COOPERATION AND DEVELOPMENT OUTCOME IN MICRO-WATERSHED

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Abstract

Micro-watershed projects are implemented to develop degraded land in India. The watershed has been analysed for ecological sustainability in terms of increased vegetation, agricultural water, forestry, fishery and other eco-system services, which are known in literature as common-pool resources (CPRs). The force of the market machinery and state-led command and control based approaches fail to allocate and manage these natural resources at the social optimum level due to the very features of such resources, political inefficiency and high transaction cost. In course of time, participatory approach (social institution) came up as an efficient model. But, managing CPRs cost-effectively through collective action is also a challenge. To look in to the problems and observed it methodologically from close quarter, we have carried out a primary survey on 149 households from four micro-watershed projects. We found development outcome of micro-watersheds depends on institutions, social capital and group maturity at the grass root level. The results also find the importance of women involvement in collective resource management. The regression model suggests that some socio-economic factors such as income of the family head, cooperation of related agencies and appropriate technologies are crucial too for the sustainability of micro-watershed projects.

Keywords: Institution, Cooperation, Social capital, Group maturity, Self-help group, Watershed

JEL Classification: Q1, Q25

1. INTRODUCTION

Natural resources (land, canal and tank water, biodiversity and genetic resources, biomass resources, forests, livestock and fisheries) are the foundation of human civilization. These resources have been degrading fast and causing the environmental crisis in general and agrarian crisis in particular which the country is

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presently struggling with (Planning commission, 2007). India with 2 per cent of world's area is presently serving about 18 per cent of the world's population and 15 per cent of livestock population (Reddy et al, 2014). In India, about 51 percent of its geographical area (329 million ha) is categorized as degraded, most of which occurs in rain-fed agro-ecosystems (Wani et al, 2001). Dry-land agricultural system, covering around three-fifths of 142 million hectares of cultivable land provides about 45 percent of India's food requirements (GOI, 2012). This agricultural system being basically rain-fed becomes a gambling in monsoons. Agricultural lands under rain-fed areas also suffer from poor soil quality, low organic and mineral content due to leaching and erosion of top soil that is carried along with surface run-off before being dumped into downstream water storage structures leading to siltation as well as poor quality of collected water (Garg, Wani, Barron, Karlberg and Rockstrom, 2012). High level of salinity is also a major problem. It can affect crop productivity, soil structure and water quality. This salinity eventually results in soil erosion and land poverty. These ecological problems are further exacerbated by high population pressure, abject poverty, and almost non-existent or poorly maintained infrastructure (Bouma and Scott, 2006).

After independence, thrust was given on enhancement of agriculture production and productivity through vertical expansion with little horizontal expansion. In recent times, emerging indications of stagnant if not decelerating growth rates in the areas where green revolution first took place has forced the policy makers to rethink and turn their attention towards the development of rain-fed agriculture to raise yield levels as well as production of food grains (Garg et al, 2012). Fan, Hazell and Haque (2000) have shown that the rate on returns to increasing levels of investment tends to decrease in irrigated areas; it actually increases in the rain-fed areas. The micro-watershed projects are considered significant among the alternative ways to enhance the agricultural production and productivity in the dry areas. Micro-watershed also play very significant role in the developing countries like India.

Micro-watershed project provides various benefits. Watershed can have low negative environmental impacts and provide a variety of livelihood options to the village community. The participatory or cooperative approach incorporates all the elements of soil and water conservation along with improvement in agricultural and social infrastructure, market and credit access as well as introduction of new agricultural technologies all bundled together under the generic name of watershed development. The goals of the watershed are flood protection, restoring wetlands and other critical habitats, or managing storm water, local water management, agriculture (fishery) and protection of nature. The soil and water conservation activities in the fields provide additional job opportunities to the small and marginal farmers. Watershed planning provides a context for integration, by using practical, tangible management units that people understand, focusing and coordinating efforts, and finding common ground and meeting multiple needs. Additionally, this process yields better management by generating ecologically

based, innovative, cost-effective solutions, forging stronger working relationships, and supporting consistent, continuous management of the resource. With this backdrop, the research quarries are: Is collective action or social capital formation among the villagers sole factor for the sustainable management of micro-watershed? Can women play significant role in such participatory projects? If not, which is the other factors playing significant role in sustainable management of micro-watershed. Does the sustainability of the watershed depend on some socio-economic factors?

The objective of this paper is to investigate the role of social capital, group maturity and socio-economic factors in sustainable watershed development project. In the following section, I discuss the study backdrop along with the hypotheses. Finally, details of data collection and analysis, results, discussion and conclusion and recommendation and research gap will come up serially. These all will culminate in the final observation relating to the sustainability of a watershed project and its dependence on social capital, group maturity of SHGs and on some socio economic factors.

2. STUDY PERSPECTIVE AND HYPOTHESIS

According to the NABARD (2006), watershed development refers to conservation, regeneration, judicious and harmonious use of human and natural resources within a particular watershed through implementation of 'ridge-to-valley' approach involving all the stakeholders, in a sustainable manner to generate a stream of various services such as food, fodder, fuel wood, water for agriculture and domestic purposes, reducing soil erosion, recharging groundwater table etc. There are a number of success stories in watershed management. All these projects have a few common characteristics: emphases on social issues (social capital), social mobilization, participatory management, transparent project monitoring and a strong sense of ownership by the local community. While the technical aspects of these programmes are no doubt important, it is the cooperation between and active participation by local beneficiaries through their social organization or village institution that determines successful outcomes. Social capital is useful for our study because evaluation of the watershed has shown that these cannot succeed without full participation of the local people and careful attention to issues of social organization. Social capital lowers the costs of working together and it facilitates cooperation (Sarkar and Ray, 2019). The indicators of social capital in the community level are: absence of hierarchy, level of education, collective action in conserving resources, broad-based understanding of group activities, equity in benefit flow or status of financial capital base or accountability, livelihood impacts and reduction in vulnerability, group activity in decision making or sense of responsibility, internal norm, mutual trust within community members and maintenance of resources and improvements. Studies (Pathak et al, 2013; Maji and Rathore, 2015) also revealed the astonishing picture of failure of such programs in

many areas of the country. Non-attainment of environmental objectives which is further weakened by a number of management related barriers and non-participation or partial participation of farmers especially in planning, monitoring evaluation and post implementation stage of project have been emerged as serious backdrop (Maji et al, 2015). Building partnerships and meeting the challenges to make them work successfully will be the foundation of successful watershed. Partnerships also help to identify and coordinate existing and planned efforts. Still other avenues are formed to build plans for broader community and environmental improvements or to prevent future problems.

Literature also shows that active participation of women encourages communities to conserve natural resources. Women's active involvement is supported on various grounds: their 'closeness' to nature, which gives them a special stake in conservation of natural resources; their high level of dependence on forests; they constituting 50 per cent of the total strength of any community (Kameshwari, 2002). In the case of watershed, self-help and user groups or village watershed committee (VWC) formed by the residents of the watershed area are the beginning as well as the end point for the programme. The criteria for the group maturity are: group alliance, group formation, group objectives, planning and testing, conflict solving, resilience, group value and world views, institutional effectiveness, self-analysis and view of change. The robust group maturity depends upon consensus among a large number of users. Although the gender dimensions of natural resource management (NRM) have been identified as key factors shaping peoples access to and use of natural resources (Cleaver, 1998a), most discussion of social capital so far appears to have been almost gender blind (Molyneux, 2002; Riddell, Wilson and Baron, 2001). But, Agrawal (2000) suggests that such interdependence helps to overcome social division and to facilitate conflict resolution. In summary, gender relations have been identified as important determinants of the capacity for collective action. Very little attentions have given to the significance of SHGs within the micro-watershed projects. These mentioned studies, therefore, lead to the hypotheses:

Hypothesis 1. Collective actions of the watershed community and group maturity (of SHGs) of the women are significantly related.

Datta (2015) found that even if improvements have been accomplished in terms of economic parameters some local factors are highly responsible for the success of the project. The process of creating and implementing a watershed plan is dynamic and iterative by nature. Because the variables involved in developing the plan are always changing and plan will change with them. Watershed development involves the following components or sectors: Human Resource Development (community development), Soil and land management (conservation and use), Water management (conservation and use), Afforestation, Pasture (fodder) development, Agricultural development, Livestock management and Rural energy management. The involvement of all these sectors is significant for the

development and education of the population inhabiting in the watershed areas. When the environment gets degraded, the quality of life of the human community within that region also deteriorates. Watershed development thus aims at the rejuvenation of the environment in an integrated and comprehensive manner. To make the project sustainable, it is necessary for all the key actors, like the Watershed Community, NGOs, Banks, Government Institutions and Technical Service Organizations to participate actively and in close coordination with each other. Success depends on involving a good mix of people and organizations and implements the plan in term of technology, community and learning, leadership, communication and public policy choice, formal and informal institutions (set of rules). A diverse group in terms of income and caste has a better chance of fulfilling these roles by bringing different talents, interests, concerns and values together. Additionally, informal social interaction can provide the glue that holds a partnership together. These observations lead to the hypotheses:

Hypotheses 2. Sustainability of micro-watershed projects (rain water harvesting structure) depends on stock of social capital, active participation of women, formal and informal institutions, caste, income of the family head, and area of the project, fund support to work the action plan, involved agency and technology.

3. STUDY SITE, DATA COLLECTION AND METHOD

3.1. SURVEY AREA OF THE STUDY

The micro-watershed projects are located in Ausgram I and II blocks in the Bardhaman district, West Bengal, India (21°20′ to 27°32′ N and 85°50′ to 89°52′ E). These are predominantly backward area with semi-arid climate and red lateritic sandy soils, with hot summers and cool winters. The average annual rainfall in the district is about 1400 mm. The rainfall during monsoons (June to September) constitutes seventy-five percent of annual rainfall. On an average a year witnesses seventy rainy days in a year (District Statistical Handbook Bardhaman, 2010-2011). Around two-third of the total population in the area belongs to backward community. The project villages are located on the upper parts of the drainage basin of the Ajay-Kunnur river system, tributaries of the Damodar River. The principle source of agricultural water here is the communal canal water which irrigates 245.63 thousand hectares of agricultural land. Unfortunately, there is no tank irrigation water data available at the district level in the district handbook (table 1). However, we have got some tank irrigation data across the villages from different village level sources.

Table 1. *Area irrigated by different Sources (in thousand hectares)*

Name of Districts	Govt. Canal	Tank	HDTW	MDTW	LDTW	STW	RLI	ODW	Others	Total
Bardhaman	245.63	0.0	7.82	0.75	11.78	0.0	12.00	0.0	0.0	277.98

Source: Government of west Bengal, District Statistical Hand Book, 2010-11. HDTW: High Capacity Deep Tubewell, MDTW: Middle Capacity Deep Tubewell, LDTW: Low Capacity Deep Tubewell, STW: Shallow Tubewell, RLI: River Lift Irrigation, ODW: Open Dug Well.

Table 1 shows the alternative sources of irrigation water. Generally, government canal is the main source of irrigation.

3.2. DATA COLLECTION METHODS

The data used in this study was collected from the primary survey which was carried out during the period from November 2016 to April 2017 and May 2018 to July 2019 in several intervals. We have collected some secondary data about village population on various dimensions (related to the study) from District Statistical Handbooks, West Bengal, India (Census, 2011) and from records of Divisional Forest Office. We have selected four watershed user villages purposively and surveyed every fifth household from the villages' household list randomly. We have also pre-tested the questionnaire in pilot survey and did the necessary modifications in the final version of the same. A total of 149 households were surveyed comprising a minimum of 25 percent from each village. The village farmers are less heterogeneous in family income, family size, landholdings, primary occupations and so on. Therefore, the sample size may be considered as ideal one. We have selected households randomly based on our study criteria: variations in total watershed project area, household differences, differences in social capital and institutional setup. We have surveyed these households along with local authorities using a set of questionnaires under the framework of collective action and group maturity index.

We have also cross-checked the collected data with the local authority such as local self-government (*panchayat* in India) and individual members, foresters, key informants like teachers of the local primary schools and the dwellers of neighbouring villages. This two-step verification was done to ensure the reliability of the collected data.

3.3. MEASUREMENT OF VARIABLES

Dependent Variable

Rain water harvesting structure (RWHS): The activities under the projects are shown in table 4. According to that, if the activities such as ponds, check dam or drains and sapling plantation are less than ten then we consider it as low level of RWHS, otherwise high.

Explanatory Variable

Attitudes towards social capital (SC): Social capital or collective action is important for sustainable water use. In this paper, we have considered collective action at the village level for comparing the relative performances of the villages. Besides, we also have measured individual households' attitudes towards their village's collective action for the sustainable management of tank water. For this, we consider ten indicators (based on Rural Participatory Appraisal) as depicted in table 5. These indicators reflect investment of the locals in the form of time and resources in the different activities relating to watershed development and management. We have used the typical Likert scale (Likert, 1932) to rate the degree to which the interviewees (farmers and local authorities) agree or disagree with an indicator. The five-point response options running from 'Very Low' to 'Very High' with the award of score 1 to 5 were used to convert the qualitative ranking into quantitative data. All the items were framed in a similar direction. We have taken the mode value of the ratings for each indicator to draw an idea of what the majority of the local villagers think as their opinion instead of considering the average values to evaluate the frameworks (Mukherjee, 2002 ; D'Silva and Pia, 2003; Sarkar and Ray, 2019; Sarkar, 2020).[2]

At the individual level, we sum up the scores of the respondents. Since five-point scales were used, convention is that the score of 3 for each indicator shows a neutral attitude. So, we define an individual's perception about collective action as favourable if that individual's scale score is at least 30. It means that on an average the respondent holds favourable attitudes on all the ten indicators. Those holding a score below 30 hold less favourable perceptions.

Gender: In watershed project, both female and male members actively participate. We have considered female equal to 0 and male equal to 1.

[2] Since the indicators are very much contextual, majority opinions are more important than the averages. So, mode values are a better measure of representing the relative importance of the indicators than the average measure. Also, it is important to note that since the study villages are located side by side, they are less heterogeneous as mentioned earlier. So, variance of each indicator across the villages might not be a relevant measure. However, it could be more important for cross regional studies.

Institution and Implementation: Institution means set of rules (North, 1990) in respect of the watershed project. If institutional arrangement is both formal and informal in a village, then it is equal to 1; if it is informal, then it is equal to 0.

Caste (C): In Indian society, general caste, considered as the higher caste in India, refers to those that lie at the top of the power and social prestige hierarchy (Adhikari and Di Falco, 2009; Sarkar, S. 2017b), while the lower caste comprises scheduled castes (SC), scheduled tribes (ST). By contrast, other backward classes are referred to as OBC. We treat this as a dummy variable (with upper caste = 1, lower caste = 0).

Income of family head: In several common pool resource studies, we find that income has been considered more as a class than as a mere continuous variable. We find in our context that the maximum and minimum income per household is INR 13600 and 1500 respectively and the mean income is INR 5600. A household with income of at least INR 5600 is defined as a high income household; otherwise a household belongs to the low income households. We introduce a dummy variable FI=1, if the household belongs to relatively high income group; 0 otherwise.

Project area: In our study the minimum project area is 644.46 ha. and the maximum is 1104.17 ha. We have taken the project areas which are more than average (874.32ha) are equal to 1, otherwise equal to 0.

Funding Support: If the funding support is less than fifty lacks, we have taken that 0 and otherwise 1.

Involved agency: In the four project, we have observed that in total 8 external agency are involved, but in varying degree across the project community. If the involved external agencies are more than 4, we have taken it as 1 otherwise 0.

Technology: In this study we observed two types of technology: capital intensive and labour intensive. We consider capital intensive technology as 0, otherwise 1.

The description and measurement of the above variables with their expected signs are summarised in the following table 2.

Other Variable

Group Maturity Index: The impact of gender on the effectiveness on social capital measured in term of the group maturity of the Self-help Groups (SHGs). Group maturity is defined as a group's potential for self-defining and self-sustaining activity (Pretty and Ward, 2001). In commons management, Pretty and Ward (2001) and Sarkar, S (2017a) have operationalized the concept based on some criteria which can be found at three stages of organizational development termed *reactive dependence*, *realization independence*, and *awareness*

interdependence. We capture group maturity for the sampled watershed using ten criteria (Appendix A) which are shown in table 6.There are three stages in the each criterion. We award SHGs a score of 1, 2 and 3 for first, second and third stage respectively. Thus, the maturity score varies from 10 to 30. The higher score of SHGs reflects greater maturity of the organization. Therefore, the maturity score is ranging from 10 to 30.

3.4. THE EMPIRICAL STRATEGY

The Logit Model

Since our dependant variable is a binary variable as depicted in table 2, we use logit regression model to find the determinants of rain water harvesting structure. In the logit model if Pi be the probability of rain water harvesting structure of the watershed project (RWHS), then (1 - Pi) will be the probability of rain water harvesting structure which is not effective. Now Pi **/(**1 - Pi**)** is simply the odds ratio in favour of effective rain water harvesting structure. A natural log of the odds ratio will provide the following result

$$\text{Li} = \ln L_i = \ln\left(\frac{P_i}{1-P_i}\right) = Z_i = \beta_1 + \beta_2 X_i \qquad (1)$$

Equation (1) is a general form of logit model. In terms of the variables of table 2, equation (1) reduces to equation (2)

$$LOGIT\ (RWHS) = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_1 + \beta_2\ (SC) + \beta_3\ (G) + \beta_4\ (II) + \beta_5\ (C) + \beta_6\ (IFH) + \beta_7\ (PA) + \beta_8\ (FS) + \beta_9\ (IA) + \beta_{10}\ (T) + u_i \qquad (2)$$

Where, u_i is the random disturbance term.[3]

We have adopted two-fold modelling strategy as follows. Since our paper focuses on collective action or cooperation and development outcome in micro-

[3] In the estimation strategy, it may be noted that SC is supposed to be determined by the rest of the variables of the right hand side of equation (2). And also, rain water harvesting structure (left hand side of equation (2) depends on the level of social capital. Hence it might appear that the best estimation strategy could be joint estimation methods such as seemingly unrelated regression estimation (SURE) and/or simultaneous equation model. However, one pre-condition of these two estimation techniques is that the dependent variable must be continuous metric variable rather than a binary categorical or dummy variable. In our study areas, respondents are mostly illiterate or have low level of education. There is also no official data on household level social capital. Hence, users of the rain water harvesting structure are better able to perceive or compare social capital as either high or low rather than as a continuous variable. Similarly, when we asked them to compare their water harvest from the structure, they replied in terms of more or less usage. Hence from the perspective of the local study context, it is more apt to consider social capital and rain water harvesting structure (RWHS) as dummy qualitative variables. So, the joint estimation is beyond the scope of the current study.

watershed therefore we first run a simple regression model of equation (2) with the only explanatory variable social capital. Next, we adopted a full model approach that involves all the variables listed in (2).

Table 2. *Description of dependent and independent variables*

Variables	**Measurement**	**Mean**	**Standard Deviation**	**Hypotheses**
Rain water harvesting structure (RWHS)	Low level of activities = 0, otherwise = 1	0.30	0.46	
Social Capital(SC)	Stock of Social Capital low = 0; high = 1	0.63	0.48	+
Gender(G)	Female = 0; Male = 1	0.15	0.36	-
Institution and Implementation (II)	Informal = 0; Formal and informal = 1	0.53	0.50	+
Caste(C)	Lower = 0; Upper =1	0.19	0.40	-
Income of family head(IFH)	Less 5000 =0; otherwise = 1	0.13	0.34	-
Project area(PA)	Small = 0, large = 1	0.63	0.47	+
Funding Support (FS)	Less than 50 lacks = 0, otherwise = 1	0.27	0.44	+
Involved Agency(IA)	Low = 0; High = 1	0.28	0.45	+
Technology(T)	Capital intensive =0; otherwise=1	0.13	0.33	+

4. RESULTS

Table 3. *Geographical characteristics of the micro-watershed project.*

Name of the Project	**Forests**	**Area under Non-agricultural Uses**	**Cultivable Waste Land**	**Net Area Sown**	**Total Irrigated Land Area**	**Total Un-irrigated Land Area**	**Canals (C)**	**Wells/Tube-wells(W/TW)**	**Tanks/Lakes(T/L)**	**Others(O)**
BAKU	256.9	144	87	417	30.1	92.4	0	13	17	0
Dombandi	222.6	21.8	5.1	39.4	33.4	6	0	29.2	0	4.2
Valki	258.4	63.4	14.2	609.2	196	413.2	0	141	52	3
Karotia	244.4	404.9	6.1	268.3	268.3	0	268.3	0	0	0

Source: Government of west Bengal, Bardhaman. District Statistical Hand Book, 2010-11. Barren and un-cultivable land, Permanent pastures and other Grazing, Land under miscellaneous tree crops, Fallow lands and other than current, Current fallows, Waterfalls are zero in the entire project. The figures are express in term of hectors. Karotiya watershed project consists of the villages: Karotiya, Dayemnagar, Hargoriyadanga, Shokadanga and Jarkadanga. We have put the data only for the Karotiya village, data of the others village are not available.

Table 3 shows the land use pattern across the study villages. Table 3 gives a break-up of the total area in the projects under different land uses. Watershed development measures have been undertaken in the villages during the period 2002–16, utilizing the funds from NABARD's (table 4). Most of the farm households are marginal land holders, many of them working as share croppers before the commencement of the micro-watershed development project, agricultural activity in the treatment village was limited to the rainy season only.

Table 4. *Description of the Survey villages, project working status and funds*

Name of the Watershed and Project time	**No. of villages**	**Total Treatment Area (Ha)**	**Total Household**	**Castes**	**SHGs**	**Ponds***	**Activities under the Project**	**Social Forestry (Sapling/Areas)**	**Total Treatment Allotment (in lakh)**
BAKU (2012-2016)	02	726.00	430(32)	ST/SC/G	13	05	Check Dam /Drains	Sapling 4 Th. /Areas 4	77, 13,200
Dombandi (2003-2009)	01	644.46	128(22)	ST	07	03	Check Dam/Drains	Sapling 20 Th. /Areas 27	33, 60,000
Valki (2002-2008)	01	954.00	842(41)	ST/SC/G/ OBC	54	15	Check Dams/ Control Stretch/ V Stretch/ 5% Model/ Gali plug/Drains (Kucha+Pucca) Room/Roads	Sapling 76 Th. /Areas 6.67	100,60, 000
Karotia (2003-2010)	05	1104.17	972(54)	ST/OBC/G /SC	35	24	Control stretch/ 'V' stretch/ 5% model/Check Dam/Drains	Sapling 1 Lakh/Areas 35	25, 00,000**

*Source: Primary survey November 2016 to April 2017 and May 2018 to July 2019. BAKU stands for Babuisole-Kuldiha; * Ponds are new/reconstruction; Th, A and L represent thousand, Acres and Lack respectively. ** means approximate value, (Check Dam 20 ft long, 3 ft wide and 1.5 ft deep).*

Table 4 shows the detail of household characteristics, working activity and funding status of the VWCs. The projects period was 2002 to 2016. The maximum working activities is in the Valki watershed committee and the minimum in BAKU. We have also mentioned the total numbers of SHGs. Each SHGs contains usually (10-12) women.

Table 5. *Social Capital in the four villages in Watershed Project*

Indicator of Social Capital	**Babuisole-Kuldiha**	**Dombandi**	**Valki**	**Karotia**
Absence of hierarchy	3	5	3	2
Education level	3	2	3	3
Collective action in conserving resources	2	4	3	2
Broad-based understanding of group activities, leadership	2	4	3	2
Equity in benefit flow/ Status of financial capital base/accountability	3	5	3	3
Livelihood impacts and reduction in vulnerability	2	5	4	3
Group activities in term of decision-making/resources conservation/attachment/sense of responsibility.	3	4	4	4
Internal norms and role clarity and external linkage-vertical and horizontal	2	4	3	2
Mutual trust within community and conflict resolution	2	5	2	3
Maintenance of assets and improvement	2	4	3	3
Total score of stock of social capital	24	42	31	27
Total score of stock of social capital in term of percentage	48	84	62	54

Source: Primary survey November 2016 to April 2017 and May 2018 to July 2019

Table 5 & 6 show the only VWC Dombandi is successful out of the four VWCs. The stocks of social capital formation along with the active SHGs are the key factors for the success of watershed project. The stock of social capital and group maturity of SHGs of women is positively and significantly correlated ($r = 0.97$, $n = 4$ and p value 0.03). In the capacity building phase (CPB) the performance of the Valki watershed project was satisfactory but that is suffering in the final project implementation (FPI) phase due to the low level of social capital and the activity of the SHGs. In the CPB there were 54 SHGs which reduced to 20 in FPI. The BAKU and Karotia VWCs fail in the CBP. Therefore, not only social capital but sufficient level of group maturity among the women also plays very important role for the successful watershed project.

Table 6. *Three-stage model of group maturity of SHGs*
(stage: I reactive dependent; stage: II realization independent; stage: III awareness interdependent)

Indicator of Group Maturity (SHGs)	**BAKU**	**Dombandi**	**Valki**	**Karotia**
Group alliance (External links and networks)	1	2	3	1
Group formation	1	3	3	2
Group objective	1	2	2	2
Planning and testing	1	2	2	1
Conflict solving	1	3	1	1
Resilience	1	3	1	1
Group value and world views (Recognition of group value)	1	3	3	2
Institutional effectiveness/ Institution (Rules and norms)	1	2	1	1
Self-analysis	2	2	2	2
Views of change	1	2	1	1
Total score of group maturity	11	24	19	14
Total score of group maturity in term of percentage	36.67	80	63.33	46.67

Source: Primary survey November 2016 to April 2017 and May 2018 to July 2019

Table 7. *Result of logit and Probit model with the dependent variable: Rain water harvesting structure (RWHS)*

Variables	**Logit-Model 1**	**Logit-Model 2**	**Probit-Model 1**	**Probit-Model 2**
	Coefficient (Robust standard Error)	**Coefficient (Robust standard Error)**	**Coefficient (Robust standard Error)**	**Coefficient (Robust standard Error)**
Collective Action (CA)	2.63***(0.63)	2.66**(0.78)	1.47***(0.31)	1.58***(0.47)
Gender(G)		-0.89(1.05)		-0.55(0.65)
Institution and Implementation (II)		0.91*(0.48)		0.57**(0.27)
Caste(C)		-0.64(0.57)		-0.35(0.35)

Income of family head[4](IFH)		-12.41***(1.04)		-3.39***(0.42)
Project area(PA)		0.45(1.15)		0.03(0.59)
Funding Support (FS)		0.49(0.48)		0.25(0.28)
Involved Agency(IA)		-1.19**(0.59)		-0.68(0.37)
Technology(T)		16.59***(1.31)		5.82***(0.70)
Constant	-2.85***(0.59)	-3.87***(0.99)	-1.60***(0.28)	-2.08***(0.41)
Number of Observation	149	149	149	149
Wald chi2	(1) 17.49	(9) 480.77	(1) 22.89	(9)614.56
Probability > chi2	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.1644	0.3563	0.1644	0.3556
Log pseudo likelihood	0.3563	-58.754926	-76.265727	-58.818825

, **, * Indicates coefficients that are significant at the 10%, 5% and 1% level or below*

The logit regression result[5] (table 7) shows the probability of rain water harvesting structure. It suggests that high level of collective action, both formal and informal institution, low level of income of the household head, low number of involvement of the external agency and labour intensive technology of the VWCs are significant determinant of the RWHS. From the model statistics, we see that both specifications have joint significance than the intercept only model. This means that all variables more or less influence the water harvesting structure.

5. CONCLUSION, DISCUSSION AND POLICY IMPLICATIONS

The study shows that the stock of social capital and the role of women through SHGs are crucial for the successful functioning of micro-watershed projects.

The first reason is the shift from a command and control based approach by the state to co-management or partnership management of natural resource. This shift requires a partnership between community institutions such as the social capital and SHGs and the local officials for sustainable management of forests, water, fishery and other resources based upon trust, dialogue, and mutually defined rights and responsibilities. Clearly, a synergy between state and civil society is needed.

[4] Land size (in acre) was found to be highly correlated with family income (correlation coefficient= 0.67, $p<0.01$, n=149). In order to avoid multicolinearity, we excluded the variable land size from the regression model of table 6).

[5] We also have similar results by employing Probit specification and hence Probit results do not require any separate analysis.

Second, village communities must learn the art of collective action for the management of their natural resources in a harmonious manner through these institutions. The new forms of management require a shift from conflict to collaboration (Sarin, 1996). Some author argue that community based natural resource management (CBNRM) is in any way community based natural resource conflict management (CBNRCM) (Baland and Plateau, 1996). The presence of social capital helps bring about this shift.

Third, social capital, institutions, income of the households, government official (involved agencies), technology of production and supportive role of women play a crucial role in the success of micro-watershed projects in our sample villages. In other words, social capital, group maturity and some socio-economic factors are very important factors for the watershed project successful. The study suggests that collective action is successful where an underlying tendency for united action already exists in a community-based on cultural values, common identity, a tradition of participation, and shared historical experiences. Schedule tribe village Dombandi have a relatively simple and cohesive social structure in the absence of traditional hierarchies and fewer divisions arising out of differences in education, income, and lifestyles. The villagers are highly benefitted from afforestation, fishery and cattle bank. Water table increases in the Dombandi village. Before the launching of watershed project, villagers were not getting drinking water all over the year. In contrast, BAKU has greater heterogeneity in term of social and economic suffering from disunity, competition and factionalism. The village has little interest in resource conservation. Lack of social capital among the Governing Body in case of Valki and Karotia are the main cause for the failure of the projects. In Valki, farmers have also formed a bank (Valki Micro Bank) which provides credit to the villagers for reconstructions of ponds and similar works. Deforestation and lack of fund management in Karotia are the main factor for failure of the project.

When social cohesion is weak, effective village leadership and support of local officials can help in building community solidarity. Strong local leaders are well known for managing their micro-watershed development and SHGs effectively can play a seminal role in promoting collective action. The formation of a number of SHGs has helped in establishing a broader based representative and participatory management system. The importance of SHGs (mixture of men and women) were reduced (from 54 to 20 especially for Valki) in all projects. In most of the cases, men were the decision maker denying women right for the same. VWCs show that the constitution of representative and stable community institutions based upon democratic norms, relative self-sufficiency and independence at the grass roots is imperative for building social capital. Presidents and management committee members must represent the will and priorities of a larger village community. Further, these institutions must be able to facilitate inter-group negotiation and consensus so that all villagers feel their interests are being safeguarded.

There are two project implementation phases: capacity building phase (CBP) and final project implementation (FPI). In BAKU CPB was implemented with the using capital-intensive technology depriving labour-intensive. Thus the village farmers that is actual beneficiaries from legitimate right. Accountability to the village community and transparency in functioning determines the effectiveness and stability of a managing committee. The experience in BAKU, Karotia and Valki community indicates that the stability broke down because the majority loses its confidence in leadership who were unable to redress their grievances, decided to withdraw from participation. Suspicion regarding misappropriation of funds by the leadership exacerbates the distrust. Only in the Dombandi watershed project funds were used properly. Therefore, institutional arrangements are required which allow periodic consultations with local communities and regular audits of micro-watershed development and SHG accounts. In our sample villages, the existence of mechanisms such as the micro-plan, the pass book and village register has proved useful but these mechanisms have not always been followed. Regular meetings of the general body and of the management committee are also needed for the smooth functioning of the micro-watershed development and SHGs. Effective micro-watershed development is possible if clear rules are based on consensus achieved in regular meeting and monitoring. Such decisions must be supported by the governing body to prevent a dominant faction from imposing its will, as in Dombandi. Rules are also required to ensure equitable distribution of benefit flow among users/VWCs while at the same time ensuring sustainable levels of exploitation. Similar rules are required to govern distribution of water among users in a watershed projects. These rules need to be based upon principles of need, equity and sustainability. In BAKU, Karotia and Valki, the villagers have developed fair rules of resource extraction of forest produce and use of water. Where communities do not have experience in collective functioning, help from local political leaders in solving such problems becomes imperative. Strong local leadership can therefore create a bond of unity among villagers leading to the development of social capital. For micro-watershed development partnerships to succeed the relationship between leaders of SHGs and local officials must be based upon mutual acceptance of clearly defined rights, responsibilities, accountability and a shared understanding of participation. The various problems that have led to the closure of SHGs are: production and technology, organization, raw material, infrastructure, finance and capital flow, marketing. However, as we met members of the failed groups, it became apparent that the failure was due more to the lack of coordination and communication between group members. SHGs of the tribal village are active and creative. Social capital inheres not just in civil society but in relationships that span the ‘public-private divide’ (Evans, 1996). High levels of social capital in many situations are not the crucial factor that creates synergy, but ‘coherent, dependable public institutions’ at the local level. Certain amount or stock of social capital is necessary for the effectiveness of collective action. This requires that local leader/s must play a facilitative role in the establishment and functioning of VWCs and SHGs.

Social capital exists in varying degrees in our sample VWCs for the purpose of collective action. A notion of collective village interest exists, even if largely in the economic sense. Social capital is glue that binds exists, but only in the germ. In tribal villages, despite the lack of hierarchy and segmentation, it is a sense of community and the need to unite for survival that is important, not democratic functioning or participation in decision-making. Leaders are obeyed and expected to make decisions for the benefit of the larger group. Building a democratic social capital which involves all individuals and all social groups, particularly in VWC such as BAKU, Karotia are not easy; it requires much hard work: mobilization on the part of leaders, support and advice from the local officials and an understanding of the benefits of collective action on the part of the VWCs or community.

The degree of success achieved in watershed planning often depends on having people that can devote substantial time to the effort. Often these watershed issues are related and therefore partnerships might need to draw from all issue groups to succeed. Authorities of the project implementation need to study these diversities before setting up community institutional arrangements, which work in one situation, may not be useful in another. Group Maturity and Social Capital are found to be highly correlated but the number of observations in our case is only 4 (n=4). This is due to time, resource and number of project constraint in the survey area. One final remark is that the framework of this study is best-fit in a dynamic collective action setup. However, we could not obtain any time-series/panel data regarding the dynamics of collective actions. Hence, we examine the validity of these two hypotheses in a static sense in the context of the study sites. We also expect that the implications in both the setups static and dynamic will not diverge significantly.

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Appendix A. Group maturity criterion

Group alliance (External links and networks) Stage 1: Only vertical; Stage 2: Only horizontal; Stage 3: Both vertical and horizontal
Group formation Stage 1: Because an external agency asked it to; Stage 2: Because one or more of its members took the initiative and there was external agency support to help it form; Stage 3: Because one of more of the members took the initiative to form the group without external support
Group objective Stage 1: To conserve or restore a natural resource or resources to a previous status (the goal of the group is to restore what once was); Stage 2: To adapt to a change in the status of a natural resource or resources (the goal of the group is to adjust to new realities); Stage 3: To create new opportunities in managing a natural resource or resources (the goal of the group is to introduce something completely new)
Planning and testing Stage 1: Individual planning and testing; Stage 2: Group planning and then individual testing; Stage 3: Group planning and group testing
Conflict solving Stage 1: Usually relies on help from outsiders to solve a problem; Stage 2: First tries to solve a problem itself before seeking help from outsiders; Stage 3: The group does not need outside facilitators to solve its problems
Resilience Stage 1: It is possible that group breaks down before its goals are achieved; Stage 2: It is possible that the group breaks down after achievements of initial goals; Stage 3: It is unlikely that the group breaks down. The purpose of the group is redefined when initial goals are achieved
Group value and world views (Recognition of group value) Stage 1: No sense of group value; Stage 2: Group based activities are narrow-based; Stage 3: Group based activities are broad-based
Institutional effectiveness/ Institution (Rules and norms) Stage 1: Very low implementation; Stage 2: Medium implementation; Stage 3: High implementation
Self-analysis Stage 1: The group has never evaluated its progress in meeting its objectives; Stage 2: The group sometimes evaluates its progress in meeting its objectives; Stage 3: The group regularly evaluates its progress in meeting its objectives
Views of change Stage 1: The group is fearful of change, it is defensive; Stage 2: The group is adjusting to change, it is reactive Stage 3: The group is creating new opportunities, it is proactive