GENDER TRANSFORMATIVE IMPACTS FROM WATERSHED INTERVENTIONS: INSIGHTS FROM A MIXED-METHODS STUDY IN THE BUNDELKHAND REGION OF INDIA

Collection

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HIGHLIGHTS

- Social and technical interventions related to agriculture, watersheds, and capacity building should enhance women's awareness, access, and decision-making role in agrarian communities.
- Strict gender norms and relations hinder the empowerment of women in the Bundelkhand region and prevent women from participating in the decision-making process at the household, farm, and community level.
- When implementing watershed projects in a highly patriarchal context, as in the Bundelkhand region, advocacy of behavioral change communication must be implemented, addressing the diverse needs of women and men.
- Strengthening of systematic and gender-sensitive institution building, social engagement, and capacity development for global water security is needed for sustainable watershed interventions.

ABSTRACT. *This study examined gender perspectives on water security by exploring an integrated water management approach for agriculture, livestock, and human consumption. The data were generated in a watershed project to enhance drought resilience of farming through groundwater recharge and agroforestry interventions in the water-scarce Bundelkhand region of Uttar Pradesh in central India. Post-intervention, a quantitative survey and qualitative gender and social analysis tools were applied to understand the benefits of the interventions for women, men, and the community as a whole. Quantitative data were collected from 700 individuals in five villages (three treatment villages and two villages where watershed interventions were not implemented). In addition, 33 semi-structured interviews and eight focus group discussions were conducted to understand local gender norms at the project sites. Data analysis revealed that the community benefits accrued from the watershed interventions included increased crop productivity and diversification of agriculture and livelihoods. However, strict patriarchal norms restricted the visibility, mobility, and communication of women within the household and community during the interventions. Considering gender diversity, this study identifies that women can benefit from participating in watershed interventions and provides a deeper understanding of the constraints and barriers to women's participation in such projects, including economic, social, and cultural factors. The construction of check dams reduced women's time per day for fetching water by about 29%. Groundwater level increases reduced the effort required of women to draw water from open wells and hand pumps. Female education is a significant factor related to the benefits of watershed interventions, and regression analysis indicated that households with higher levels of education of adult women were significantly more likely to benefit from the interventions than other households. To avoid perpetuation of the exclusion of diverse local knowledge and gender inequality at the community level, mechanisms must be developed and adjusted continuously such that whole communities, including men and women, are empowered to participate in the decision-making process at various levels and for different purposes. When implementing watershed projects in a highly patriarchal context, as in the Bundelkhand region where women are hidden behind the strong presence of men, advocacy of behavioral change communication must be implemented regularly. The community needs to be sensitized toward systematic and gender-sensitive institution building, social engagement, and capacity development for local as well as global water security.*

Keywords. *Bundelkhand region, Gender, Social norms, Transformative, Watershed intervention.*

Submitted for review in June 2019 as manuscript number NRES 13568; approved for publication as a part of the Global Water Security Collection by the Natural Resources & Environmental Systems Community of ASABE in January 2020.

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  ISSN 2151-0032 https://doi.org/10.13031/trans.13568

The inexorable growth of the world's population has led to questions about whether sufficient food can be produced to meet the escalating demand and to concerns about global food security in relation to women's empowerment (Clement et al., 2019). A majority of the rural population depends on subsistence agriculture or subsidized food imports (rather than food trade) for their minimal nutrition. Food production, both commercial and subsistence, requires large quantities of water. Thus, food security is intimately linked with water-resource security. In some humid temperate regions, plant growth is sustained by rainfall alone, but in many drier regions, access to irrigation is required for optimal production (Leonard et al., 2015). Water is not simply a commodity but rather a fundamental life support, as it is essential for human consumption, cooking, and other household functions, as well as for growing crops, manufacturing, and other industries (Postel, 2003). Water scarcity can lead to communal disharmony, diminish agricultural production, reduce food security, lead to shifts in population, and weaken economic development.

Groundwater plays a pivotal role in Indian agrarian livelihoods and human well-being. In the 1930s, well irrigation accounted for over 78% of total irrigation, compared to 10% sourced from canals (Prakash, 2005). Despite past efforts to improve the sustainability of groundwater in India, the problem of groundwater extractions exceeding recharge remains severe, particularly in Uttar Pradesh (Shah, 2009; Sakthivadivel, 2007). In general, groundwater scarcity can be one of the important factors that limit empowerment of women; therefore, any policy changes or initiatives to improve the inclusive educational opportunities and empowerment need to consider water availability issues (Kookana et al., 2016; Leder et al., 2017).

Watershed development has been conceived as a strategy for protecting the livelihoods of people inhabiting fragile, water-limited ecosystems. The aim has been to ensure the availability of drinking water, fuel wood, and fodder and to raise the income and employment for farmers and landless laborers through improvement in agricultural production and productivity (Rao, 2000). Watershed development has been conceived as one of the important rural development programs in India, where rainfed agriculture is characterized by low productivity, degraded natural resources, and widespread poverty (Dash et al., 2011; Arya, 2007). Mondal et al. (2016) confirmed that watershed development programs have been conceived as a mechanism for improving agricultural productivity and mitigating resource degradation in rainfed and drought-prone regions by improving various ecological sustainability indicators, such as biodiversity, soil health, hydrologic function, energy use, and crop management (Sreedevi et al., 2006; Vohland and Barry, 2009; Rockstrom et al., 2010; Glendenning and Vervoort, 2011; Garg, et al., 2012).

The impact of watershed development efforts on women is a key issue. The success of women's involvement has varied for many reasons, including inadequate project design, cultural and social constraints, as well as policy and legal constraints (Tennyson, 2002). Past watershed projects around the globe (Leder et al., 2017; Shrestha and Clement, 2019; Udas and Zwarteveen, 2010) revealed that gender issues have been a part of watershed management projects. However, the extent to which these issues were addressed has varied, and the recommended changes have not always been made.

Zwarteveen (1997) and Meinzen and Pradhan (2001) found that formal and informal membership rules of local management organizations often exclude women. It became clear that the poor and powerless are easily excluded from the benefits of improved natural-resource management and that women benefit less than men (Sangameswaran, 2006). When women are particularly targeted in water security programs, some may benefit while others can be further excluded due to their caste, class, or age (Leder et al., 2017). Hence, it is important to recognize diverse women and men's critical awareness and needs. Following the argument put forth by Mitra and Rao (2019) and Leder et al. (2017), rather than using gender as a proxy for women, more nuanced perspectives that conceptualize gender as socially constructed relationships, shaped by intersecting ties of ethnicity, caste, class, age, marital status, religion, and other forms of social difference, are adopted in this analysis (Nightingale, 2010; Crow and Sultana, 2002; O'Reilly et al., 2009; Leder et al., 2019).

Further, it is widely understood that access to safe and sufficient water is controlled not only by environmental factors but also by social, political, and institutional factors and that water use and management are generally gendered in nature (FAO, 2003). Several studies (e.g., Abu-Rabia-Queder and Morris, 2018; FAO, 2003; Varua et al., 2018; Hussain, 2007) have revealed that women and men understand the environment differently, have different uses for natural resources, and have different levels of influence and representation in the management of natural resources and decision-making. This imbalance of power is influenced by gendered roles within rural households and communities and the gendered division of labor (Leder et al., 2019).

In most developing countries, women are responsible for household water collection as well as water use and management, including hygiene within the household and community (Upadhyay et al., 2005). Men are perceived to be responsible for production and management of farms or small businesses, even though women are very much involved in these enterprises. Despite women's significant role in water use and household management, women's needs and uses of water are often not represented in water resource management policies or projects (Varua et al., 2018; Leder et al., 2017, 2019; Udas and Zwarteveen, 2010; Shrestha and Clement, 2019; Suhardiman et al., 2015).

Watershed interventions do not just make large contributions to irrigated agriculture. They can also impact water availability for domestic and livelihood purposes. Thus, these interventions can benefit women who have a responsibility for fetching and using water for domestic purposes (Hussain, 2007). Women use irrigation water for domestic as well as productive and livelihood purposes, deriving a range of benefits from irrigation water. Domestic uses of water include water for washing, bathing, cleaning, cooking, and other household activities. Production uses include

water for crop production where women contribute to various production activities, and for small-scale activities that enable women to grow agricultural produce (such as vegetables and fruits), raise livestock, and run micro-enterprises. These activities help households increase their incomes, improve housing conditions including better sanitation, and enhance food security and nutrition and overall family health. Access to good-quality irrigation water from nearby irrigation systems in the local setting also saves time and labor for women, who no longer need to travel long distances to fetch water for washing, bathing, and livestock. Understanding gender roles and norms can be valuable in planning water interventions and policies that are based on knowledge of how and why people make the choices that they do in water use in order to meet their needs.

This study evaluated (1) the level of participation of women in the watershed interventions in the region; (2) changes in household labor demands resulting from the watershed interventions; (3) how demands on women's time through their household responsibilities, e.g., fetching drinking water and providing help in farm activities, relate to household income; and (4) implications of water security for drudgery reduction, empowerment of women, and improvement in the livelihood and well-being of village communities.

DATA AND METHODS

The survey sample was drawn from the Bundelkhand region in the state of Uttar Pradesh in central India. The Bundelkhand region is greatly affected by water scarcity, land degradation, and poor socio-economic status. The Parasai-Sindh watershed was selected for this study and comprises three villages referred to as Parasai, Chhatpur, and Bacchauni (25° 23′ 56″ N to 25° 27′ 9.34″ N, 78° 19′ 45.71″ E to 78° 22′ 42.57″ E). The watershed covers nearly 1250 ha. Watershed interventions, such as construction of check dams, gullies, and other water harvesting structures, were undertaken during 2012-2016 with the collaboration of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) along with the national partner, the Central Agroforestry Research Institute (CAFRI, formerly known as the National Research Centre for Agro-Forestry, or NRCAF), within the district administration, the government of Uttar Pradesh, and local communities. The project was funded by the Coca-Cola India Foundation for Rural Water Infrastructure. The pilot sites of the watershed project are located 20 km from the city of Jhansi. The survey sample for this study included the three above-mentioned villages (Parasai, Chhatpur, and Bacchauni), comprising 638 households, where ICRISAT-CAFRI watershed interventions were implemented. Two neighboring villages (Imiliya and Khaira) were selected as control villages where watershed interventions were not implemented (table 1).

A mixed-methods approach was used to ensure that the study findings were grounded in participants' experiences. Two survey instruments were administered in the field: one was a quantitative household survey using structured interview schedules, and the other was a detailed qualitative tool called the Gender in Irrigation Learning and Improvement Tool (GILIT; Lefore et al., 2017) followed by context-specific focus group discussions (FGDs) for men and women.

A purposive random sampling method was employed to collect the quantitative data. A team of ten enumerators was engaged for the field investigation. The team members had experience in conducting research and familiarity with watershed interventions and agriculture. The data collection was undertaken using digital tools, and software programs were prepared in English using Survey Solutions (https://manage.mysurvey.solutions) for the household surveys to ensure quality data collection. The interviews included 222 households in the three villages in which watershed interventions were implemented and 64 households in the two villages in which no watershed interventions were implemented. Data were generated from 572 respondent individuals for the quantitative interviews drawn from the 286 households.

In every household, one male (specifically head of the household) and one female were interviewed to study the gender dynamics in watershed implementation and its effect on the household. Of these households, a majority (160) were headed by both a male and a female, while only two households were female-headed and 60 households were male-headed. The selected households had 54% male members and 46% female members. The sex ratio was as low as 79.58 women to 100 men, which is far below India's national sex ratio of 93.47 (Government of India, 2011, p. 466). This is a first indicator of the great gender inequality; the state of Uttar Pradesh is known for its high inci-

Table 1. Characteristics of study locations and sample selected.

Characteristics		Villages					Total
		Parasai	Chhatpur	Bacchauni	Imiliya	Khaira	
Total number of households (*N*)		213	150	275	272	304	1214
Households selected (*n*) and % selected[a]		85 (40%)	59 (39%)	78 (29%)	35 (13%)	29 (10%)	286 (24%)
Farm size[b]	Large (%)	35.29	30.51	29.49	22.86	17.24	
	Medium (%)	15.29	35.59	23.08	22.86	6.90	
	Smallholders (%)	31.76	27.14	17.95	17.14	41.38	
	Landless and labor (%)	17.65	6.78	29.49	37.14	34.48	
Women interviewed (*n*)		85	59	78	35	29	286
Men interviewed (*n*)		85	59	78	35	29	286
Average family size (*n*)		4.22	4.59	3.51	3.39	3.86	3.91
ICRISAT watershed intervention village		Yes	Yes	Yes	No	No	

[a] Percentage of total households in the village.

[b] Farm size calculations were based on gross sown area. The classification is as follows: labor and landless = 0 to 0.81 ha, smallholders = >0.82 to 1.62 ha, medium = >1.63 to 2.83 ha, and large >2.83 ha.

dence of female feticide (India Today, 2018). The literacy rate is only 12.4% for females and 41.5% for males, which is far below the national average literacy rate of 65.46% for females and 80% for males (Government of India, 2011, p. 826). The low literacy rate among women in the villages equals the national average literacy rate for both sexes after British rule in 1947. However, the literacy rate among children, both male and female, is greater than 60%.

Qualitative assessments of the watershed intervention impacts were conducted using the GILIT tool (Lefore et al., 2017) developed by the International Water Management Institute (IWMI), which assesses meaningful participation of men and women in collective irrigation schemes. The GILIT tool covers men's and women's:

- Access to scheme resources (including information in the design phase, as well as land, water, and other inputs).
- Participation in scheme membership, leadership, and decision-making.
- Access to scheme benefits, including access to market information, packaging, and payments from product sales or processing, depending on the location and crop.

The statements in the GILIT tool were probed with some members of the watershed committee that was established for the project period (2011-2015) in retrospect, about 30 to 40 men and women farmers in each village were random sampled for focus group discussions (FGDs) disaggregated by sex, and in-depth interviews with female and male farmers of different caste and age as well as key informant interviews with project staff were conducted. Thus, a total of about 700 respondents were contacted.

RESULTS

CHARACTERISTICS OF STUDY LOCATIONS

As shown in table 1, data were generated from about 35% of the households in the villages with watershed interventions and from about 11% of the households in the villages without watershed interventions. Among the sampled households, representation included all farm size categories. The average family size was approximately four to five members across all the study villages. There are 388 open wells in the watershed area that are the primary source of domestic and agricultural water, as tube wells do not work due to the hard rock aquifer conditions. Soils in the watershed area are reddish to brownish red in color (Alfisols and Entisols) and are characterized by shallow (10 to 50 cm) coarse gravel and light texture, with poor water-holding capacity (Singh et al., 2016).

Education

About one-third of the household members were illiterate, with an equal percentage of household members who had education up to secondary level and above. The villages with no watershed interventions had a higher proportion of literate members compared to the villages with watershed interventions, especially Khaira. Table 2 shows that the literacy rates were lower for women (29% to 65%) than men (53% to 66%) across all villages except Khaira, where the literacy rates were almost equal in the >18 years age group. The literacy rates increased with age. Only 18% of the children less 10 years old were literate, while the literacy rates were 36% for 10 to 18 years and 47% for >18 years. It is interesting that literacy was higher for female children than for male children in the 5 to 9 years age group.

Table 2. Literacy rate in households by gender and age (%).

	Age Group					
	>18 Years		10 to 18 Years		5 to 9 Years	
Village	Male	Female	Male	Female	Male	Female
No interventions						
Imiliya	54	37	34	46	12	17
Khaira	66	65	26	25	8	10
Watershed interventions						
Bacchauni	53	29	31	47	16	24
Chhatpur	54	33	31	40	15	27
Parasai	59	35	28	48	13	17

Caste

In terms of caste (table 3), the majority of the selected sample belonged to backward caste (61%) and scheduled caste (27%), followed by forward caste (11%). The dominant backward caste in the selected locations is the Yadav community. Forward caste (FC) is a social group that does not qualify for benefits and other affirmative action schemes operated by the Government of India. Groups that qualify for benefits are classified as backward caste (BC), other backward class (OBC), scheduled castes (SC), or scheduled tribes (ST), and they can receive defined benefits for education, special government schemes, government employment, and political representation. The groups within each classification are subject to change, depending on social, educational, and economic factors (https://en.wikipedia.org/wiki/Forward_caste).

Sources of Income

The study revealed diversification of livelihood that led to earned income from different sources. In the villages where watershed interventions were not implemented, the income from farm activities and non-farm activities was equal. In contrast, in the villages with watershed interventions, the farm income was about 67% and income from non-farm sources was about 33%. This difference is attributed to increased agriculture and related activities (or at least the increased economic return of agriculture) resulting from the watershed interventions, which improved groundwater recharge and the availability of water for longer periods during the year. The activity-wise income data reveal that the villages with watershed interventions had a good percentage of income from livestock as well as from businesses and salaried jobs. Income from livestock

Table 3. Household-wise caste groups in study locations (%).

Village	Forward Caste (FC)	Backward Caste (BC)	Scheduled Castes and Scheduled Tribes (SC and ST)
No interventions			
Imiliya	31	54	14
Khaira	24	48	28
Watershed interventions			
Bacchauni	9	50	41
Chhatpur	19	81	0
Parasai	8	56	35

and the sale of milk was greater for the two villages in the middle and lower end of the watershed compared to the village (Parasai) in the upper portion of the watershed (fig. 1).

Cropping Patterns

Across the study region, crop cultivation is the main source of livelihood. Where irrigation is available, the most commonly cultivated staple crop is wheat, followed by food crops under rainfed agriculture that include barley, groundnut, pigeon pea, green gram, and black gram (table 4). Minor crops in the region are mustard, soybean, fodder crops, sesamum, and vegetables, mostly for household consumption. Most of the staple and legume food crops are set aside for home consumption before they are sold in the market.

Livestock plays an important role in the region's rural economy. Many farmers in India maintain mixed farming systems (i.e., a combination of crop and livestock production) in which the output from one enterprise becomes the input for another, thereby realizing resource efficiency. The livestock in the study villages consisted of draft animals and milking animals. Livestock are considered important sources of income as well as wealth in rainfed areas, but common property resources (e.g., forests and barren/waste lands) are being depleted, making it difficult to arrange for grazing and livestock feeding. Prior to the watershed interventions, water shortages left many farmers with a choice between livestock and crop production, but not both. Moreover, increasing use of tractors reduced the need for draft animals, and increased dependence on chemical fertilizers led to a reduction in the number of animals maintained for manure production. The paucity of farm labor on annual contracts also discouraged farmers from rearing large numbers of livestock. There has been an increase in the number of livestock, especially mulching animals, since implementation of the watershed interventions. This is evident from the livestock inventory data, especially for the villages with watershed interventions (table 5). The data show that 56% of the livestock consisted of milking animals (female buffalo and local cows), while only 15% were draft animals (bullocks and male buffalo).

Livestock care and maintenance are largely in the hands

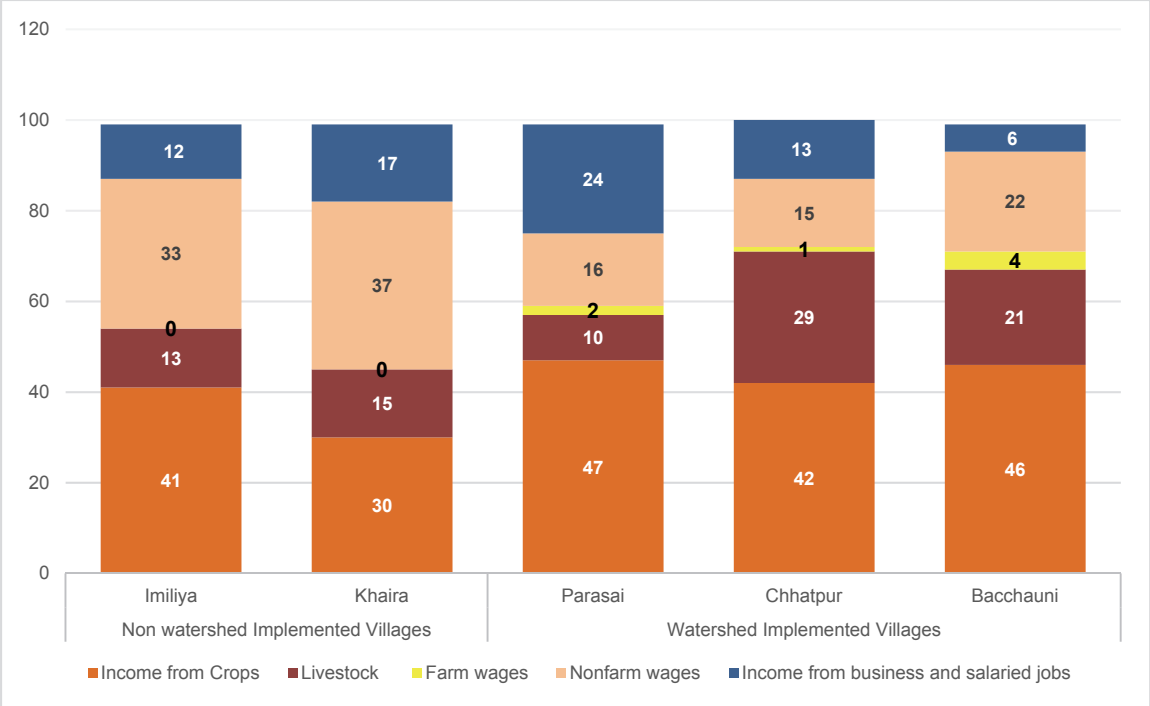

Figure 1. Share of income from different sources, 2018 (values are %)

Table 4. Cropping patterns in selected locations.

Village	Season	Crops Sowing Area (ha)					
		Black Gram	Fodder Crops	Green Gram	Groundnut	Wheat	Other[a]
Imiliya	Post-rainy (*Rabi*) season	-	-	-	-	27.62	6.07
	Rainy (*Kharif*) season	12.46	-	2.47	28.03	-	0.53
Khaira	Post-rainy (*Rabi*) season	-	-		-	15.78	0
	Rainy (*Kharif*) season	4.96	-	0.81	19.93	-	0
Bacchauni	Post-rainy (*Rabi*) season	-	1.82	-	-	76.81	4.77
	Rainy (*Kharif*) season	46.38	1.01	6.96	54.61	-	1.74
Chhatpur	Post-rainy (*Rabi*) season	-	1.86	-	-	66.15	5.95
	Rainy (*Kharif*) season	41.70	1.01	6.58	-	-	1.66
	Summer season	-	-	-	-	-	0
Parasai	Post-rainy (*Rabi*) season	-	0.51	-	-	104.21	5.77
	Rainy (*Kharif*) season	52.97	0.20	12.65	76.79	-	1.50

[a] Other crops include barley, chickpea, maize, soybean, vegetables, sesamum, and mustard, which are grown on very small parcels of land.

Table 5. Livestock holdings of selected households.

Village	Bullocks (%)	Male Buffalo (%)	Female Buffalo (%)	Local Cows (%)	Young Stock (%)	Goats (%)
Imiliya	4	4	29	23	29	13
Khaira	6	2	38	17	21	13
Bacchauni	6	2	35	15	23	18
Chhatpur	16	3	28	17	12	20
Parasai	13	2	34	11	18	19

of women. Most animal farming activities, such as fodder collection, feeding, watering, health management, and milking, as well as the household-level processing, value addition, and marketing are performed by women. Although there is considerable involvement and contribution of women to livestock activities, huge gender inequalities exist in the study villages in terms of livestock management (e.g., access to technology, credit, information, inputs, and services), probably because of inequalities in the ownership of productive assets, including land and livestock. The rapidly increasing demand for livestock products creates opportunities for empowerment of women (Patel et al., 2016).

IMPACTS OF WATERSHED INTERVENTIONS BASED ON QUALITATIVE ASSESSMENT

Review of past watershed projects around the globe revealed that gender issues have been a part of watershed management projects. However, the extent to which these issues were addressed has varied, and the recommended changes have not always been made. The degree of success of women's involvement has varied for many reasons, including inadequate project design, cultural and social constraints, as well as policy and legal constraints (Tennyson, 2002).

The selected locations in the Bundelkhand region are male-dominated patriarchal societies. Strong gender norms limit or restrict the visibility, mobility, and communication of women within the household and the village. Low literacy among women is also a contributing factor for low gender equality. The women participants expressed interest in participating in development initiatives in their village. They desired access to information, increased involvement, and regular meetings to increase their awareness. They were also enthusiastic to form groups, even though the caste system plays a major role in the formation of groups. Post-intervention, the results revealed that women expressed interest in being part of the entire watershed intervention process, from commencement to establishment as well as maintenance.

Based on inferences from the qualitative discussion using the GILIT tool, it was observed that women are underrepresented as intervention receivers and are formally disadvantaged in participation scheme management and/or access to scheme services, which results in a lack of equal access to benefits. In addition, it was clearly visible that the men and women were not aware of and knowledgeable about national policies, acts, regulations, and goals that prioritize equitable access to resources, participation, and benefits for men and women in the three villages where the watershed intervention project was implemented. The women and men in the three intervention villages scored low on all three components of the GILIT tool: (1) access to scheme resources; (2) access to scheme membership, leadership opportunities, and decision-making; and (3) access to scheme benefits. The low scores indicate that the scheme approach showed little or no sensitivity to gender equality and requires attention and redress.

Conversations with the members of these rural communities revealed that they have limited knowledge of the concept of gender equality. One of the reasons could be the low levels of literacy of both women and men. Many of the programs sustained at national and local levels were not disclosed to women by the local governing body (i.e., Gram Panchayat). None of the women had participated in the elections in the study villages. The watershed intervention project aimed to ensure equal benefits for both men and women in terms of access to water. However, strong inherent gender and social norms did not allow women to participate or share the benefits. Decisions about water allocation were mostly made by male community members. The strong patriarchal norms limited women's participation in these discussions and decisions. Except during the rainy season (especially during years with good rainfall), women are most affected by the decrease in water or non-availability of water, and women are responsible for securing water for domestic use and for livestock rearing. The triple burden of fetching water, firewood, and fodder continues to plague women in these regions. It adds drudgery because women need to spend more time collecting water. Water restrictions also negatively affect women more than men because men are only responsible for securing irrigation water. Proximity to the check dams affects access to irrigation, while others use open wells. Irrespective of the watershed program, women have to fetch water with hand pumps or open wells that are often 1 or 2 km distant. Mostly women and children older than 10 years are involved in fetching water. However, check dams are usually constructed far from the village, which makes accessibility to women unfeasible.

The watershed intervention project made women aware that check dams increase the groundwater level, and thereby open wells have sufficient water to meet their domestic needs. Analysis of the FGDs revealed that women had very low access to information about the watershed interventions, although some had access to television, mostly for entertainment. However, the women lamented that they do not have enough leisure time to watch television or listen to the radio to increase their general access to information. Women do not own mobile phones, but they use the mobile devices of other household members, usually men. In farming, men make most of the decisions, with little or no input from women.

The women were usually not provided with information on training, and/or the training was not held at times or locations that allowed women to participate. During the FGDs, it was observed that women never attended any other meetings in the village. No support services related to agricultural product collection, sorting, or marketing were provided through the watershed interventions; however, an informal advisory role was played by the scientists and scientific officers involved in the watershed project.

Impacts of Watershed Interventions Based on Quantitative Assessment

The time spent fetching water is a significant barrier to female empowerment. In this water-scarce region, acquiring water for drinking, domestic purposes, and livestock use requires considerable time (table 6). The watershed interventions reduced this time by 4 to 5 min per trip, and reduced the number of trips per day. Groundwater level increases are also attributed to the watershed interventions, which reduced the time required to fetch water with hand pumps and open wells.

Gender Implications for Global Water Security

It is well known that water is an essential need for all life: humans, fauna, and flora. It is also recognized that, for communities to become prosperous and for the well-being of the people living in those communities, access to safe and adequate water for drinking, domestic uses, and sanitation is a pressing need. Without a safe and adequate supply of water, poverty, malnutrition, infectious diseases, and conflicts are more likely.

Water security is not just an environmental concern. It is also a social issue that needs to be addressed in greater detail, especially through gender, considering the multiple important roles of women in agrarian societies. It was evident from this study that the women have basic information and knowledge related to crop production and allied activities, as well as on cropping decisions based on water availability. However, women's decision-making ability is restricted due to lack of confidence, social norms, and unequal power within their households and communities. Even though massive watershed management programs have been implemented in the Bundelkhand region by various development authorities, in most cases women are excluded from these programs. This study implies that gender (especially women) responsiveness, inclusion, and participation in water policy-making, management, and institutions needs to be strengthened to achieve local as well as global water security.

Gender-Based Transformative Solutions

The current global water emergency, especially in semi-arid regions, calls for serious consideration of enhancing water use efficiency along with more equitable water access. "More crop per drop" is the slogan for these scenarios, whereas the importance of gender inequality is often insufficiently considered or completely ignored. To move toward more gender equality, there is a need for a transdisciplinary approach to harnessing water, storing water, and governing water in the future. In addition to an understanding local gender and social norms, this gender transformative approach requires reorganizing perceptions of water as a system that has multiple functions and impacts individuals, households, communities, and agro-ecosystems as a whole. These functions have deep implications for global water security.

Table 6. Time spent fetching water by women in intervention villages before and after watershed interventions, 2018.

	Time Use (min)		Time Saved after Intervention	
Village	Before Intervention	After Intervention	(min)	(%)
Bacchauni	238	168	70	29
Chhatpur	202	148	54	27
Parasai	158	108	50	31
Overall	207	147	60	29

The division of agricultural labor in the villages is guided by gender norms; hence, women's labor is associated with domestic and time-intensive tasks such as sowing, weeding, and harvesting, while men engage in technology and market-related tasks, which require them to leave the domestic space and engage with wider social networks. Compared to women from the upper caste, women from the scheduled castes (socially marginalized groups) have greater mobility, less strict norms, and can move freely to purchase inputs, such as fertilizer. The social norms prevailing in the study region are sometimes oppressive and rigid for women belonging to the upper caste, and the social structure itself works in ways to keep the hierarchy in place.

Based on women's need for money, marriage, and education, as expressed in an FGD during the watershed interventions, teak saplings were provided to 80 families with small daughters (up to 5 years old) to be planted on bunds in the fields (Leder, 2017). These teak trees would be sold upon maturity (20 years later) to pay for marriage dowries for the girls. The project's slogan was *Ladhko ko khet, ladhkiyo ko medh, har modh par, sau sagaaun ka pedh* ("Land to boys, bund to girls, on every bund, 100 teak trees"). As the slogan indicates, land ownership is for boys, while girls can be invested in through a higher dowry, which promises a husband of higher value and through this, women's possible upward social and economic mobility. Two important insights emerge from this understanding. On the one hand, even if interventions are targeted to help women according to their stated need for economic support, these interventions can lead to reinforcing gender dependence, despite being well intended. On the other hand, a focus on learning beyond the initial interventions can help develop gender-sensitive projects in the future and bring about the desired gender transformation.

Statistical Analysis of Watershed Intervention Impacts by Gender

The impacts of the watershed interventions on different parameters were analyzed (tables 7 and 8). The responses were recorded as an increase, decrease, or no change based on the different types of sustainable capital used to derive goods and services to improve the quality of life. The direct impact of the watershed interventions was determined through changes in farm income, crop production, irrigation facilities, availability of water for domestic use, drudgery reduction for both men and women, and reduction in time spent fetching water for domestic use. The indirect impacts were changes in school enrollment, health status, and diversification of livelihood. The overall participation rates across the three villages was low for both women and men, as the non-response rate ranged from 42% to 50% for men and from 68% to 75% for women. The watershed interventions improved agricultural practices and biodiversity by introducing sustainable practices, but not up to the full capacity, and the respondents agreed that the watershed interventions increased farm income and crop production in

Table 7. Impact of watershed interventions for men in the study locations (%).

Village	Response Category	Farm Income	Crop Production	Availability of Water for Agriculture	Availability of Water for Domestic Use	Drudgery Reduction	Reduction in Time Spent Fetching Water	School Enrolment	Health Status	Diversification of Livelihood
Bacchauni	No response	68	69	65	68	69	69	74	72	73
(*n* = 78)	No change	0	0	0	0	0	3	4	10	9
	Increase	31	29	35	31	28	28	22	17	18
	Decrease	1	1	0	1	3	0	0	1	0
Chhatpur	No response	36	37	36	41	44	44	44	42	46
(*n* = 59)	No change	2	2	2	0	2	3	10	12	12
	Increase	59	59	61	58	44	51	46	44	41
	Decrease	3	2	2	2	10	2	0	2	2
Parasai	No response	26	28	26	27	29	28	33	28	31
(*n* = 85)	No change	4	1	0	0	4	0	8	19	14
	Increase	68	68	72	73	58	71	59	52	54
	Decrease	2	2	2	0	9	1	0	1	1
Overall	No response	43	45	42	45	47	47	50	47	50
(*n* = 222)	No change	2	1	0	0	2	2	7	14	12
	Increase	53	52	56	54	44	50	42	37	38
	Decrease	2	2	1	1	7	1	0	1	1

Table 8. Impact of watershed interventions for women in the study locations (%).

Village	Response Category	Farm Income	Crop Production	Availability of Water for Agriculture	Availability of Water for Domestic Use	Drudgery Reduction	Reduction in Time Spent Fetching Water	School Enrolment	Health Status	Diversification of Livelihood
Bacchauni	No response	83	83	82	83	83	83	88	83	83
(*n* = 78)	No change	0	0	0	0	0	0	0	0	0
	Increase	17	17	18	17	17	17	12	15	17
	Decrease	0	0	0	0	0	0	0	1	0
Chhatpur	No response	61	63	59	63	64	63	69	63	66
(*n* = 59)	No change	2	2	2	0	0	0	2	2	3
	Increase	36	34	37	36	32	36	29	34	31
	Decrease	2	2	2	2	3	2	0	2	0
Parasai	No response	62	64	62	65	65	65	67	65	66
(*n* = 85)	No change	2	1	0	0	4	0	4	8	12
	Increase	34	34	38	35	29	35	29	27	22
	Decrease	1	1	0	0	2	0	0	0	0
Overall	No response	69	70	68	71	71	71	75	71	72
(*n* = 222)	No change	1	1	0	0	1	0	2	4	5
	Increase	28	28	31	29	26	29	23	25	23
	Decrease	1	1	0	0	2	0	0	1	0

most cases. At the household level, assets for livelihood promotion were not successfully generated for the poor and landless, but instead benefitted households with substantial landholding. Very few self-help groups have formed in the study locations, and their roles and responsibilities are not understood. In terms of water availability for agriculture and domestic use, an increase was evident, but several members of the community observed no change.

Building inclusive governance structures and strengthening the role of civil society, especially for women, in water governance are essential components for addressing vulnerability and fostering resilience and sustainability in urban as well as rural areas (Figueiredo and Perkins, 2013). Women possess incomparable knowledge of local ecological and water conditions due to their gendered roles and responsibilities, and this knowledge would benefit local, national, and international negotiations and decision-making processes in terms of social justice and resource use efficiency. Democratic mediation of equity conflicts related to water and sustainable long-term management of water resources are only possible through public participation (Figueiredo and Perkins, 2013).

In this analysis, the study households were divided in two groups: households that benefitted from the watershed interventions in respect to any of the nine above-mentioned attributes (assigned a value of 1) and the remaining households (assigned a value of 0). The dependent variables affected by the watershed interventions are listed in table 9.

Table 9. Determinants of households that benefitted from watershed interventions based on logistic regression analysis.

Variable	Coefficient[a] (benefitted households / unbenefitted households)
Gross sown area (ha)	0.0157
Education level of household head[b]	0.102
Highest female education level in household[b]	0.367**
Large animals (*n*)	0.025
Small ruminants (*n*)	-0.015
Do you know that a watershed development program had been implemented in your village? (yes = 1; no = 0)	3.152***
Decision maker in household (male and female adult = 1; male adult only = 0)	0.928**
Caste dummy (backward = 1; otherwise = 0)	-0.317
Caste dummy (SC and ST = 1; otherwise = 0)	-0.786
Constant	-3.547***
Number of observations	222
LR chi^2 (9)	58.14
Prob > chi^2	0
Pseudo R^2	0.1926

[a] Asterisks indicate significance: *** = p < 0.01, ** = p < 0.05, and * = p < 0.1.

[b] No formal schooling = 0, up to primary school = 1, up to intermediate = 2, graduate = 3, and above graduate = 4.

In this examination, logistic regression was been applied. Appropriate socio-economic covariates were considered and tested to determine their role and to observe whether the households benefitted from the watershed interventions in the study region. Gross sown area (ha), education of the head of household, highest female education level in the household, livestock ownership, distribution of household decision-making power, awareness of watershed, and caste of the household were considered as exogenous covariates in the analysis.

Female education was a significant factor related to benefit from the watershed interventions, and the regression results indicate that households with higher levels of education of adult women were significantly more likely to benefit than other households. Education of the head of household and livestock ownership were not significant. Awareness about the watershed interventions and households with decision-making by both male and female adults were the other covariates that had significant contribution to realizing the maximum benefit from the watershed interventions. It is evident that most of the respondents were not actively involved in providing feedback on the watershed interventions in their locations. This calls for enhanced awareness at both the community and government level to reap maximum benefits from the watershed interventions that will directly or indirectly contribute to the overall purpose of global water security.

CONCLUSION

For women's empowerment to gain more momentum, the inclusion of women in decision-making processes is a pre-requisite to sustainable development in rural environments, especially for ensuring local as well as global water security (Clement et al., 2019). Although some benefits of the watershed interventions were realized, most of the watershed intervention activities did not adequately address key gender issues, along with cultural and social constraints that limited rural women's involvement in project activities. Regardless of the level of input, these issues must be considered and projects must be designed to fit the norms of a particular rural setting. With no supporting policy and legislation, the involvement of women in watershed management projects will continue to be limited. The construction of the check dams reduced women's time per day spent fetching water by about 29%. Groundwater level increases reduced the effort required of women to draw water from open wells and hand pumps. Female education was a significant factor related to benefits from the watershed interventions, and the regression results indicated that households with higher levels of education of adult women were significantly more likely to benefit than other households.

This study confirmed that women and girls carry the primary responsibility for the domestic water supply, and thus they may be at risk due to poor access to water and sanitation, while they have limited rights to water resources and limited decision-making authority concerning water use. This inequality has to be recognized, given the fact that women play a crucial but often unrecognized role in managing water for rural livelihood and food security.

For gender transformative results via an integrated watershed management approach, it is important to make technical knowledge available to women. Because functional literacy allows community members and leaders to act collectively and harness the benefits of watershed interventions, efforts must be undertaken to achieve higher functional literacy for women through training, e.g., participatory gender training (Leder et al., 2016). Enhanced awareness of women's equal rights and deliberate efforts promoting women's agency are critical for sustainable development of watersheds. Involving women in building up the social capital will enable women and young people to challenge the existing gender and cultural norms while reducing possible conflicts in the community and households. Watershed intervention projects require gender transformative approaches across all social levels, from the household and community to the watershed project team. New common watershed guidelines (Wani et al., 2015) provide resources and policy support to address issues of gender equality and the status of vulnerable groups. This study provides initial answers to a larger question that requires further research: How to combine economic and technical interventions with social and institutional interventions to challenge social norms that reinforce inequality in order to make interventions more inclusive, thereby empowering and enhancing the overall well-being of men and women, and boys and girls.

ACKNOWLEDGEMENTS

The authors acknowledge support from the CGIAR Research Program on Water Land and Ecosystems (CRP-WLE) for implementing this study in the Parasai-Sindh watershed region. The authors are thankful to Dr. Sreenath Dixit and the IDC team at ICRISAT for their support. A special thanks to all the partners who are involved in this watershed project since its inception, including the staff of CAFRI. The authors are also thankful for the constructive comments by the journal reviewers. The participation and support by the men and women in the study region who volunteered to be interviewed is greatly valued.

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