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Institutional arrangements and stakeholder knowledge of watershed management for food security improvement: a case study of Qersa District, East Haraghe Zone, Ethiopia

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Abstract

The importance of community-based watershed management for rural development is well acknowledged, yet its comprehensive nature remains underappreciated. This study examines the perceptions of stakeholders and their level of coordination in implementing the watershed approach and its impact on food security. Data was collected from 63 professionals with diverse roles across organizations and 337 farmers from three micro watersheds in Qarsa Woreda, East Hararghe Zone, using surveys and interviews. Results showed varying views: 36% of professionals and 12.6% of farmers see it as a holistic rural development strategy, while 9% of professionals and 36.5% of farmers view it mainly as soil and water conservation. Chi-square tests revealed significant differences in professional perspectives based on organizational role and experience (p-values of 0.05 and 0.01), but farmers' views were consistent across watersheds. The study also highlighted a lack of effective collaboration among stakeholders, both vertically and horizontally, in supporting local watershed management initiatives. To maximize the benefits of watershed management for food security, it is crucial to improve stakeholder understanding, enhance institutional coordination, and strengthen accountability mechanisms. Addressing these areas through better educational programs and collaborative efforts can support sustainable rural development and improve food security for communities and ecosystems.

Keywords/Phrases: Coordination, Farmers, Institutional Arrangement, Integration, Professionals, Rural Development

1 Introduction

Integrated Watershed Management (IWM) has gained global recognition as a critical strategy for fostering sustainable food security and mitigating environmental impacts. It is widely acknowledged for its ability to address complex environmental issues while promoting socio-economic resilience (Godfray *et al.*, 2010; Munang *et al.*, 2011; Gulati *et al.*, 2012; FAO, 2021). Successful implementations in countries such as China, Sri Lanka, and the Philippines showcase IWM's effectiveness in managing environmental challenges, enhancing social equity, and improving economic stability (Suhas *et al.*, 2010; Rawat, 2014; Parvathi, 2013). In sub-Saharan Africa, including Uganda and Kenya, IWM has also demonstrated success in ecological preservation, promoting sustainable land use practices, and increasing resilience to climate change impacts (Nick & Woldehanna, 2012; FAO, 2017).

In Ethiopia, watershed management was initially introduced in the 1970s to address soil erosion and land degradation through a top-down, centralized approach (Alemu & Kidane, 2014; Moken *et al.*, 2015; Gadisa, 2016). This period was marked by "planning in the dark" due to unclear criteria for land rehabilitation technologies, coupled with a policy framework emphasizing stringent government regulation (Bantider *et al.*, 2019). This approach often led to ineffective planning and persistent natural resource depletion (Hassen, 2022; UNEP, 2016;

Nigussie *et al*., 2018), highlighting the limitations of the early integrated watershed management strategy (Mekonnen *et al*., 2011; Tefera, 2015).

Since 1991, Ethiopia has made significant strides in watershed management by broadening its focus beyond soil and water conservation to include socio-economic and environmental objectives (German *et al*., 2007; Bantider *et al*., 2020). The introduction of various policies and strategies, such as the agricultural-led industrialization development policy, has integrated watershed management into broader economic and rural development goals, including food security (Assefa, 2012; Amogne, 2014; Bantider *et al*., 2020). Additionally, the establishment of community-based participatory watershed management guidelines in 2005 has facilitated standardized planning and coordination among institutions (Desta *et al*., 2005). Furthermore, the 2011 Climate-Resilient Green Economy (CRGE) initiative was developed to enhance sustainable watershed management and resilience to climate change impacts (FDRE, 2012). Despite some improvements in natural resource conservation, agricultural practices, and livelihoods, and fostering synergies among technologies, policies, and institutions, the watershed approach has not fully met expectations for advancing rural development and food security (Worku *et al*., 2018; Mekuriaw, 2017; Gebregziabher *et al*., 2016; Gashaw, 2015; Bantider *et al*., 2019; Gashaw *et al*., 2014; Alemu & Kidane, 2014).

One of the primary challenges in watershed management is the varied interpretation and understanding of its concept, which has led to confusion in conservation and development planning (Vasant & Lin, 2012; Beley & Bewket, 2015; Devi, 2015; FAO, 2017; Setyo, 2019; Elfithri *et al*., 2018; Heal, 2019). This lack of consensus among stakeholders - who often possess differing knowledge, values, and priorities - results in fragmented approaches and conflicting objectives that undermine effective implementation (German *et al*., 2007; Gashaw *et al*., 2014; Alemu & Kidane, 2014; Tefera, 2015). Additionally, the absence of a cohesive institutional framework and inadequate knowledge exchange exacerbate these issues, leading to compromised outcomes (Reddy *et al*., 2017; Arfasa & Tona, 2019; Thiemann *et al*., 2018). Policies developed since 1990 have generally fallen short of their goals due to the limited scope of individual institutions and insufficient integration of local knowledge (Bantider *et al*., 2020).

It is widely acknowledged that effective watershed management requires strong institutional frameworks and a shared understanding among stakeholders (Gulati *et al*., 2012; Bantider, 2019; Katusiime, 2023). However, existing studies tend to focus on the physical aspects of watershed management and overlook the importance of institutional factors and the interconnected nature of the management process (Nigussie *et al*., 2018; Hurni *et al*., 2015; Gashaw *et al*., 2014; Alemu & Kidane, 2014). Furthermore, the fragmentation caused by evolving concepts and sector-oriented planning hinders integrated approaches, with agriculture, forestry, and water resources often operating in isolation and neglecting their interconnections (Brooks *et al*., 1991; Wang *et al*., 2016). There is also a lack of research addressing practitioners' perspectives on how watershed management relates to rural development and food security (Mulugeta, 2015). Addressing these challenges is vital for advancing watershed management to enhance food security and rural development. This study aims to examine stakeholder perspectives and analyze the institutional framework for watershed management in Qarsa Woreda, East Hararghe Zone, Oromia Regional State, to address the gaps between theoretical frameworks and practical implementation, ultimately aiming to improve food security outcomes.

2 Methodology of the Study

2.1 Description of the Study Area

The study was conducted in Qarsa Woreda, which is situated in the East Hararghe Zone of the Oromia Region in Ethiopia. Geographically, the Woreda is located between latitudes 9^o17' and 9^o29'N, and longitudes 41^o12' and 41^o56'E to the west. The district experiences a bimodal rainfall pattern characterized by an average annual rainfall of 1225 mm/year. The annual mean minimum and maximum temperatures are recorded at 12.5^oC and 26.6^oC, respectively. The rainy seasons include Belg (Arfasa) from March to May and Kiremt (Gana) from June to September, with a dry season prevailing from October to Febru-

ary (Qarsa Woreda Agriculture Office, 2022).

Agriculture forms the backbone of the rural economy in Qarsa Woreda, predominantly practiced under rain-fed conditions. The agricultural system is characterized by mixed crop-livestock production, with maize (*Zea mays* L.) and sorghum (Sorghum bicolor) serving as staple crops. Additionally, khat (*Catha edulis*) and coffee (*Coffea arabica*) are important cash crops cultivated in the area. Watershed management strategies have been implemented over an extended period through various initiatives such as Free Mass Mobilization (FMM), Sustainable Land Management Program II (SLMPII), and Productive Safety Net Public work (PSNP_PW). However, despite these efforts, the Woreda continued to face significant challenges related to chronic food and nutrition security, soil erosion, soil infertility, and water stress.

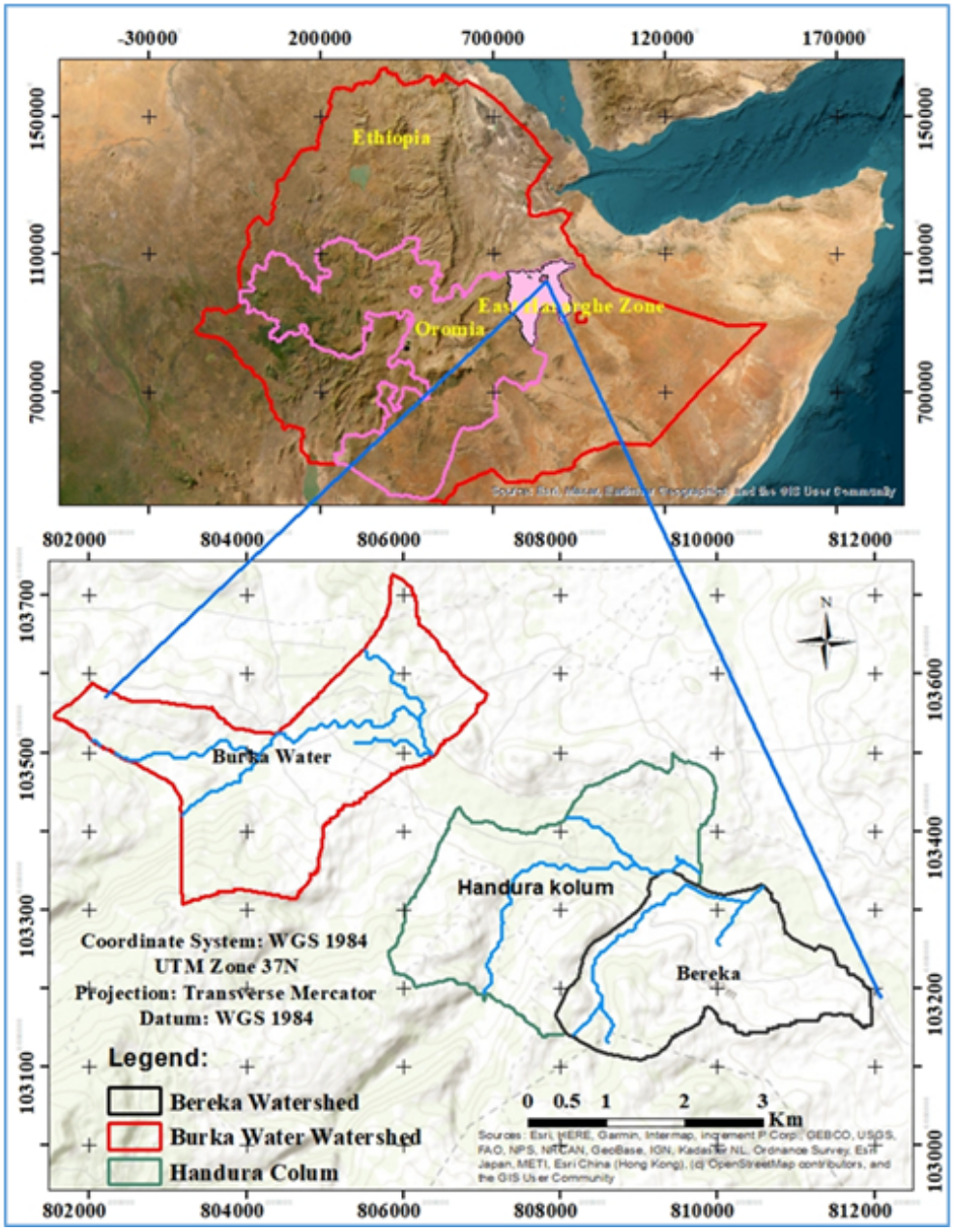

Figure 1. Map of the study area

2.2 Sample design and data collection methods

The study focused on these micro watersheds (Figure 1). Specifically, the Free Mass Mobilization program was a government initiative that did not receive any external funding support. Conversely, the Sustainable Land Management Program and Productive Safety Net Program were funded by external sources. Despite their differences, all three programs adhered to the same watershed management guidelines and shared a common objective: promoting sustainable natural resources management and enhancing ecosystem health to improve food security. This unified objective underscores their commitment to addressing local challenges such as soil erosion, soil infertility, and water stress, and other related watershed management activities for livelihood improvement.

The study utilized a mixed-methods approach, combining quantitative data collection through a household survey with qualitative data from focus groups and key informant interviews (following Creswell, 2003). The study area, Qarsa Woreda, was purposefully selected due to the presence of free mass mobilization, a sustainable land management program, and a productive safety net program simultaneously. The micro watershed was selected based on specific criteria, such as sites adjacent to each other, historical similarity of watershed management interventions, similar land use systems, and soil and water conservation practices. Based on this, one micro watershed from each program approach was selected. Respondent households were selected using a sample size determination method outlined by Kothari (2004), which typically involves statistical calculations to determine the minimum number of respondents needed for the survey to achieve valid results.

$$S = \frac{Z^2 * P * (1-P)}{C_2} \quad (1)$$

Where: Z = Z-value (1.96) for 95 confidence level
P = is the percentage picking a choice, expressed as a decimal (0.5)
C = is the confidence interval expressed as a decimal (0.05 = $\pm$0.05)

Subsequently, the actual sample size for the study area was determined as:

$$SS_{pk} = \frac{S}{1 + \frac{S-1}{P_k}} \quad (2)$$

Where: SS_{kp} is the sample size for the known population size
S is the sample size for the unknown population calculated using Equation 1
P_k is the known population size from which the sample size is calculate

Then a total of 337 individuals were randomly selected from the total population in three micro watersheds: 118 (35%) from Baraka, 107 (31.8%) from Burka Watter, and 112 (33.2%) from Adhura Kosum (Table 1). Additionally, 63 professionals and managers were selected based on their expertise, organizational roles, and current involvement in watershed management.

Table 1. The maximum likelihood estimates of the logistic regression model

No.	Name of micro watershed	Program approach	Area in Ha	Population	
				HH	Sample size
1	Andhura Kosum Micro watershed	Free Mass Mobilization	759.5	734	112
2	Baraka Micro watershed	PNSP-PW	565.7	639	107
3	Burqa Water micro watershed	SLMP-II	853.1	765	118
			2178.3	2138	337

(Sources: Data from '*kebele*' administration and development agent)

The selection process involved individuals from different levels: 9 from the federal level, 14 from the regional level, 13 from the zonal level, 14 from the Woreda level, and 13 from the kebele level. Furthermore, five focus group discussions were conducted at various government levels and within the three

micro watersheds. Each group consisted of 7 to 9 members selected based on their knowledge, gender, age, experience, educational background, social status, and understanding of watershed management and community participation.

In addition, before starting the study, a log sheet was designed to track daily activities related to watershed management in two zones, two districts, and six kebeles. The log sheet recorded the activities of experts and development agents involved in watershed management, documenting their experiences, challenges, and achievements. Its main goal was to assess the effectiveness of current practices and the knowledge level of local experts and development agents in watershed management. Analysis of the information revealed that the activities did not align with the core principles of watershed management, indicating a lack of understanding among participants. The analysis of results from the log sheet framework was adjusted to align with the research goals, relevant literature (Meierdiercks *et al*., 2024; Wang *et al*., 2016), community-based participatory guidelines (Desta *et al*., 2005; MoA, 2020), and practical field experience to assess the holistic comprehension of watershed management practices. Additionally, Förch and Thiemann's (2004) components of watershed management were employed to compare the daily recorded activities in the log sheet. Subsequently, three key concepts were identified as crucial benchmarks for evaluating stakeholders' understanding and perspective on watershed management practices. These include:

- Watershed as a physical soil and water conservation concept,
- Watershed as a natural management concept, and
- Watershed as a holistic approach to rural development concept.

2.3 Data Analysis

The data gathered from surveys conducted in households, by professionals, and through focus group discussions were carefully organized and inputted into SPSS 26 for analysis. Basic descriptive statistics such as mean, standard deviation, and frequency were used for presentation. Methods of discourse analysis were used to further explore the developing trends and patterns. The institutional capacity data analysis involved both subjective and objective interpretations.

3 Results and Discussions

3.1 Socio-demographic characteristics of the household and professionals

3.1.1 Socio-demographic characteristics of the household

This section provides an overview of the characteristics of farm households.

Table 2. Socio-demographic characteristics of households

Variable		Frequency	Percent
Sex of the household	Male	294	87.2
	Female	43	12.8
Age of farmer HHS	18-30	66	19.6
	31-45	144	42.7
	46-64	114	33.8
	> 64	13	3.9
Educational level HHs	Cannot read & and write	191	56.7
	Read and write	52	15.4
	Primer (1-4)	29	8.6
	Secondary (5-8)	43	12.8
	Complete (9-12)	22	6.5

Sources: 2021-2022 survey

The data reveals that the majority of participants (87.2%) belonged to male-headed households, while 12.8% were from female-headed households. In terms of education, 56.7% had no formal education, while 15.4% had basic literacy skills, 15.4% were in primary education, 8% were in secondary school, and 6.5% had completed grade 9. The average age of the participants was calculated to be 41.2, with a standard deviation of 11.35 (Table 1). The characteristics of farm households surveyed in this study indicate a predominantly male-headed, low-educated, middle-aged population engaged in subsistence farming. Thus, capacity building measures need to be adapted to enhance the watershed management practices for the livelihoods and food security improvement.

3.1.2 Socio-demographic characteristic professionals

Table 2 provides a detailed summary of the socioeconomic characteristics of the professional individuals included in the study. The data shows a significant gender imbalance in professional roles, with the majority of respondents being male (84.7%). Additionally, a large number of participants had extensive professional experience, with over half having more than 10 years of experience (55.1%). This suggests that the survey included a group of professionals with a wealth of experience. In terms of education, most participants held a bachelor's degree (59.7%), while only a small percentage had a certificate (1.4%).

Table 3. Descriptive statistics of professionals respondent characteristics

Characteristics	Groups	Frequency	Percent
Sex of the respondent	Male	61	84.7
	Female	11	15.3
Government hierarchy level	Federal level	12	16.7
	Regional level	16	22.2
	Zone level	15	20.8
	Woreda level	16	22.2
	Kebele level	13	18.1
Age of the respondent	(20-29)	8	11.1
	(30-39)	40	55.6
	(40-49)	18	25.0
	Above 50	6	8.3
Organizational position	DA	9	12.5
	Supervisor	2	2.8
	Expert	24	33.3
	Team leader	27	37.5
	Manager	10	13.9
Work Experience	1-5	19	26.4
	6-10	13	18.1
	Above 10	40	55.5
The educational level of the respondent	Certificate	1	1.4
	TVET/Diploma	7	9.7
	Degree	43	59.7
	MSC	21	29.2

Sources: 2021-2022 survey

The survey also ensured a diverse representation of government levels, allowing for a comprehensive understanding and effective resolution of relevant issues.

3.2 Knowledge and perception on integrated watershed management among professionals

Over the past decade, watershed science has faced significant scientific and technical challenges that have shaped current integrated watershed management strategies for rural development (Wang *et al*., 2016; Gopa, 2021). Our survey results reveal notable variations in how professionals perceive integrated watershed management: 54% primarily view it as natural resource management, 36.5% interpret it as rural development, and 9.5% see it mainly as soil and water conservation (Figure 2). This discrepancy indicates a lack of consensus and suggests an incomplete understanding of the watershed concept among professionals. The observed variations underscore a challenge in achieving a unified approach to watershed management. The diversity in perceptions highlights the need for conceptual frameworks and agreement on the principles and implications of integrated watershed management. This finding is consistent with Meierdiercks *et al*. (2024), who observed that 96% of definitions describe a watershed merely as a geographical region, with only 35% linking it to terms such as river basin, drainage basin, or catchment, and just 7.8% incorporating human activities. Similarly, Meshesha and Tripathi (2015) emphasized that despite ongoing efforts to advance watershed management for sustainable rural development, the conceptualization of the approach remains problematic.

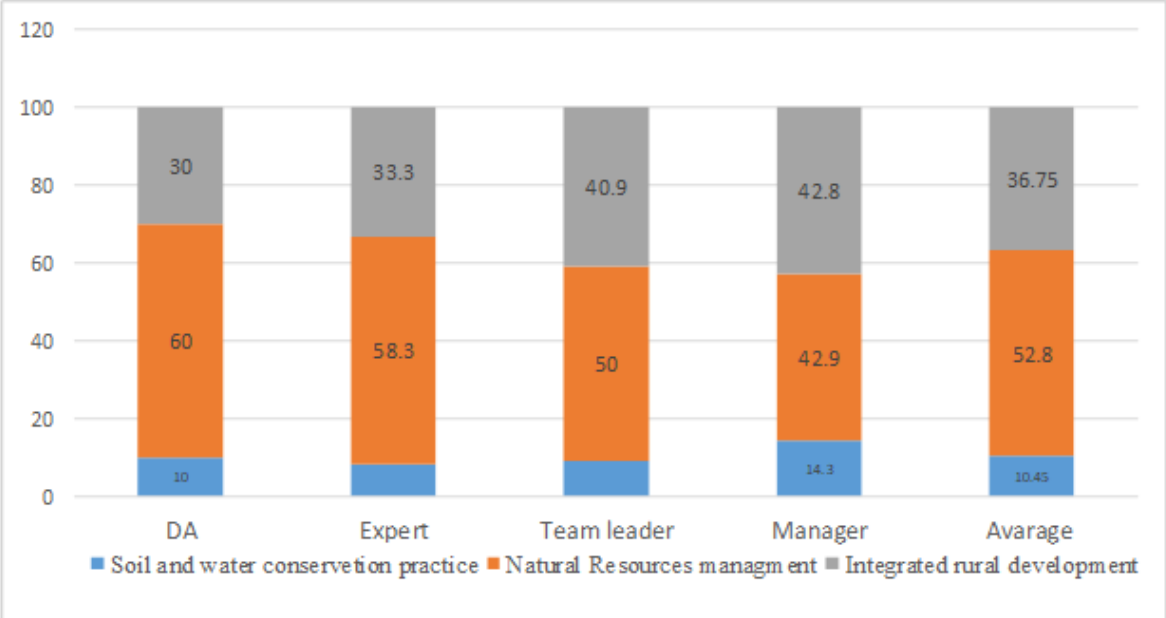

Figure 2. Perceived meanings and understanding of watershed development by professional (Sources: 2021-2022 survey)

Stakeholders' perception and understanding of the watershed management concept were also assessed using factors such as type of organization, work experience, field of study, organizational hierarchies, organizational positions, and educational level (Table 3). The chi-square test revealed that the type of organization, work experience, and field of study significantly impacted stakeholders' understanding of the concept, with P values of 0.016, 0.031, and 0.002, respectively. Interestingly, positions within an organization and educational background demonstrated similar comprehension and perception of the watershed management concept. Individuals with expertise in natural resources or related fields showed a greater understanding of watershed management than those from different backgrounds. This implies that watershed management is often seen primarily as part of natural resources management rather than a sustainable approach to rural development. Similarly, individuals working in agriculture had a better grasp of watershed management than those in other sectors, suggesting that other organizations may not see watershed management as a viable strategy for rural development. Furthermore, the significant asso-

ciations found in this study emphasize the need for tailored approaches and targeted interventions to enhance stakeholders' comprehension of this concept, particularly for those with different organizational affiliations, work experiences, and academic backgrounds.

Table 4. Knowledge and understanding of professionals about watershed management at different level (N=63)

Group	Soil and water cons ervation practice (%)	Natural Resources management (%)	Integrated rural development (%)	Chi-Square	Df	P-Value	SF level
Type of organization affiliation	18.9	55.3	25.8	24.746	12	0.016	SN
Organizational hierarchy	5.93	54.03	40.04	7.228	8	0.512	NSF
Organizational position	5.43	45.79	48.77	5.404	8	0.714	NSF
Work Experience	6.1	60.8	33.1	10.604	4	0.031	SF
Field of study (professions)	3.85	57.22	38.93	20.819	6	0.002	SF
Educational level	2.56	67.53	29.9	4.809	6	0.569	NSF
Overall	7.13	56.78	36.09				

Sources: 2021-2022 survey

3.3 2.6 Knowledge and perception of farmers about watershed management

Regarding the knowledge and understanding of the local community, the study's findings revealed that the perception of watershed management varied among the local community. About 17.8% of farmers involved in SLMP II micro watershed, 11.9% in PNSP_PW, and 8.9% in community mass mobilization micro watershed considered watershed management as a rural development approach, while the majority of the respondents viewed it as natural resources management and soil and water conservation (Table 2). This indicated that a limited number of individuals within the community perceived it as a means to enhance economic progress and improve the standard of living in rural regions. Conversely, the majority of farmers predominantly regarded it as a method of environmental preservation, prioritizing it over alternative approaches. The chi-square test's statistical analysis also revealed a significant difference among the three micro watersheds in terms of their performance. Specifically, the micro watershed where participants of the SLMP II program were involved showed significantly better results compared to both the PNSP_PW micro watershed and the free mass mobilization micro watershed (P=0.04).

The findings from the surveyed households and focus group discussions reveal insights into how different groups of farmers perceive watershed management and the associated resources provided by various programs. Farmers involved in PNSP-PW and SLMP II micro watershed projects view the resources and financial aid not as integral components of watershed management but as incentives or compensation for their labor. On the other hand, farmers participating in the free mass mobilization program see watershed management as a government-driven enforcement program that mandates their involvement in activities such as soil conservation work during the dry season and tree planting in the summer months. The varying viewpoints within the three micro watersheds demonstrate the influence of indigenous knowledge and traditions on perspectives regarding watershed management. Farmers' perceptions are primarily influenced by their direct participation in specific projects rather than by institutional frameworks or comprehensive strategies. This narrow perspective prevented farmers from fully understanding the importance of sustainable watershed management practices in promoting long-term environmental health, improved soil fertility, and increased water availability, which are crucial for enhancing food security. The findings align with the research of German *et al.* (2007) and Terefe *et al.* (2015), who noted that differing stakeholder perceptions make it challenging to adopt a holistic watershed management approach. Similarly, Thiemann *et al.* (2018) reported that reliance on traditional methods and strategies poses a significant challenge to holistically implementing watershed management. Linking the financial aid and resources to the broader objectives of watershed management is important rather than viewing them as mere compensation.

Table 5. Knowledge of farmers about watershed management across the three micro watersheds

	Baraka PNSP-PW N=118	Burka Water_SLMP N=107	Adhura kosum_Regular N= 112	Over all N=337	Pearson Chi-Square	Df	P-value
Soil and water conservation	50 (42.4%)	30 (28.%)	52 (46.4%)	132 (39.2%)	9.900	4	0.042
Natural Resources Management	58 (45.8%)	58 (54.2%)	50 (44.6 %)	162 (48.1)			
Integrated rural development	14 (11.9 %)	19 (17.8%)	10 (8.9%)	43 (12.8)			

Sources: 2021-2022 survey

3.4 Knowledge and perception of watershed among professionals and the local community

Figure 3 illustrates the varying perception and knowledge of watershed management across different tiers of government and community levels. At the federal level, approximately 67% of respondents perceived it as a holistic approach to rural development, while 33% saw it as natural resource management. Similarly, at the regional level, 64% considered watershed management a comprehensive rural development, with 36% linking it to natural resource management. This result indicates a consistent perception at the federal and regional levels, with a strong emphasis on watershed management as part of comprehensive rural development. However, opinions diverged significantly at the zone level, with 54% connecting it to natural resource management, 38% to comprehensive rural development, and 8% specifically identifying it as soil and water conservation. At the woreda and kebele levels, the predominant view was that of natural resource management, with 64% and 69% respectively holding this perspective. The community-level survey results displayed a mix of opinions, with 46.6% considering watershed management as natural resource management, 40.7% as soil and water conservation, and only 12.7% regarding it as comprehensive rural development.

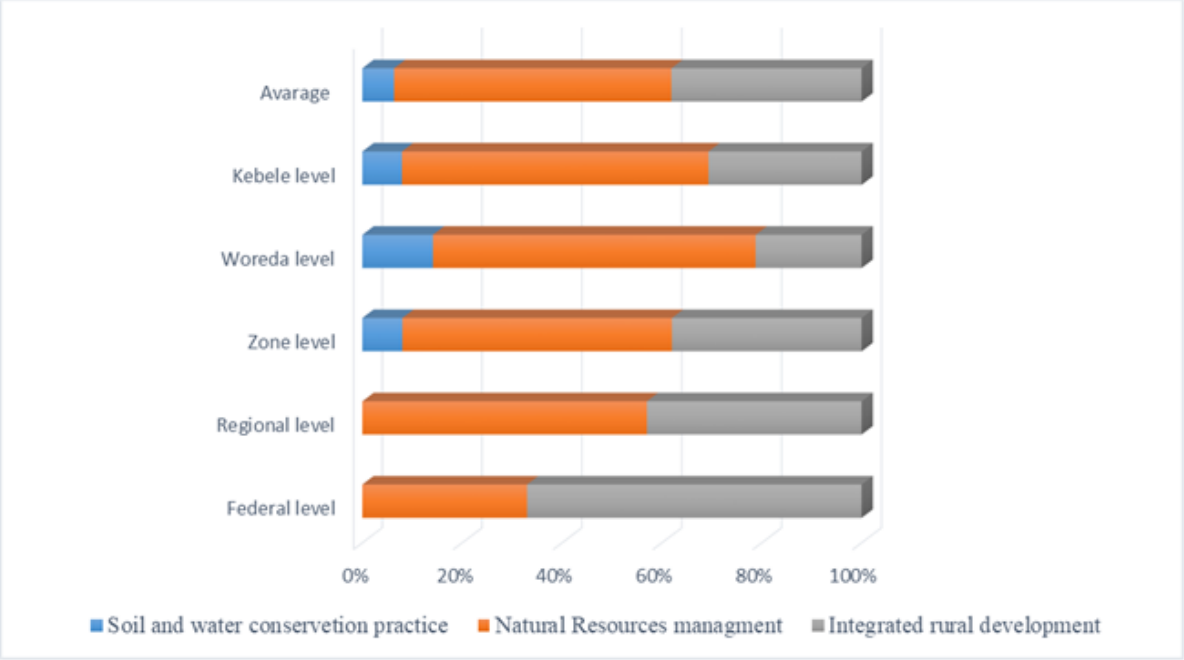

Figure 3. Perceived meanings and understanding of watershed development by different experts across government hierarchies (Sources: 2021-2022 survey)

The study's findings showed a significant difference in the perception of watershed management between government bodies and local communities. The focus group discussions confirmed that the lack of agreement among different levels of governance resulted in significant obstacles and fragmented initiatives, ultimately reducing the effectiveness of watershed management. This lack of unity not only

impacts food security but also hinders broader development goals, highlighting the need for a cohesive approach to address current challenges and promote sustainable resource management. Additionally, the study underscored the necessity of enhanced communication among governmental entities, local communities, and other relevant stakeholders engaged in watershed management. This observation aligns with the findings of several studies conducted by Wang *et al.* (2016), Cohen & Davidson (2011), Worku & Tripathi (2015), and Gashaw (2015), which also emphasize that the current approach to watershed management primarily focuses on the physical aspects, rather than adopting a comprehensive approach. Unless there is a collective understanding established at all levels, this trend is likely to persist. Narendra *et al.* (2021) also emphasize the importance of a unified vision and a holistic approach in watershed management. Their study highlights the significance of education as a crucial stepping-stone towards improving watershed management.

3.5 Institutional arrangement for watershed management

This section examines how the three micro-watershed approaches handled watershed management practices at the local level and the institutional structure in place across different governance levels. At the federal level, the Ethiopian Federal Democratic Republic amended Proclamation No. 1263/2021, showing that watershed management responsibilities are divided among the Ministry of Agriculture, the Ministry of Water and Energy, the Ministry of Irrigation and Lowland Areas Development, and the Environmental Protection Agency under the Ministry of Planning. Each ministry has specific duties that contribute to a comprehensive management strategy, including policy formulation, supervision, and coordination of watershed management efforts across the country.

The Oromia Proclamation No. 242/2021 has distributed watershed management responsibilities among various regional bureaus and entities, such as the Oromia Bureau of Agriculture, Oromia Bureau of Land, Oromia Bureau of Irrigation and Pastoral Development, Oromia Bureau of Water and Energy, Oromia Environment Commission, and Oromia Forest and Wildlife Enterprise, as well as their corresponding line departments at the zone and district levels. Each entity has specific duties and responsibilities aimed at a comprehensive management approach, including policy development and implementation, oversight, capacity building, coordination, and on-the-ground execution of watershed management activities across the region and specific areas. At the community level, the kebele administration and development agent are primarily responsible for overseeing watershed management.

Figure 4 illustrates the hierarchical arrangement of watershed management at federal, regional, and community levels in the three micro watersheds. The Ministry of Agriculture (MoA) and the regional line department are responsible for coordinating community-based participatory watershed management, including the Sustainable Land Management Program (SLMP) and the Rural Productive Safety Net Programme (PSNP). However, these two programs have their own organizational structure and staff under the MoA and the Oromia Bureau of Agriculture to carry out the program activities. At the woreda level, there is no separate organizational structure for SLMP-II and PSNP-PW to undertake the program activities. Consequently, the government structure, particularly the woreda agriculture office, assumes the responsibility for managing watersheds and takes on the coordination role. At the local level, the Kebele Administration and the community-based watershed committee are primarily responsible for overseeing the management of the three micro-watersheds.

Despite the structured framework for watershed management established across various government hierarchies, the household survey indicated significant gaps in the participation and coordination of federal and regional entities at the village level (see Figure 5). A majority of participants (approximately 97% in the mass mobilization program, 94% in PNSP-PW, and 78% in SLMP-II) expressed dissatisfaction with the lack of support from federal and regional authorities, as well as the inconsistent monitoring and evaluation of the program at the village level. Furthermore, the Development Agent (DA) and district-level experts interviewed emphasized that the decentralization process has not fully empowered local authorities to effectively plan and allocate budgets based on their criteria to address the needs of their communities.

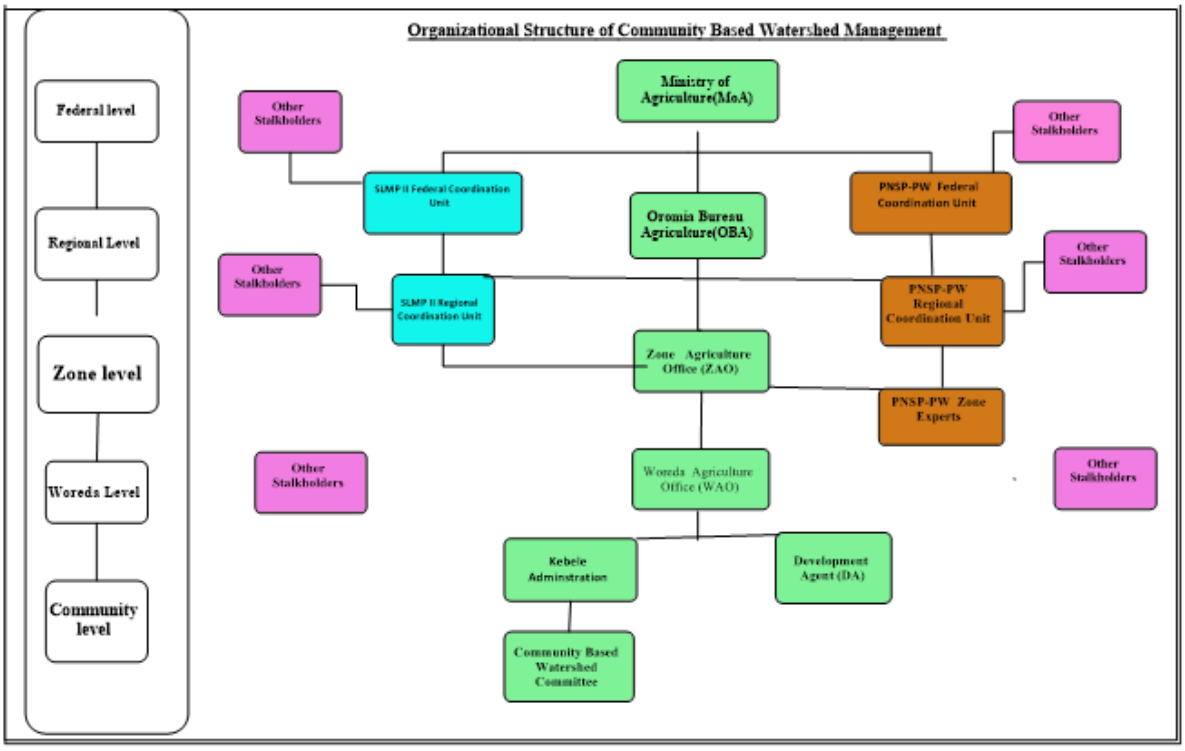

Figure 4. PSNP, SLMPII, and free mass mobilization's institutional arrangement (Sources: constructed by authors)

This finding reveals conflicting perspectives on attributing the main challenges in watershed management solely to local government and community involvement. Instead, the success or failure of a specific integrated watershed management strategy relied on the engagement of higher-level government authorities and their commitment to their responsibilities (Nigussie *et al.*, 2018; Abuto,.2009).

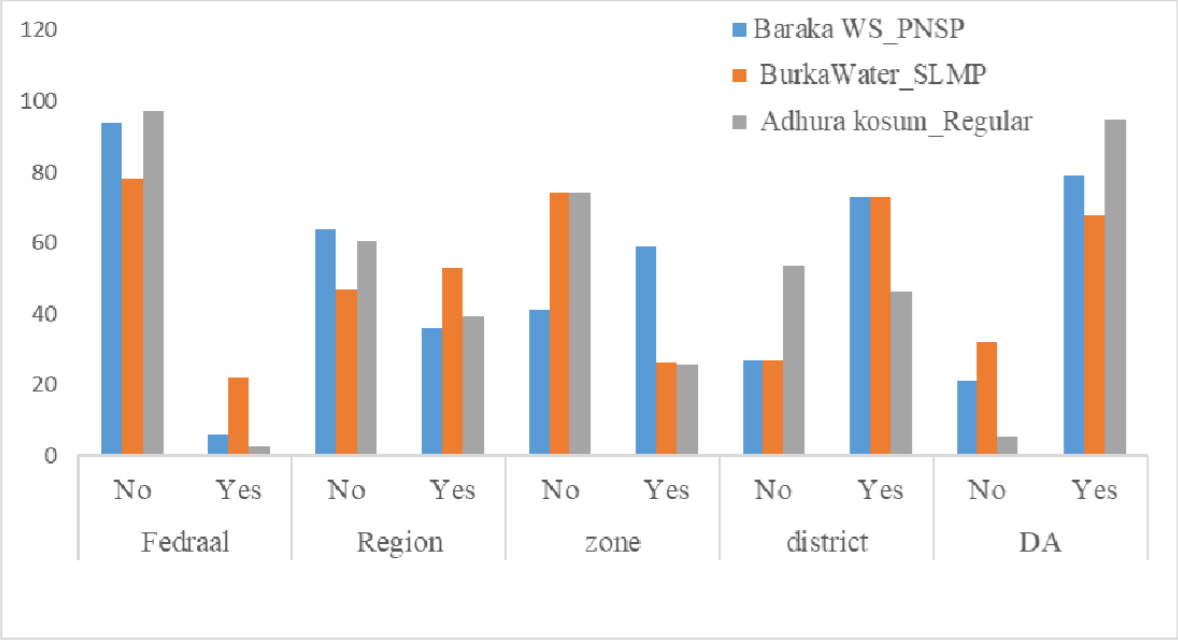

Figure 5. Farmer feedback on government support for watershed management in three micro watersheds at the community level

The findings from the survey underscore the existence of well-organized watershed committees in the three micro watersheds as a positive aspect of the initiatives. Nevertheless, respondents from the three program approaches and woreda-level experts have reported that there is a lack of transparency in the selection of watershed management committee members, which was predominantly made by the political leaders and Development Agents (DAs), as indicated in Figure 6. Focus group discussions also criticized the selection process at both kebele and woreda levels, with political leaders and development agents having a significant influence. They further explained that, despite this, the SLMP II program approach is better at involving the community in the selection process of committee members than the PNSP-PW and Free Mass Mobilization. However, none of the program approaches followed the watershed management guidelines during committee selection or any watershed management process.

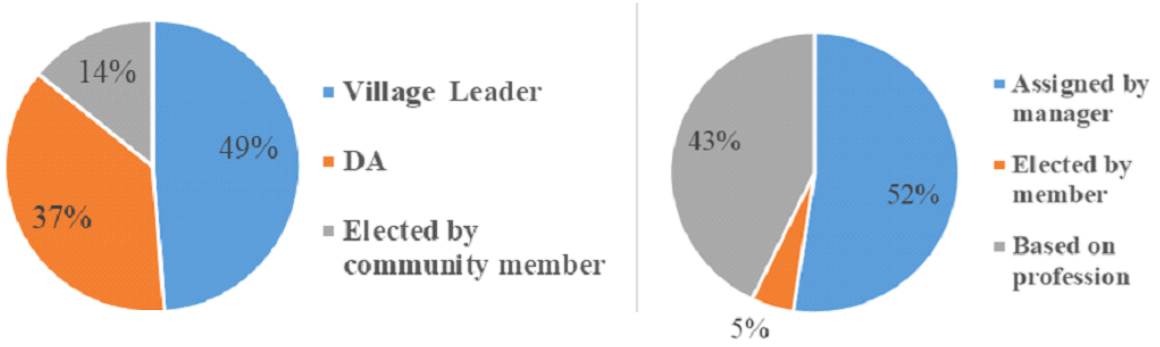

Figure 6. Kebele and Woreda watershed committee selection approach as indicated by the participate respectively

Watershed management at the local level involves not only formal strategies but also informal systems that rely on community-based organizations, traditional leaders, religious leaders, established regulations, and cultural norms. However, interviews with the Focus Group discussions in all three program approaches have revealed that the importance of informal institutions has been declining over time as the government structures have taken over their responsibilities. These interviews have also unveiled that this transition towards formalization in watershed management has led to the loss of traditional knowledge, cultural practices, and community unity, which have been vital in different environmental and social aspects. The study also reveals that government structures may not always be as responsive or adaptable to local needs and conditions as informal systems and lack practical application on the ground at the local level. Almost all of the watershed committee members in the three micro watersheds indicated that the institution lacked practical application on the ground and was politically affiliated, which affected the community participation in decision-making, planning, implementation, and evaluation of watershed practices.

However, the success of an integrated watershed management approach depended on the involvement of government authorities at all levels and the local community. The finding aligns with Gashaw *et al.* (2014) emphasis on the importance of inclusive community institutions in reducing poverty. Kidane *et al.* (2014) also highlighted the role of local institutions in conserving natural resources at the community level. Other studies by Nigussie *et al.* (2018) and Bekele *et al.* (2023) have also shown that the success or failure of integrated watershed management strategies relies on the participation of higher-level government authorities and their dedication to their duties. This study suggested creating transparent and accountable multi-stakeholder platforms to enhance communication and collaboration among government agencies, local communities, and other stakeholders that consider the interests and concerns of local communities in watershed management.

Partnership and stakeholder coordination in Watershed Management

The success or failure of watershed management may depend on the degree of responsibility that partners

feel for cooperation and coordination. The study assessed variables influencing collaboration and coordination among stakeholders at various government levels. Figure 7 provides a visual representation of the feedback from respondents at each government level, highlighting how these factors are perceived across different tiers of government.

Furthermore, respondents from the SLMP-II and PNSP-PW projects at the federal and regional levels reported that, despite having formal platforms for the technical and steering committees for planning, implementation, monitoring, and evaluation of watershed management activities, coordination and integration were notably weak or even nonexistent due to the lack of effective accountability mechanisms. In the context of free mass mobilization, experts and managers at the federal and regional levels indicated that there was no collaborative platform. Instead, each ministry, organization, and department operated with its own separate plan. This lack of integration was also confirmed by experts at the zonal and woreda levels, who observed that watershed management planning was largely sector-based, driven by top management directives. Development agents further highlighted that, although the planning process is intended to be bottom-up, it frequently takes place at higher levels and is then handed down to lower levels. Kebele watershed committees shared this perspective, emphasizing their limited knowledge and understanding of coordination and integration, which are crucial for effective watershed management.

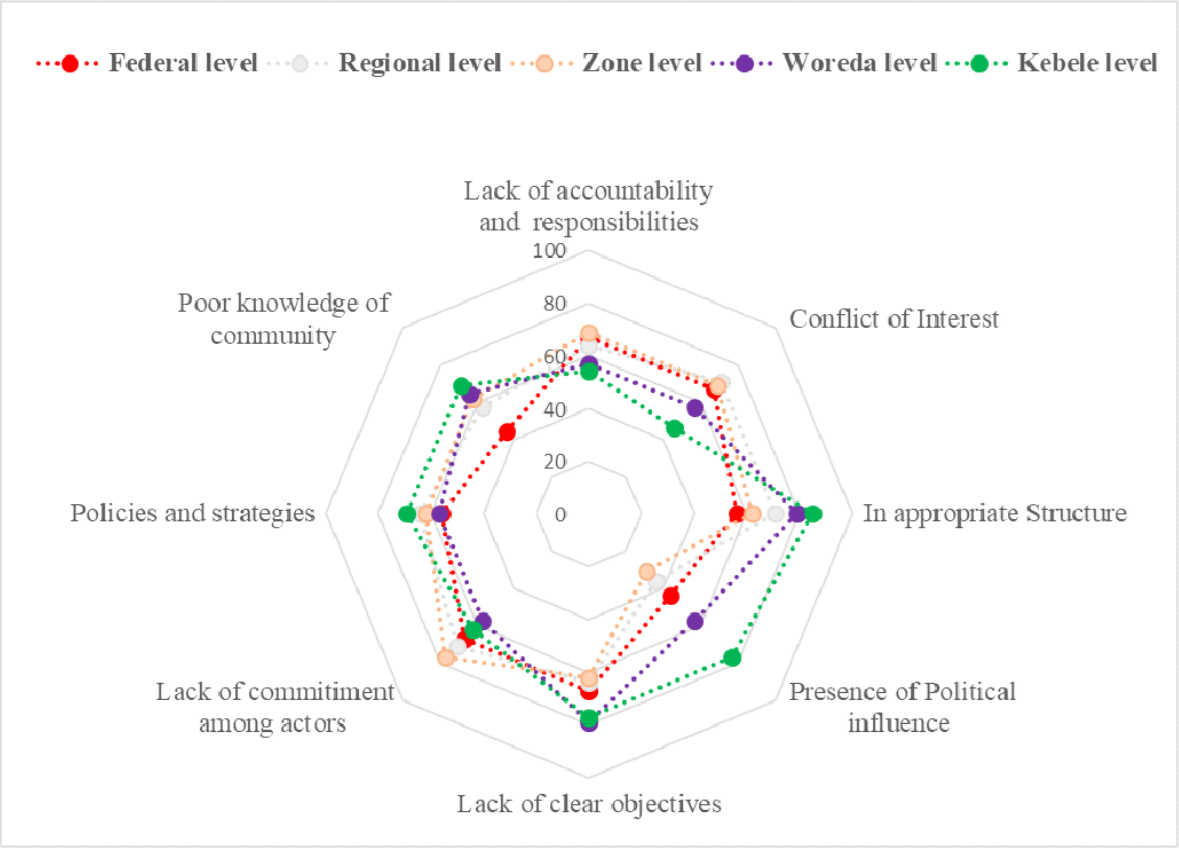

Figure 7. Factor influencing coordination in watershed management across government hierarchy (Sources: 2021-2022 survey)

The study on three micro watersheds has shown that, despite the existence of formal platforms for technical and steering committees responsible for the planning, implementation, monitoring, and evaluation of watershed management activities at different levels for SLMP-II and PNSP-PW, and at the woreda and kebele levels for the free mass mobilization micro watersheds, there is a significant lack of coordination and integration due to the ineffective accountability mechanisms in place across all three

watersheds. Moreover, the watershed management practices across all three micro watersheds studied are not aligned with the specific laws and guidelines established for each watershed. This observation is consistent with the FAO (2017) study, which indicated that the absence of accountability mechanisms negatively influences the effectiveness of promoting collaborative actions within watershed management. Similarly, research by Berardo *et al*. (2019) and Abiye (2019) reported that the lack of proper coordination results in ineffective watershed management. Many experts also concur that "sectoral ego" contributes to the lack of coordination, leading to fragmented interventions that fail to produce cumulative positive impacts. Further supporting this view, Bantider *et al*. (2020) examined eight policy documents and sixty-three laws enacted post-1990s related to natural resource management and found that these policies did not achieve the intended outcomes largely due to ineffective implementation and inadequate communication with local stakeholders.

3.6 Watershed management capacities for food security

The study explored how watershed management can improve food security by examining factors such as water availability, soil fertility, and agricultural practices from the perspective of household perceptions. A majority of participants (72.3%) in the mass mobilization programs, including PNSP-PW (75.4%) and SLMP-II (78.5%), reported an increase in crop yield as a result of the continuous implementation of watershed-based physical and biological soil and water conservation measures. These findings remained uniform across the three micro watersheds under investigation. Additionally, households mentioned seeing improvements in water availability, animal feed, and income opportunities due to these practices. Figure 8 shows a summary of the improvements reported by households in the three programs in detailed data.

These findings align with Degefa's (2005) definition of food security, which describes it as the ability of farmers and pastoralist households to meet their food and essential needs through diverse livelihood activities, including farming, livestock raising, non-farm businesses, or wage labor. Gashaw (2015) also highlighted that integrated watershed management covers various sectors—such as environment, agriculture, forestry, and animal husbandry—with the goal of improving food security. Meanwhile, Danacioglu and Tagil (2019) emphasized the potential of watershed management to enhance agricultural productivity and promote sustainable tourism through the preservation of natural and cultural heritage.

Despite the positive impact of watershed management on food security, the research findings indicate that challenges limit its full potential across the three micro watersheds. One significant challenge is the differing perspectives on watershed management across various levels of government and the community. At the federal and regional levels, it is viewed as integral to rural development. However, at the zonal and woreda levels, opinions vary, with a stronger emphasis on natural resource management. At the community level, there is a mix of viewpoints: some see watershed management primarily as natural resource management, while others focus on soil and water conservation (see Table 2 and Figure 3). Sector-specific planning and a limited understanding of coordination among the watershed committees have contributed to an incomplete recognition of watershed management's transformative potential in enhancing food security. Without addressing these underlying issues, the potential benefits of watershed management may not be fully realized.

This aligns with Sayer *et al*. (2013), Moken *et al*. (2015), and System *et al*. (2020), who highlight that a holistic approach to watershed management is crucial for balancing environmental, socio-economic, and political objectives to improve the quality of life for local communities and ensure sustainable management. Additionally, Gashaw *et al*. (2014) and Hurni *et al*. (2015) emphasize the need to bring together various stakeholders, including government agencies, local communities, and others, to develop a shared understanding of the holistic concept of watershed management. The study emphasizes the need for utilizing knowledge-sharing platforms, such as extension services, training programs, and community-based organizations, to adopt a holistic approach to watershed management.

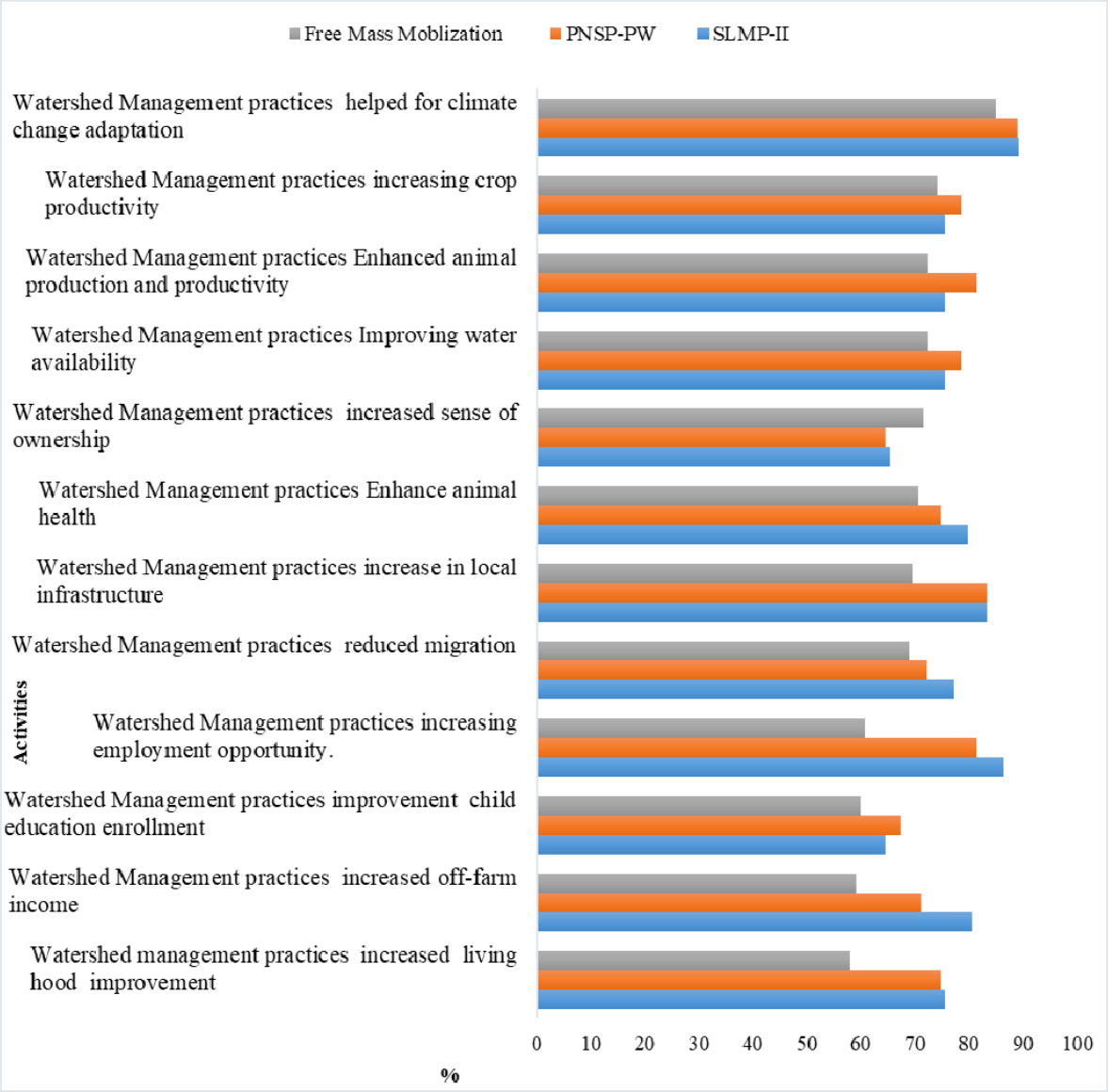

Figure 8. Households' perception on the effectiveness of watershed management practices for food security (Sources: 2021-2022 survey)

4 Conclusion

The study explored how institutional frameworks and stakeholder knowledge influence watershed management and its impact on food security. Findings from three micro watersheds reveal that effective watershed management significantly enhances agricultural productivity, water resource management, employment opportunities, and livestock feed, thereby improving food security. Despite these benefits, there is a notable discrepancy in understanding between professionals and farmers.

Individuals with expertise in natural resources and agriculture exhibit a nuanced grasp of watershed management, aligning their perspectives with the goals of managing natural resources and agricultural productivity. In contrast, professionals from other sectors view watershed management as peripheral to their specific organizational goals. Similarly, participants in the micro watersheds viewed watershed management as isolated measures related only to their specific projects, rather than as an integral part of a broader developmental strategy. This limited perspective, which emphasizes immediate, sector-specific benefits over the holistic potential of watershed management, obstructs the adoption of a more

integrated approach. As a result, this narrow understanding undermines the effective implementation of comprehensive watershed management strategies, which are essential for maximizing benefits and promoting sustainable rural development.

The study identifies significant issues with stakeholder coordination and accountability, revealing inadequate collaboration both vertically (across different levels of government) and horizontally (among various departments and agencies). Focus group discussions highlight the insufficient involvement of federal and regional experts and managers in providing technical support and conducting regular monitoring and evaluation at the village level across all three micro watersheds. This lack of effective oversight and support from higher authorities poses a risk to the success of watershed management initiatives. Enhanced coordination and active engagement from federal and regional levels are crucial for ensuring comprehensive and effective implementation at the grassroots level.

To optimize the effectiveness of watershed management for food security, it is essential to enhance stakeholder understanding, foster collaborations among government agencies, local communities, and other relevant entities, and strengthen accountability mechanisms. Integrating watershed management into rural development projects, aligning these strategies with local objectives, and securing robust policy support are also critical for success. By addressing these factors and advancing educational initiatives and institutional collaboration, stakeholders can achieve sustainable rural development and improved food security, ensuring long-term benefits for both ecosystems and communities.

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Ethical approval and consent to participate:

The research methods employed in this study adhered closely to the prescribed guidelines and regulations. The research protocol underwent a thorough evaluation by the CoDS (Collage of Developmental Study of Addis Ababa University Institutional Review Board) and obtained ethical approval, as evidenced by the case number 050/03/2023.

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Data will be made available on request.

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