draught area. Learning from Hydrology Project to improve the planning, development, and management of water resources, as well as flood forecasting and reservoir operations in real-time. The reservoir operation is based on real time hydrological information in the catchment and is integrated with the climate forecast which would minimize likelihood of floods and ensure the availability of water for various uses. Study of the hydrology in respect of Google Earth through GIS management is essential for study of Watershed. After handover of the scheme to the community based organization i.e water user's association sufficient und must be accumulated by the WUA for operation & maintenance of the scheme.

c) Water Management Aspects

Proper Water Management is essential to utilized every drop of water Agriculture, Horticulture and fishery activities which is included a) Avoiding Flood irrigation, b) Application of drip / sprinkler must be increased c) Right seed selection in respect of variety / species for low water consuming crops d) Green house, Poly tunnel, Port tray etc. technologies may be incorporated. Regular assessment of availability and utilization of water resources through a system of water budgeting and accounting is required. Creation of water storages, annual re-excavation management, water conservation measures by water users association is required. Study after each season with water users association as well as Women Agripreneurs is required to identify justified water use efficiency from current level. Reducing the gap between Irrigation Potential Created (IPC) and irrigation Potential Utilized (IPU) through CAD and micro irrigation systems is essential.

d) GIS Management Aspects

Over lapping minor irrigation scheme may be avoided by proper GIS management by locating it accurate latitude and longitude and it will reduce the merging of command area.

e) Environmental Aspects

The surface based minor irrigation system tapped more water for cultivation and ground water will be saved for future use. In one side it will protect the area from drought and also reduced natural calamities related to flood.

f) Project Management Aspects

Capacity building Training, Exposure, Orientation, and Immersion is required for success of the project. Proper HR policy as per must be developed in light of dedication and hierarchy of the scheme. Development of strong Information System which include Management Information System (MIS), Decision Support System (DSS) and Executive Support System (ESS) for proper documentation, Evaluation and monitoring of the sub-project. Android Mobile / Tab based real time monitoring is essential. Before scheme and after scheme photographs and data may be store through GIS application in the dedicated website of the project.

Expected Outcomes of the research work:

The research work concludes wide range of recommendation for overcoming the defunct situation of the minor irrigation structure to assure sustainable growth & expansion of agricultural Development in West Bengal. Ultimately, this study will enlighten the hope of new management practice - opportunities and avenues for economic independence of small and marginal farmers by proper maintenance and operation of the Minor Irrigation System through farmers' institution and thus agriculture based entrepreneurial ecosystem will be developed in near future in the sustainable way.

Recommendation:

All the micro-irrigation structure that have already developed, or implementing phase or that will be developed in nature future by any implementing agency must be managed by farmers' institution to assure its sustainability. A hybrid cadre of engineer and social development specialist may be deployed for this noble venture for socio-economic development of the farmer as well as women agripreneur. Remarkable role of Women Agripreneur assured schemes sustainability which is the main factor of socio-economic development of the society. As its benefit cost ratio more than 1 for this reason both Government & non Government organization may adopt this model for socio-economic uplift of the society in sustainable way

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- a) Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) under Ministry of Agriculture and Farmers Welfare Deptt. of Agri., Coopn. & Farmers Welfare
- b) Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGA)
- c) Integrated Watershed Management Programme (IWMP)
- d) Jal Kranti Abhiyan (JKA)
- e) West Bengal Accelerated Development of Minor Irrigation Project (WBADMIP)