



INVESTIGATING PUBLIC PERCEPTION AND PARTICIPATION IN WATERSHED MANAGEMENT: A CASE STUDY OF MAHARASHTRA

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Abstract: This paper discusses the challenges faced by poor and marginal farmers in India who rely on degraded land in rain-fed areas due to soil erosion and water resource depletion. The focus is on sustainable land and water resource management to boost productivity, conserve resources for future generations, and provide equitable livelihoods for the poor. The watershed is presented as a holistic approach to land and water management that has shown positive results in terms of enhanced soil and water conservation and agricultural productivity. However, it is challenging to prioritize people's developmental needs and objectives over land or water and their potential for development. The paper employs mixed methods, including primary and secondary sources of data, FGD, and participation and perception indexes. The findings reveal a lack of ownership perception values among farmers, which hinders their active participation in watershed management. Therefore, it is crucial to cultivate an augmented sense of ownership among farmers to ensure their active participation in the program, ultimately leading to better management of resources in the area.

Keywords: Rain-fed agriculture, watershed development, people's participation, Perception Index

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INTRODUCTION

As a result of soil erosion caused by runoff and water resource depletion, millions of poor and marginal farmers in India are compelled to rely on degraded land in

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rain-fed areas, and they are also exposed to various agro-climatic, production, and market hazards. Given these circumstances, an important concern is how to sustainably manage land and water resources to boost productivity, conserve resources for future generations, and provide equitable livelihoods for the poor. While these are undoubtedly noble goals, specific management strategies must focus on what is feasible. Those who rely on land and water resources for their livelihoods, including small-scale farmers, livestock owners, and foresters, among others, come to realize that their interactions with one another have repercussions for others in a watershed setting.

As a holistic approach to land and water management, the watershed presents a vast opportunity for enhancing crop productivity, whether for rain-fed crops or under small-scale irrigation, and for generating biomass for livestock. Over the past fifty years, India has faced these challenges head-on and made significant investments in watershed management, employing a blend of technical innovations, participatory approaches, and an enabling policy framework. Positive results are apparent in terms of enhanced soil and water conservation and agricultural productivity in normal rainfall years in regions that were overlooked by the conventional green-revolution-based rural development approach.

In the 1990s, the concept of sustainable livelihoods emerged in response to the realization that rural development strategies that focused solely on agricultural production were insufficient to meet the needs of rural and landless poor populations. Rural livelihoods, which are frequently not agrarian or land-based, often rely only partly on agricultural land and livestock. An individual's or a household's income may also be derived from alternative sources, such as migration, side hustles, or handicraft production. For land-based development programs, such as the watershed development program, it is challenging to prioritize people's developmental needs and objectives over land or water and their potential for development.

In this context it is noteworthy that National Authority for sustainable development of Rain fed Areas (NASDORA) and other institutional arrangements are indispensable for implementation of program from national level to local micro watershed level for sustainable development and raising productivity. It is pertinent to mention that the present policy for agriculture growth in the country continues to lay emphasis on conventionally enhancing irrigation potential in different parts of the country. Divergence in normal monsoon causes variations in rainfall intensity and pattern expressed by droughts

and floods resulting in serious fluctuations in water availability. The fluctuation in water availability is responsible for variation in agricultural production, which renders rain fed production unstable and inconsistent, exacerbating food security and intercepts the availability of agricultural products. Due to the fact that rain-fed soils are generally infertile and prone to water and wind erosion, which renders the overall environmental endowment rather fragile, agricultural production in uncertain rainfall areas is associated with high risk factors and as a result, the level of rural poverty in such areas is much higher than in irrigated areas. People in rain fed areas are resource poor having low risk-taking capacity as these areas extend into remote corners, sometimes almost into inaccessible areas, with poor communication facilities and logistic supports, a cause of demotivation on the part of the service providers and the procurer of output.

Over the years, the Government of India has set aside substantial budgetary provisions for micro-watershed rehabilitation and development. The main trust of this program is to change in agricultural policy, which acknowledges the neglect of rain fed and common areas during the period of the green revolution and accepts a link between the degradation of rain fed areas and the poverty of large number of people. Despite various rural and agricultural development programs taken so far by different ministries of government of India, agriculture sector which contributes significantly to GDP (15 %) remains at the helm of erratic rainfall causing not only serious damage in farming and implementing agricultural plans. Rain fed farming is important and is gradually emerging with the objective of feeding the growing populace by raising agricultural production with sustenance. Rain fed agriculture is complex, diverse and risk prone and is characterized by low level of productivity and low input usage.

The variability and instability of yield in Indian agriculture have resulted in fluctuations in rainfall. In order to address this challenge, the aim is to transform rain-fed farming into a more sustainable and productive system to support the population dependent upon it. To achieve this goal, the government of India has accorded high priority to the holistic and sustainable development of rain-fed areas through the implementation of the watershed development approach. Different ministries are implementing a large number of projects aimed at enhancing production and livelihoods of the people through the watershed development programme. The national watershed development project for rain-fed areas (NWDPR), which has been implemented by the Ministry of Agriculture since 1990-91, is the largest project in terms of scope and extent. The state of Maharashtra is known as a state with large share of rain-fed area

with a meagre proportion of area under irrigation land and paradoxically; large share of available irrigation water is being used mainly for water consuming cash crop like sugar dominated by large affluent farmers, and as such, irrigation needs of the state as a whole and more predominantly the poor marginal and small farmers are not addressed notwithstanding the larger area being covered under the drought-prone zone (Tripathy, 2017).

Prof. Tripathy aptly remarked that the vast natural, human and other resources of the area have not been properly managed due to failure of various land based development programs; and hence, to check further depletion of the existing resources and to bring about socio-economic changes keeping a balance between the production and the environment, to address some of the basic question of survival such as: long-term self-reliance and sustainability in the livelihood system, regeneration of bio-mass and the degraded eco-system, entitlement and equitable control over community, and economic viability of a self-managed resources system at the micro-level etc. the alternative viable opportunity available is watershed development approach only when boosted through micro-finance (Tripathy,2010,2013, 2017).

The present study has been confined to National Watershed Development Program for Rain fed Areas (NWDPR), which is the main program for the development of rain fed areas through the watershed development approach of the government of India. The NWDPR had three-fold objectives, namely:

Talking the watershed as a basis to conserve and upgrade croplands and waste lands as vital resources.

To develop and demonstrate location specific technologies for proper soil and moisture conservation measures and crop production-stabilization measures required under different agro-climatic conditions.

To make arrangement of the fodder, fruit, and fuel resources of the village communities by use of appropriate alternative land use systems.

OBJECTIVES AND SCOPE OF THE STUDY

- i) The primary objective of this study is to comprehend the extent of people's participation and their perceptions regarding the advantages of watershed programs.
- ii) Another aim of this study is to scrutinize the opinions of the residents regarding their engagement and the efficacy of the watershed programs.
- iii) The research will also investigate the difficulties and obstacles in adopting these programs in the chosen watersheds within the sample districts of

Maharashtra, namely Kolhapur, Nagpur, Raigarh, and Nanded. The scope of the study is limited to specific villages/blocks within these four districts of Maharashtra.

METHODOLOGY

About collection of primary data, a multistage stratified sampling has been adopted. Keeping in mind the coverage of the state as well as the performance in percentage utilization of fund over total allocation under National Watershed Development Program for Rain fed Areas (NWDPRRA), in the first stage, four districts of Maharashtra namely, Kolhapur from the north, Nagpur in the Vidarbha region in the east, Raigarh from the Konkan region in the west and Nanded in the Marathawada region in the central towards south have been selected.

Despite heavy rainfall, due to sloppy hills and soil, much of the water is runoff and unutilized as the soil couldn't retain much water in the Konkan region of Raigarh. Though the Godavari River flows in Nanded, but this constitutes a major part of Marathawada region which is a dry region in Maharashtra. Both Nagpur and Raigarh are backward regions of the state which comes in the Vidarbha region in the east and the Konkan region in the west of Maharashtra respectively.

In the second stage, one watershed where NWDPRRA is in operation has been selected from each district considering its performance. Gadhinglaj block from Kolhapur district, Kuhi block from Nagpur district, Murud block from Raigarh district and Himayatnagar block from Nanded district have been selected. Finally, one beneficiary village and another non-beneficiary village, thus, an aggregate of two villages from each block have been selected for the purpose of the present study. The beneficiary villages are Baserge, Mandhal, Walke-Shirgoan and Takarala from the block Gadhinglaj, Kuhi, Murud and Himayatnagar respectively. The non-beneficiary villages selected for the study are Hasursasgiri, Navegoan Devi, Chorde and Parwa, from the respective blocks. The selection of districts, blocks and villages samples is presented in Table 1.

The study was conducted in October 2022 with the help of brief interview schedule in all the four sample districts to understand the perception of the beneficiary households and their involvement in the development of watershed and its sustainability. There is a serious problem of accessibility of such information in the public domain, besides inconsistency in information/

data on issues correlated to the spread/coverage and physical and financial progress of watershed projects.

Households being the unit of enquiry for our study, 40 households from beneficiaries have been selected following the technique of stratified random sampling without replacement. Thus, finally a sample of 160 households has been selected for study purpose.

The sustainability of the environmental management programs such as watershed intervention program depends on the understanding of the nexus of the community's perception, participation, and livelihoods. However, there are little studies on the interactions of these very important parameters. This study investigated the nexus of farmers' perception, participation, livelihoods, and their implication for sustaining watershed management program in Maharashtra. To this end, household survey, focus group discussion and key informant interview were employed to collect and analyse the data.

The data collection procedure involved the use of face-to-face individual interviews and FGDs. Individual interviews were conducted with stakeholders who could not participate in group discussions, and these stakeholders were fewer in number and held higher positions in the administrative hierarchical ladder. On the other hand, FGDs were conducted with stakeholders who were working at the village level, and thus were more representative of the grassroots-level perspective.

Table 1: Sample districts, blocks and villages selected for the study.

<i>Districts</i>	<i>Blocks</i>	<i>Beneficiary village</i>	<i>No. of sample Households covered</i>
Kolhapur	Gadhinglaj	Baserge	40
Nagpur	Kuhi	Mandhal	40
Raigarh	Murud	Walke-Shirgoan	40
Nanded	Himayatnagar	Takarala	40
4 districts	4 blocks	4 villages	160 households

PEOPLE'S PARTICIPATION IN WATERSHED MANAGEMENT

The participatory integrated watershed management approach introduced and developed over the decades includes, in addition to the technical aspects, the economic, social, political, and cultural dimensions of natural resources preservation and management. Watershed management has developed a multi-disciplinary activity in which suitable institutional and organizational

procedures are required for the coordination/ implementation of watershed management activities. The development of concepts and approaches, and the watershed management involvements from several parts of the world emphasizes more investigation, analysis, and consultation among watershed management stakeholders for greater consensus on what has been achieved and what more can be done better. Stakeholders are emphasizing the requirement for a stronger overview of several important concerns to watershed management development.

The concept of integrated and participatory watershed development and management has emerged as the cornerstone of rural development in the dry and semi-arid regions of India. Over the years the country has been making increasing investments in this area with the objective of enhancing the production potential of rainfed agriculture.

Cohen and Uphoff (1980) unfold that community involvement should include people's participation in decision-making, implementation of programmes, monitoring and evaluation as well as sharing the benefits from development projects.

The Food and Agriculture Organization (1982) elaborated that peoples' participation is essential to enhance economic and political relationship within wider societies.

Kumar and Pretty (2002) have recognized different levels of participation, ranging from passive to active levels, and have concluded that active participation is where and when local people are totally involved in all processes of management.

Leach and Sabatier (2002) revealed that participatory watershed planning must go beyond initial implementation of policies; the implementation stage must be followed by a system of monitoring and evaluation so that local people will be able to follow and measure project developments.

Table 2 reveals the information regarding beneficiary Self Help Group (SHGs) and Users Groups (UGs) of the beneficiary villages covered in our study in different watersheds. There are self-help groups in the study villages, which are voluntarily formed for their mutual benefits in the use of water resources, production, marketing, financial transactions etc. There are also water users' groups; the members may be from the SHGs or outside the purview of SHGs. While in the watershed-1(Kolhapur) there are 7 SHGs, the highest number of 17 such groups are manifested in the watershed-111(Raigarh), followed by watershed -11(Nagpur) (15).

Table 2: Information Regarding Self Help Groups (SHGs) and Users Groups (UGs) of the Villages under Selected Watersheds

Sr. No	Particulars	Watershed - I (Kolhapur) Basarge Village		Watershed - II (Nagpur) Mandhal Village		Watershed - III (Raigarh) Walke- shirgoan Village		Watershed - IV (Nanded) Takarala Village	
		S.H.G.	U.G.	S.H.G.	U.G.	S.H.G.	U.G.	S.H.G.	U.G.
1	Total No. of SHGs / UGs in the village	7	9	15	16	17	5	9	10
2	No. of SHGs / UGs are involved in watershed management	4	9	4	5	4	2	2	4
3	No. of SHGs / UGs formed by women only	5	0	14	0	5	0	1	0
4	No. of SHGs / UGs farmed only by women and are involved in watershed management	0	0	4	0	0	0	2	0

Source: Interview schedules, field survey, village panchayat office record of the various watersheds, 2002-03 to 2017-18

Similarly, the watershed - II (Nagpur) occupies the highest number of 16 such groups followed by 10 such groups in the Watershed - IV (Nanded) and 9 UG in the watershed - I (Kolhapur). With regard to SHGs / UGs which are involved in watershed management we have all the 9 UG in the watershed - I (Kolhapur) involved in the watershed management, followed by watershed - IV (Nanded) where 4 UG out of 10, are engaged for such activity. The data relating to no. of SHGs / UGs formed (by women only) shows that there are 14 out of 15 SHG in watershed - II (Nagpur), 5 out of 7 in the watershed - I (Kolhapur) and 5 out of 17 SHG in the Watershed - III (Raigarh) and the lowest number of one out of 9 SHG in the watershed - IV (Nanded) were functioning in the beneficiary villages of different watersheds. No. of SHGs / UGs farmed only by women and are involved in watershed management found in two watersheds watershed - II (Nagpur) (4) and 2 in the watershed - IV (Nanded). It was interesting to note that the involvement of women in the

management of watersheds found to be very high in watershed - II (Nagpur), followed by watershed - I (Kolhapur).

Table 3: Information regarding Contribution to the Fund (in Rs.) by the Self-Help Groups (SHGs) of the beneficiary Villages under Selected Watersheds

Sr. No.	Particulars	Watershed - I (Kolhapur)	Watershed - II (Nagpur)	Watershed - III (Raigarh)	Watershed - IV (Nanded)	Overall
1	Contribution of SHGs farmed for the other activities					
	i) Only men	0	1	0	2	3
	ii) Only women	4	14	10	13	41
	iii) Total	4	15	10	15	44
2	Fund available by sources (other activities)					0
	i) Bank	10,000	15,000	10,000	10,000	45,000
	ii) Govt. Sector	0	0		0	0
	iii) Others	0	0		1	1
3	Contribution of SHGs farmed watershed management only					0
	i) Only men	0	0	0	0	0
	ii) Only women	5	2	6	2	15
	iii) Total	5	2	6	2	15
4	Fund available by sources (in Rs.)					0
	i) Bank	1,00,000	1,00,000	1,50,000	1,00,000	4,50,000
	ii) Govt. Sector (Only women)	0	0	0	0	0
	iii) Others	0	0	0	0	0

Source: Field survey, village panchayat office record of the various watersheds, 2002-03 to 20017-18

Table No. 3 provides the information regarding contribution to the funds by Self Help Group (SHG s) of the beneficiary villages under selected watershed. For other than watershed management, while in watershed-IV (Nanded) two Self Help Group have been formed by men and one at watershed-II (Nagpur),

but in watershed-I (Kolhapur) and watershed-III (Raigarh) no Self-Help Group in found to be formed by men. The maximum numbers of SHGs (14) were formed in watershed II-(Nagpur) by women, followed by (13) watershed-IV (Nanded) and watershed-III (Raigarh) (10). Watershed-I (Kolhapur) presents the lowest number of SHGs of 4.

Regarding formation of exclusively for watershed management SHGs, all such SHGs have been formed by women in the selected watershed area. The highest number of such SHGs is found at watershed III-(Raigarh) (6), followed by watershed-I (Kolhapur) (5). Fund available by sources indicated that the public sector banks have exhibited their interest in providing funds for such activities of the watersheds users or SHGs relating to the watershed management. The amount of funds available for watershed related activities ranges from Rs.1 lakh to 1.5lakhs, whereas for activities other than watersheds the bank funded in the range of Rs.10,000 to 15,000 to the SHGs.

Table 4 (A): Information regarding Irrigation Sources of the Villages under Selected Watersheds

Sr. no.	Type of sources	Watershed - I (Kolhapur) Basarge village				Watershed - II (Nagpur) Mandhal village			
		No. Capa. Length	Area in ha		% change in area	No. Capa. length	Area in ha		% Change in area
			2002-03	20017-18			2002-03	20017-18	
1	Irrigated land (Govt) ha	0	0	0	0	0			0
2	Irrigated land (pvt.) ha.	120	78	102	30.76	435.82	234.67	262.45	11.83
3	Tanks (Govt)	1	1	2.2	120	2	3.21	5.27	64.17
4	Tanks (pvt.)	5	2.3	9.2	300	3	4	6	50
5	Well (Govt.)	2	11	17	54.54	4	19	26	36.84
6	Well (pvt.)	9	23	65	182.61	21	101	131.06	29.76
7	Shallow tube-well	2	4	10	150	9	16.11	23.95	48.66
8	Deep tube-well	2	1	5	400	0	0	0	0
9	Others	5	13	22	69.23	0	0	0	0

Source: Field survey, village panchayat office record of the various watersheds, 2002-03 to 20017-18

Table 4 (B): Information regarding Irrigation Sources of the Villages under Selected Watersheds

<i>Watershed - III (Raigarh) Walke-Shirgoan village</i>				<i>Watershed - IV (Nanded)Takarala village</i>			
<i>No. Capa. Length</i>	<i>Area in ha</i>		<i>% Change in area</i>	<i>No. Capa. length</i>	<i>Area in ha</i>		<i>% Change in area</i>
	<i>2002-03</i>	<i>2017-18</i>			<i>2002-03</i>	<i>2017-18</i>	
0	0	0	0	0	0	0	0
376.68	127	324	155.12	271	110	125	13.63
1	1.75	4	128.57	0	0	0	0
4	2	5	150	0	0	0	0
5	11	23	109.09	1	2	3	50
64	111.12	137.48	23.72	7	15	20	33.33
15	17	29	70.58	11	25	45	80
14	9	11	22.22	5	7	10	42.85
54	49	72	46.93	0	0	0	0

Source: Field survey, village panchayat office record of the various watersheds, 2002-03 to 2017-18.

Information relating to irrigation sources of the beneficiary village under the selected watershed has been analysed in the table No.4(A) and 4(B). It is revealed that during the period 2002-03 to 2017-18, due to NWDPRRA the irrigation potentiality has been enhanced in the entire watershed. About irrigated land (Private), the highest increase of 155.12% has been noticed in the watershed-III (Raigarh).

Similarly, in case of irrigation through tanks (Govt), there has been increased area of irrigation, the highest percentage of increase 128.57% in watershed-III (Raigarh), followed by 120% in the watershed-I (Kolhapur). Though enhanced irrigation potentiality has been created due to watershed and visible increase in cultivation has taken place in all the watersheds but in the watershed-I (Kolhapur), the highest percentage of change has been found. Irrigation through tanks (private), well (pvt.), shallow tube well and others, the increase in area of irrigated land has been 300%, 182.61%, 150%, 400% and 69.23% respectively. In case of irrigation through 'Govt. wells' the higher increase of 109.09% has been found in the watershed-III (Raigarh). Deriving from Table -4 (A) & (B), the capacity of watershed sources in each of the villages, both in aggregate and per hectare or per 100 people are as tabulated below.

Table 4C: Aggregate Capacity of watershed sources in each of the villages, both in aggregate and per hectare or per 100 people

Capacity (No./ length / area)				
Source	Kolhapur (Basarge)	Nagpur (Mandhal)	Raigarh (Walke- Shirgaon)	Nanded (Takarala)
Irrigated land (Govt)ha	0	0	0	0
Irrigated land (pvt.) ha.	120	435.82	376.68	271
Tanks (Govt)	1	2	1	0
Tanks (pvt.)	5	3	4	0
Well (Govt.)	2	4	5	1
Well (pvt.)	9	21	64	7
Shallow	2	9	15	11
tube-well	0	0	14	5
Deep tube-well	2	0	54	0

Source: Field Survey

Table 4D: Capacity per hectare or per 100 people

Capacity (No./ length / area)				
Source	Kolhapur (Basarge)	Nagpur (Mandhal)	Raigarh (Walke- Shirgaon)	Nanded (Takarala)
Irrigated land (Govt) per hectare	0	0	0	0
Irrigated land (pvt.) per hectare	0.16	0.27	2.22	0.38
Per 100 people				
Tanks (Govt)	0.02	0.05	0.02	-
Tanks (pvt.)	0.12	0.00	0.01	-
Well (Govt.)	0.05	0.04	0.67	0.13
Well (pvt.)	0.22	0.22	8.52	0.92
Shallow	0.05	0.09	2.00	1.45
tube-well	-	-	1.86	0.66
Deep tube-well	0.05	-	7.19	-

Source: Calculated from field survey and population and area data from Indiavillageinfo.in

The tables above (4c & 4d) indicate that, broadly Raigarh district is relatively endowed with higher number of water sources on a per capita basis. In descending order of watershed sources, the districts can be arranged as Raigarh,

Nanded, Nagpur and Kolhapur. Interpreted together with the relative increase between two time periods (2002-03 and 2017-18) presented in the charts that follow, Kolhapur shows strong increase in watershed sources indicating success of watershed intervention and participation.

The relative increase in the sources of watershed during different time periods (2002-03 and 2017-18) is presented in Figures 1-4. As evidenced by the following graphs, the share of private sources, especially irrigated lands, wells, and tanks has increased markedly over the 15-year span especially for Kolhapur and Raigarh districts.

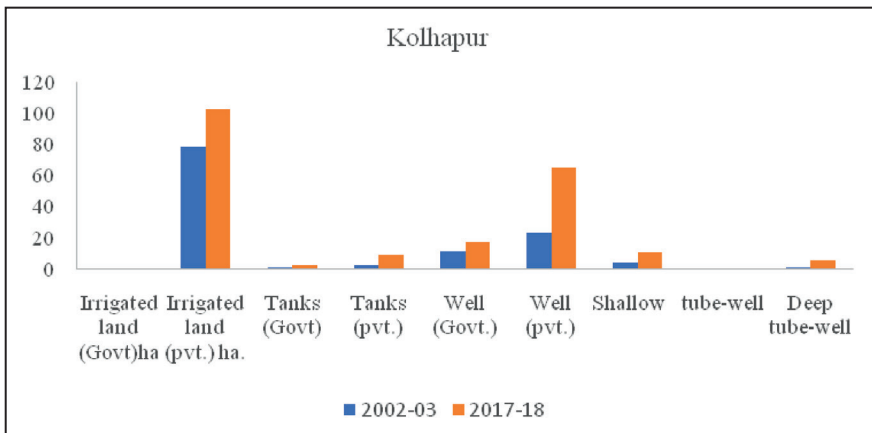


Figure 1: Increase in watershed 2002-03 to 2017-18 (Kolhapur)

Source: Field Survey

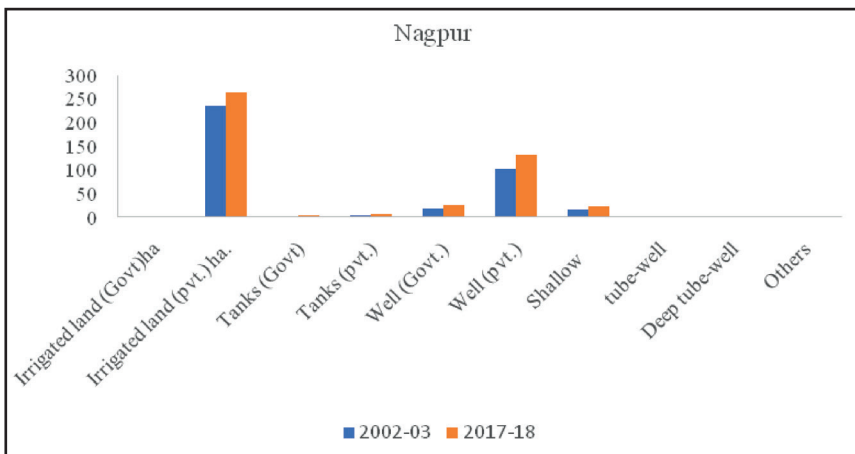


Figure 2: Increase in watershed 2002-03 to 2017-18 (Nagpur)

Source: Field Survey

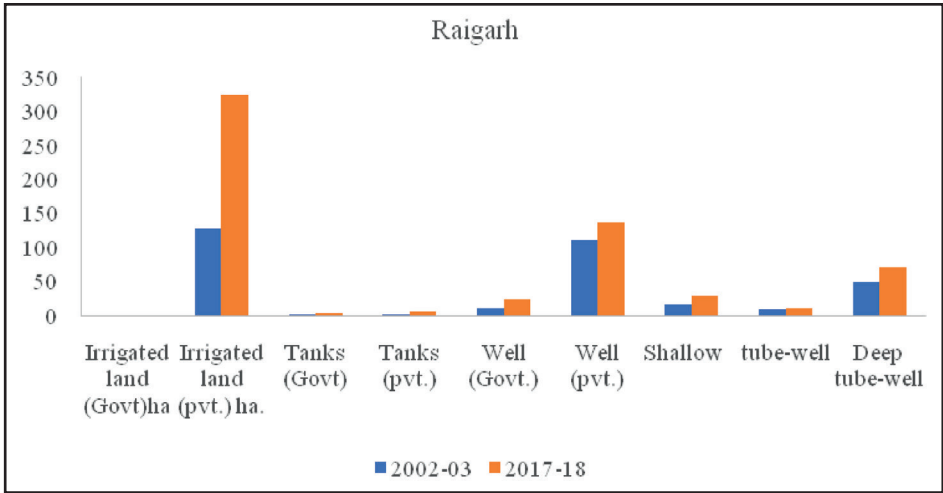


Figure 3: Increase in watershed 2002-03 to 2017-18 (Raigarh)

Source: Field Survey

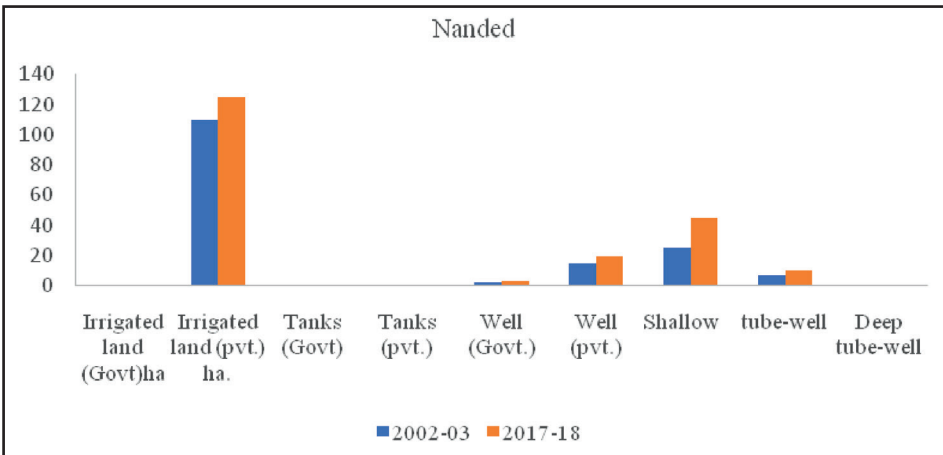


Figure 4: Increase in watershed 2002-03 to 2017-18 (Nanded)

Source: Field Survey

Certainly, in the realm of irrigation through tanks administered by the Government, a notable expansion in the area of irrigation hath come to pass. The zenith of such augmentations hath been witnessed in watershed-III (Raigarh), where the percentage of increase reached a towering 128.57%, closely followed by a staggering 120% in the watershed-I (Kolhapur). Whilst the watershed schemes have engendered a marked elevation in the potentiality of irrigation, leading to a perceptible surge in cultivation across all watersheds,

the watershed-I (Kolhapur) hath displayed the most significant alteration percentage-wise.

Moreover, the application of private tanks for irrigation hath wrought a colossal surge in the area of irrigated land. The use of private wells hath engendered an increase of 182.61%, whilst shallow tube wells have stimulated a rise of 150%. In addition, other modes of irrigation such as the employment of wells administered by private entities, have given rise to increases of 300%, 400%, and 69.23%, respectively. However, in the case of irrigation through wells controlled by the Government, the watershed-III (Raigarh) hath displayed the largest percentage increase of 109.09%.

Table 5(A): Information Regarding Water Harvesting Structure of the Villages under Selected Watersheds

Sr. No.	Type of Structure	Watershed - I (Kolhapur) Basarge village			Watershed - II (Nagpur) Mandhal village		
		Total no. working			Total no. working		
		2002-03	2017-18	% change of working	2002-03	2017-18	% change of working
1	Tanks	1	4	300	3	3	0
2	Check Dams	0	0	0	6	6	0
3	Nalla Plugs	2	6	200	3	3	0
4	Weirs	0	0	0	0	0	0
5	Farm Ponds	1	4	300	0	6	100
6	Diversion	0	0	0	0	0	0
7	Submersible Check Dams	0	2	0	0	0	0
8	Percolation Well	4	10	150	0	0	0
9	Any other (boar wells)	0	0	0	0	0	0

Source: Field survey, village panchayat office record of the various watersheds, 2002-03 to 2017-18.

Tables 5(A) and 5(B) unfold information regarding water harvesting structure of the villages under selected watersheds of Maharashtra. About the numbers of farm ponds, there has been an increase of ponds from 02 to 25, there by the highest increase of 1150% in the watershed-III (Raigarh) followed by an increase of 1 to 4 ponds (an increase by 300%) in the watershed-I (Kolhapur), followed by an increase of zero to 6 (an increase by 100%) in the watershed-II (Nagpur). Though number of tanks could not register any increase in watershed-II (Nagpur) and watershed-III (Raigarh), but it has increased from 1 to 4 (an

Table 5(B): Information Regarding Water Harvesting Structure of the Villages under Selected Watersheds

Sr. No.	Type of Structure	Watershed - III (Raigarh) Walke-shirgoan village			Watershed - IV (Nanded) Takarala village		
		Total no. working			Total no. working		
		2002-03	2017-18	% Change of working	2002-03	2017-18	% Change of working
1	Tanks	3	3	0	0	0	0
2	Check Dams	0	0	0	0	0	0
3	Nalla Plugs	0	0	0	0	0	0
4	Weirs	0	0	0	0	0	0
5	Farm Ponds	2	25	1150	0	0	0
6	Diversion	0	3	0	4	4	0
7	Submersible Check Dams	0	0	0	25	45	80
8	Percolation Well	0	0	0	15	20	33.33
9	Any other (boar wells)	0	0	0	0	0	0

Source: Field survey, village panchayat office record of the various watersheds, 2002-03 to 2017-18.

increase by 300%) in watershed-I (Kolhapur). Regarding the 'Nala plugs' and 'percolation well' there has been an increase of 200% and 150% respectively in the watershed-I (Kolhapur). The numbers of submersible check dams have the highest increase from 25 to 45 during the period 2001-02 to 2006-07 and thus, an increase of 80% is attained mainly in the watershed-IV (Nanded).

Table 6(A): Information regarding Sources of Drinking Water of Villages under Selected Watersheds

Sr. No.	Type of Sources	Watershed - I (Kolhapur) Basarge village		Watershed - II (Nagpur) Mandhal village	
		Functioning	Not Functioning	Functioning	Not Functioning
1	Hand Pump	6	0	31	0
2	Wells	5	0	19	0
3	Ponds	4	0	6	0
4	Stand Posts	0	0	3	0
5	Household taps	26	0	153	0
6	Springs	0	0	0	0
7	Others (boar well)	0	0	0	0

Source: Field survey, village panchayat office record of the various watersheds, 2002-03 to 2017-18.

Table 6(B): Information regarding Sources of Drinking Water of Villages under Selected Watersheds

Sr. No.	Type of Sources	Watershed – III (Raigarh) Walke-shirgoan village		Watershed – IV (Nanded) Takarala village	
		Functioning	Not Functioning	Functioning	Not Functioning
1	Hand Pump	0	0	5	0
2	Wells	16	0	7	0
3	Ponds	0	0	0	0
4	Stand Posts	15	0	0	0
5	Household taps	425	0	0	0
6	Springs	1	0	0	0
7	Others (boar well)	0	0	25	15

Source: Field survey, village panchayat office record of the various watersheds, 2002-03 to 2017-18

A comprehensive depiction of the diverse types of drinking water sources available in the selected watershed villages has been presented in Table 6(A) and 6(B). It is a source of great satisfaction to take cognizance of the fact that all the water sources in the carefully selected watersheds are fully operational. However, it has recently been brought to our attention that a staggering 60% of the bore

Table 7(A): Information regarding Occupational Status of the SHG / Beneficiaries of the Villages under Watershed - I (Kolhapur) Basarge Village

Sr. No.	Occupational Group	Total no of Group	Total no of Beneficiaries	SC (%)	ST (%)	General other than Minorities (%)	Minorities (%)	Woman (%)	Total (%)
1	Agriculture	5	60	2 (3.33)	1 (1.66)	16 (26.66)	0	41 (68.33)	60 (66.66)
2	Poultry	0	0	0	0	0	0	0	0
3	Dairy	2	30	4 (13.33)	1 (3.33)	9 (30)	2 (6.66)	14 (46.66)	30 (33.34)
4	Business	0	0	0	0	0	0	0	0
5	Rural Artisan	0	0	0	0	0	0	0	0
6	Service	0	0	0	0	0	0	0	0
7	Landless Labour	0	0	0	0	0	0	0	0
8	Others	0	0	0	0	0	0	0	0
9	Total	7	90	6 (16.66)	2 (4.99)	25 (56.66)	2 (6.66)	55 (114.99)	90 (100)

Source: Taluka Agriculture officer, Gadhinglaj, Dist. Kolhapur, village panchayat office Record, 2002-03 to 2017-18.

wells, specifically 15 out of 25, have succumbed to functional obsolescence, owing to a lack of adequate maintenance measures. Nevertheless, it has become indisputably evident that the watershed intervention has efficaciously rendered a positive impact on the beneficiary villages, by bestowing upon them a dependable and sustainable supply of potable water facilities, thus reinforcing their socio-economic development.

The depiction of the occupational status of the Self-Help Group (SHG) beneficiaries' villages situated in the watershed Basarge village of Kolhapur has been expounded in Table 7(A). The analysis reveals that 66.66% of the beneficiaries are engaged in the pursuit of agriculture, which is their primary occupation. Significantly, 68.33% of these beneficiaries are women. Following agriculture, dairy farming, which involves both men and women, has been found to be the secondary occupation, accounting for 33.34% of the beneficiaries. Moreover, it has been discovered that most of the direct beneficiaries come from the weaker sections of society, particularly women, Scheduled Castes (SCs), and Scheduled Tribes (STs).

Table 7(B): Information regarding Occupational Status of the SHG / Beneficiaries of the Villages under Watershed - II (Nagpur) Mandhal Village

Sr. No	Occupational Group	Total no of Group	Total no of Beneficiaries	SC (%)	ST (%)	General other than Minorities (%)	Minorities (%)	Woman (%)	Total (%)
1	Agriculture	4	80	9 (11.25)	6 (7.5)	0	11 (13.75)	54 (67.5)	80 (26.67)
2	Poultry	1	20	1 (5)	0	4 (20)	6 (30)	9 (45)	20 (6.66)
3	Dairy	0	0	0	0	0	0	0	0
4	Business	2	40	6 (15)	8 (20)	4 (10)	4 (10)	18 (45)	40 (13.33)
5	Rural Artisan	6	120	2 (1.67)	0	24 (20)	0	94 (78.34)	120 (40)
6	Service	0	0	0	0	0	0	0	0
7	Landless Labour	2	40	6 (15)	4 (10)	16 (40)	6 (15)	8 (20)	40 (13.33)
8	Others	0	0	0	0	0	0	0	0
9	Total	15	300	24 (47.92)	18 (37.5)	48 (90)	27 (68.75)	18 (255.84)	300 (100)

Source: Project Report on N.W.D.P.R.A. 10th five-year plan, Kushi, Nagpur, Department of Agriculture Government of Maharashtra, 2002-03 to 2017-18.

Table 7(B) has been depicted the information about occupational status of the SHGs / beneficiaries of the villages under watershed - II Mandhal village (Nagpur). It is found engaged in rural artisan (40%) as their occupation, and interestingly more than the third of such beneficiaries (78.34%) are women. Next to rural artisan, agriculture as an occupation (26.67%) has been found involving both men and women. It is further found that most of the direct beneficiaries are belonging to the weaker sections of the society especially from women, SC, ST categories.

Table 7(C): Information regarding Occupational Status of the SHG / Beneficiaries of the Villages under Watershed – III (Raigarh) Walke-Shirgoan Village

Sr. No	Occupational Group	Total no of Group	Total no of Beneficiaries	SC (%)	ST (%)	General other than Minorities (%)	Minorities (%)	Woman (%)	Total (%)
1	Agriculture	7	89	14 (15.73)	11 (12.35)	23 (25.84)	9 (10.11)	32 (35.96)	89 (41.59)
2	Poultry	2	24	3 (12.5)	2 (8.33)	4 (16.67)	6 (25)	9 (37.5)	24 (11.21)
3	Dairy	2	23	5 (21.73)	4 (17.39)	3 (13.04)	6 (26.08)	5 (21.73)	23 (10.74)
4	Business	5	64	9 (14.06)	5 (7.81)	18 (28.12)	8 (12.5)	24 (37.5)	64 (29.92)
5	Rural Artisan	0	0	0	0	0	0	0	0
6	Service	0	0	0	0	0	0	0	0
7	Landless Labour	1	14	2 (14.28)	1 (7.14)	2 (14.28)	1 (7.14)	8 (57.14)	14 (6.54)
8	Others	0	0	0	0	0	0	0	0
9	Total	17	214	33 (15.42)	23 (10.75)	50 (23.36)	30 (14.01)	78 (36.44)	214 (100)

Source: Interview schedules, field survey, village Panchayat office Record, 2002-03 to 2017-18.

Certainly, the stratification of occupational status pertaining to the Self-Help Group (SHG) beneficiaries' hamlets located within the purview of the Walke-Shirgoan village in Raigarh, is demonstrated in the Table 7(C). As per the findings, a preponderant proportion of 41.59% are engaged in the agricultural domain, and intriguingly, a significant slice of 35.96% constitutes

of women beneficiaries. Following agriculture, business pursuits have been noted to be the occupation of 29.92% of the populace, encompassing both genders. Additionally, it has been ascertained that a major chunk of the direct beneficiaries hail from the deprived sections of society, especially the women, Scheduled Castes (SCs), and Scheduled Tribes (STs).

Table 7(D): Information regarding Occupational Status of the SHG / Beneficiaries of the Villages under Watershed - IV (Nanded) Takarala Village

Sr. No	Occupational Group	Total no of Group	Total no of Beneficiaries	SC (%)	ST (%)	General other than Minorities (%)	Minorities (%)	Woman (%)	Total (%)
1	Agriculture	3	41	8 (19.51)	5 (12.19)	11 (26.82)	7 (17.07)	10 (24.39)	41 (33.06)
2	Poultry	1	14	2 (14.28)	0	7 (50)	1 (7.14)	4 (28.57)	14 (11.29)
3	Dairy	2	25	5 (20)	2 (8)	9 (36)	2 (8)	7 (28)	25 (20.16)
4	Business	1	16	2 (12.5)	1 (6.25)	2 (12.5)	2 (12.5)	9 (56.25)	16 (12.90)
5	Rural Artisan	0	0	0	0	0	0	0	0
6	Service	0	0	0	0	0	0	0	0
7	Landless Labour	2	28	4 (14.28)	1 (3.57)	2 (7.14)	6 (21.43)	15 (53.57)	28 (22.58)
8	Others	0	0	0	0	0	0	0	0
9	Total	9	124	21 (16.93)	9 (7.25)	31 (25)	18 (14.51)	45 (36.29)	124 (100)

Source: Interview schedules, field survey, village Panchayat office Record, 2002-03 to 2017-18.

Table 7(D) has been depicted the information about occupational status of the SHGs / beneficiaries of the villages under watershed –IV (Takarala village, Nanded). It is found that the highest number of beneficiaries is engaged in agriculture (33.06%) as their occupation. Next to agriculture, landless labour as an occupation (22.58%) has been found involving both men and women. It is further found that most of the direct beneficiaries are belonging to the weaker sections of the society especially from women, SC, ST categories.

Table 8: Statement wise frequency and percentage distribution of farmers regarding their participation in planning of watershed Development N=160

<i>District Block Villages Statement</i>	<i>Kolhapur Gadbinglaj Baserge</i>	<i>Nagpur Kuhi Mandhal</i>	<i>Raigarh Murud Wal- ke-Shirgoan</i>	<i>Nanded Himayat- nagar Takarala</i>	<i>Total & (Percentage in paren- thesis)</i>
Have you participated in planning meeting of Soil and Water Conservation (SWC) programme?	Yes 14	Yes 12	Yes 10	Yes 10	46 (28.8%)
Did you share information to include in planning of soil and water conservation programme?	Yes 10	Yes 14	Yes 8	Yes 10	42 (26.3%)
Did you suggest any idea in the planning of agricultural crop cultivation in the watershed area?	Yes 16	Yes 12	Yes 10	Yes 6	44 (27.5%)
Did you give any information during planning of various forest trees planted in the watershed?	Yes 6	Yes 8	Yes 6	Yes 4	24 (15%)
Did you make any suggestion during planning of check dam in the watershed?	Yes 8	Yes 10	Yes 8	Yes 6	32 (20%)
Do you motivate your fellow farmers to participate in planning of SWC programme?	Yes 8	Yes 6	Yes 10	Yes 8	32 (20%)
Do you think that watershed is beneficial to the locality	Yes 28	Yes 34	Yes 36	Yes 34	132 (82.5%)
Do you consider that watershed has benefitted in bettering ecosystem or biodiversity	Yes 32	Yes 30	Yes 34	Yes 2	98 (61.25%)
What are the problems that threaten to watershed	C and D 32	B, C and D 30	A, C and D 34	Cand D 36	Illustrated in Venn Diagram below
Do you consider that you have some ownership on the watershed	No 36 Yes 4	No 34 Yes 6	No 32 Yes 8	No 36 Yes 4	No: 138 (86.3%) Yes: 22 (13%)

Problems: A. Basic design flaws B. Implementation problems C. Loss of reservoir storage/ reliability of water supply D. Deposit of soil /mud

Note: Figures in parentheses are in percentage

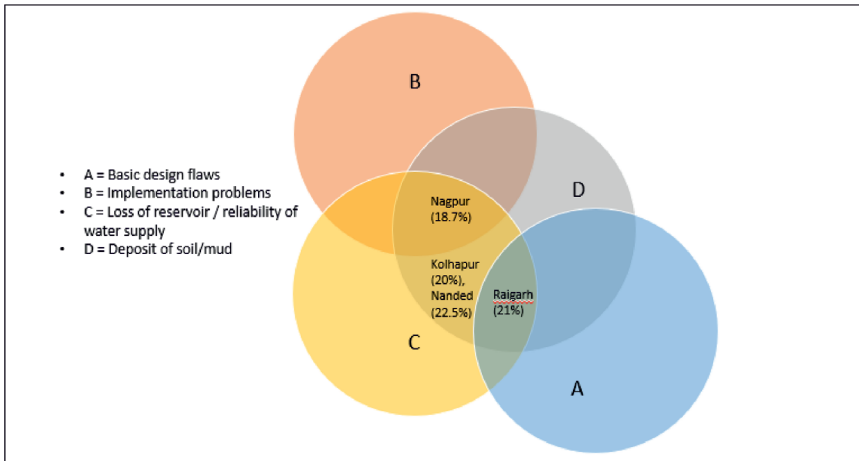


Figure 5: Venn diagram – perception of problems/threat to watershed

Source: Calculated from Table 8

The sample villages were subjected to a meticulous survey encompassing a multifaceted set of inquiries that spanned across three overarching dimensions, namely: participation in the planning of watershed programmes, perception of benefits and predicaments, and the challenges thereof. The survey responses have been methodically collated and are presented in Table-8, while the responses pertaining to predicaments and challenges have been vividly illustrated in the form of a Venn diagram (Figure-5).

Evidently, a preponderance of the farmers, amounting to approximately 81%, are of the conviction that watershed programmes not only hold promise for societal benefits but also augur well for the environment, with a staggering 61% attesting to the same. Despite this encouraging trend, it was observed that merely between 25% - 30% of the total respondents manifested a willingness to attend the watershed programme planning meetings. Furthermore, the active involvement of the farmers, as gauged by their propensity to proffer suggestions, disseminate relevant information or even motivate their peers to partake, plummeted to a range of 15% - 20%.

Upon probing the farmers regarding the predicaments or threats that impinge on the efficacy of watershed programmes, it was found that nearly all farmers from the four districts bemoaned two major concerns, viz. the loss of reservoir and the accumulation of soil/mud. This was corroborated by the Venn diagram (Figure-xx), which exhibited an overlap of circles C and D, signifying a commonality of these concerns across all four districts. Moreover, farmers

from Nagpur evinced their apprehension towards implementation glitches (circle B), whereas those hailing from Raigarh voiced their concern pertaining to design flaws (circle A).

As circle C and D represent a ubiquitous concern across all districts, it behoves the government officials to address these concerns with alacrity by proffering viable solutions or affording adequate safeguards to assuage the apprehensions of the farmers.

PARTICIPATION INDEX AND PERCEPTION INDEX:

Using the survey responses from Table-8, we derive a matrix of Participation Index and Perception Index, based on Yes/No responses to a set of questions about the participation in planning meetings and the perception of the respondents about the watershed management.

Participation Index is calculated for responses on participation in planning meeting of Soil and Water Conservation Programme, sharing of information in the planning meeting, offering suggestions in the meetings, specifically with respect to check dam and forest tree planation and motivation of other farmers to participate in the meetings. Perception Index is calculated based on responses to perception of benefits of the watershed to the locality, biodiversity, and sense of ownership.

The formulas for deriving the indices are:

$$\text{Participation Index} = \frac{\sum_{j=1}^N Y_{ij}}{N} \times 100$$

$$\text{Perception Index} = \frac{\sum_{j=1}^N Y_{ij}}{N} \times 100$$

Where,

$Y_{ij} = 1$, if the farmer responds Yes to participation in the j th activity; and 0 otherwise

$N =$ Total number of respondents

The calculated results are presented in the scatterplot and tables as follows:

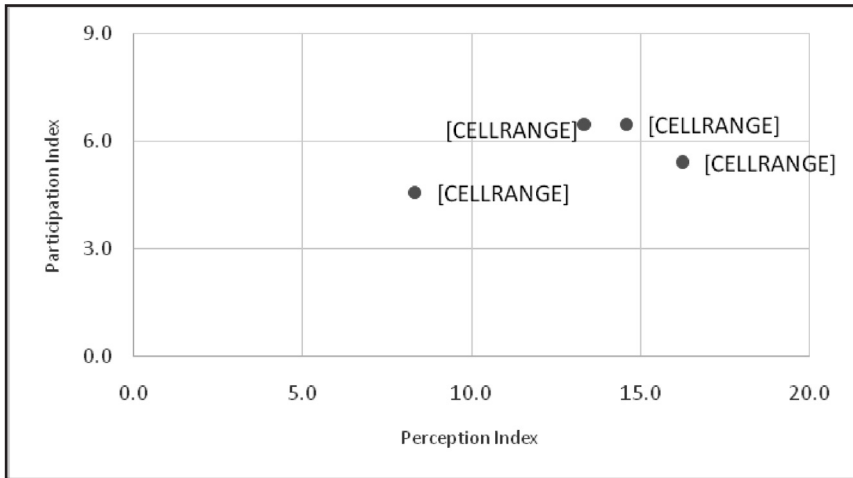


Figure 6: Participation and Perception Indices

Source: Calculated values from field survey

As Figure 6 demonstrates, participation of the farmers in watershed management is directly correlated with their perception of benefits of the programme. For example, Nanded district scores low on participation because, the perception index is also low – meaning, the farmers in the district are not fully convinced of the benefits of watershed management. Whereas Kolhapur and Nagpur fare better in participation because the farmers of the district view the benefits of the programme more positively, as demonstrated by the corresponding perception index. From a policy implementation view, this is an important finding, and this conveys a conclusion that the government agencies need to do more fieldwork to disseminate information about the benefits of watershed management programmes to the farmers. The break-up of the calculated values are presented in Table 9.

Table 9: Perception, Benefit, Ownership and Participation Indices

<i>District</i>	<i>Perception Index</i>	<i>Benefit perception Index</i>	<i>Ownership perception Index</i>	<i>Participation Index</i>
Kolhapur	13.3	18.8	2.5	6.5
Nagpur	14.6	20.0	3.8	6.5
Raigarh	16.3	21.9	5.0	5.4
Nanded	8.3	11.3	2.5	4.6

Source: Calculated from field survey

Table 9 above unfolds the cities of Nagpur and Raigarh reign supreme in the hierarchy of benefit perception and ownership. Meanwhile, Kolhapur and Nagpur hold the upper hand in terms of participation. It is Raigarh district that stands tall in both aspects, basking in the glory of perception and participation. Alas, the district of Nanded suffers from a low standing in both categories of benefit perception and participation.

As the Perception Index undergoes an introspective breakdown, it reveals that the ownership perception values for even the districts of Kolhapur and Nagpur are lamentably meagre. Thus, ensuring that farmers cultivate an augmented sense of ownership is not just important, it is an utmost necessity for the program officials. By doing so, the farmers will be more inclined to participate actively in the domain of watershed management, which will ultimately lead to better management of the resources in the area.

FINDINGS AND SUGGESTIONS OF THE STUDY

In the context of our study, in addition to above crucial inferences, it was revealed in the PRA that crucial challenges for sustainable watershed management are to accomplish justice between competing users through participatory processes; improve ecosystem services; and secure socio-economic development to improve livelihoods.

The PRA unanimously opined that despite positive changes in socio-economic condition of farmers resulting from watershed program, the economic advantage was too little to push them out of the vicious circle of misery. It was therefore, recommended to further strengthen the subsidiary input supply chain including market intelligence and remunerative prices of crop, apart from strengthening the existing conservation efforts.

The PRA remarked that promotion of sustainable livelihoods for tribes through tree-based farming approach, plantation of cashew nut trees, adoption of soil and water conservation measures are indispensable to tackle the water crisis in tribal villages.

It was further realized in the PRA that to address some of the basic question related to the sustainability in the livelihood of tribes such as: regeneration of biomass and the degraded eco-system through community participation, entitlement and equitable control over water resources, economic viability of a self-managed resources system at the micro-level etc. are indispensable through the formation of water users' society.

Serious concerns were expressed by the PRA on the issue of sediment from improperly managed construction sites, eroding stream banks; problems

associated with renovation of check dams, and the imperative need for periodic promotion of labour-intensive ground water recharging and the by augmentation of water resources. One of the most significant problems associated with watershed development has been land degradation in rain fed areas due to soil erosion from runoff.

Ensuring that farmers cultivate an augmented sense of ownership is not just important, it is an utmost necessity for the program officials. By doing so, the farmers will be more inclined to participate actively in the domain of watershed management, which will ultimately lead to better management of the resources in the area (Table 9). Therefore, it is crucial for the program officials to take the necessary steps to encourage and empower the farmers to take ownership of their land and water resources. This can be achieved through various means such as education, training, and providing incentives for sustainable farming practices. Encouraging and empowering farmers to take ownership of their land and water resources through education, training, and incentives for sustainable farming practices is crucial for the success of the program.

Collective efforts by government and non- government organizations in collaboration with local tribal communities can help mitigate water stress, paving the way for improvement in the quality of life of the people (Rekha Krishnan *et al.*, 2003). Undoubtedly, to meet the food production for the teeming millions of people and productivity of agricultural crops / vegetables with optimum use of water; we need to emphasize on watershed which acts as a panacea to looming water crisis.

Moreover, in order to address the challenges of water scarcity and land degradation in rain fed areas, it is essential to adopt better agricultural practices such as organic farming and the cultivation of less water-intensive crops. Inter cropping and the introduction of new technologies for sustainable productivity can also play a crucial role in this regard, particularly in tribal hilly regions that are highly susceptible to degradation processes (Tripathy, 2020).

Thus, a comprehensive developmental strategy based on integrated management of land, water, and other production resources, coupled with appropriate cropping and agro techniques, is necessary to achieve sustainable production in these areas. By emphasizing soil-water-plant conservation, this approach can help to ensure the long-term viability of rain fed agriculture and support the livelihoods of rural communities in these regions.

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