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UNDERSTANDING GENDER VULNERABILITY AND ADAPTATION TO WATER STRESS AMONG ARABLE CROP FARMERS IN PATIGI LOCAL GOVERNMENT AREA, KWARA STATE, NIGERIA

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ABSTRACT

Men and women face different water-related challenges due to their specific roles and responsibilities in the agrarian sector, as well as the gender power relations they experience. Consequently, this study examined the adaptation strategies to water stress employed by male and female arable farmers in Kwara State, Nigeria. Simple random sampling was used to select 140 respondents. Data was collected using an interview schedule and analysed using descriptive and inferential analysis. The study revealed that poor credit facilities and insufficient water supply were major constraints faced by arable farmers in the study area. Vulnerability to water stress was higher among female arable farmers. Adaptation strategies used by female arable crop farmers were mulching and planting shade trees, while their male counterpart used contour planting, cover crops, and irrigation. Therefore, providing women arable crop farmers with access to resources and irrigation systems *is essential, and gender-sensitive policies should be implemented for male and female farmers.*

Keywords: Gender, arable crop, water stress, vulnerability adaptation strategies.

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1. INTRODUCTION

Water stress is a major concern among arable crop farmers. It can lead to reduced yields, increased costs, and increased vulnerability to climate change (Laskari et.al, 2022; Obuobie,et.al, 2012; Haskett et, al, 2000) . As such, it is important to understand how gender affects water stress among farmers. According to previous studies (Akinbile, et.al, 2012; Akinsanya, 2012; Fakoya, et.al, 2002), men and women are both involved in arable farming. These authors further stated that levels of involvement differ between genders. In the agrarian sector, men and women typically have different roles. Generally, men are responsible for the more physically demanding and hazardous tasks, such as operating large machinery and tending to livestock (Akinbile et.al, 2012). They are also usually in charge of maintaining buildings, fences, and other structures. Women typically manage the household, including the preparation of meals and caring for the children. Additionally, they often assist with more labour-intensive tasks such as planting and harvesting crops, as well as tending to the garden. In some cases, women also play a role in managing the finances of the family farm (Gonzaga, et.al,2022; Zunaidi, A., & Maghfiroh, 2021)

Water stress is a major environmental factor affecting agricultural productivity. It is defined as the lack of availability of water resources to meet the demands of society and ecosystems. Water stress can lead to reduced crop yields due to the limited availability of water for irrigation and can result in drought (Zhao et al., 2020; Orimoloye et al., 2022). Additionally, water stress can cause water scarcity, leading to increased competition between different uses of water and potential water shortages. This can, in turn, lead to reduced agricultural productivity, lower crop quality, and increased production costs (Dinar et al., 2019; Orimoloye et al., 2022).

Obtaining a consistent water supply is becoming increasingly difficult. This is brought on by several factors, such as population growth, climate change, and excessive water withdrawal from aquifers and rivers (Distefano & Kelly, 2017; Averyt et al., 2013). Arable farmers are vulnerable to water stress as they depend on access to reliable water sources to keep their crops growing. When water is scarce, it can lead to crop failure, lower yields, and reduced income for farmers. In addition, farmers may be forced to use limited water resources inefficiently, leading to soil erosion and nutrient depletion. On a larger scale, water stress can cause droughts, water shortages, and water scarcity, which can all have a negative impact on local economies and food security. In extreme cases, water stress can cause the displacement of farmers and an increase in food prices, leading to hunger. Farmers in Patigi local government area of Kwara state, Nigeria, are also vulnerable to water stress because of long-term temperature rises and precipitation declines, pervasive poverty, frequent droughts, unequal land distribution, and an overreliance on rain-fed agriculture.

Gender plays a significant role in how individuals experience and respond to environmental crises. Men and women may have different access to resources and experience varying degrees of vulnerability to environmental hazards, leading to differing adaptive strategies. For example, research has found that women are often more likely than men to take on the responsibility of caring for family members affected by environmental disasters (Gokhale, 2008). Additionally, the roles of men and women may vary depending on the context of the environmental crisis, and differences in adaptive strategies may be based on culture, class, and other factors. Understanding these gender-based differences is crucial for developing effective strategies to address water stress.

Gender analysis of water stress among arable crop farmers is a relatively new field of research. There is a lack of data and studies that specifically focus on how gender affects water stress among arable crop farmers. Most of the existing research focuses on water stress among farmers in general but does not specifically address the impact of gender on water stress among arable crop farmers. Furthermore, there is a need for research that examines the differences in vulnerability to water stress between male and female arable crop farmers and how they adapt to the crisis. This research gap needs to be addressed to better understand the gender dynamics of water stress among arable crop farmers and how to effectively address it.

In addition, studying the gender analysis of water stress between men and women arable farmers is important because it can help understand the gendered impacts of water scarcity. This knowledge can be used to develop targeted solutions to ensure that both men and women arable farmers have equitable access to water resources for their farming operations. It can also help inform policies and practices that support the economic empowerment of women arable farmers, who are often disadvantaged when it comes to accessing water resources. Understanding the gendered impacts of water stress can also help identify potential strategies to reduce water consumption, conserve water, and improve water governance. In this light, this study intends to assess the adaptation strategies to water stress among arable crop farmers across gender lines.

2. LITERATURE REVIEWS

2.1 Gender Differences in Vulnerability to Water Stress

Water stress is a phenomenon caused when there is an imbalance between the demand for water and its availability in a given environment. While water stress affects both genders, evidence points to the fact that females tend to be more vulnerable to water stress than their male counterparts due to a variety of reasons. Sharmin & Islam (2013) found that women in rural Bangladesh were more vulnerable to climate-induced water insecurity than their male counterparts. The researchers found that women were disproportionately affected by water scarcity because of the gendered roles and responsibilities they typically take on within the family. Women and girls in the study were more likely to oversee the household's water collection, and this increased their vulnerability to water insecurity as they had less access to safe drinking water and less control over their water resources.

A study conducted by Glazebrook et al. (2020) revealed that women had limited economic opportunities and were more likely to participate in unpaid activities such as collecting water. The study further showed that, compared to men, women had fewer opportunities to find employment due to traditional gender roles and poverty. Huynh & Resurreccion (2014) found in their study that women were more vulnerable to water stress due to their constraints in time and labour management than men, which in turn reduced their agricultural productivity.

Furthermore, access to agriculture and its utilization is another variable of water access in terms of gender. Women have a more limited role in crop production, land ownership, and labour division, thus restricting their livelihood-related activities and making them more vulnerable to water stress (Dankelman, 2010; Chanana-Nag & Aggarwal, 2020). Dankelman (2010) further posited that the lower socioeconomic and power status of women can be an obstacle to their capacity to manage climate-related stresses, given that men typically have a greater command over land, access to enhanced irrigation technologies, and more financial resources.

Studies have found that gender inequality in access to irrigation has a negative effect on crop production and access to food, particularly in terms of water stress and limited resources (Huynh & Resurreccion, 2014; Rao *et al*., 2019; Ingutia & Sumelius, 2022). Research has shown that access to irrigation and water resources is often gendered, with women limited in their ability to access, operate, and maintain irrigation systems due to general economic, infrastructural, and cultural barriers (Walker, 2019; Khandker *et al*., 2020). Because of these gender disparities, male farmers have higher access to irrigation than female farmers, meaning that crops grown by males are more likely to be irrigated and thus more likely to be productive (Makombe *et al*., 2017).

2.2 Adaptations to Water Stress: A Gender Perspective

Gender analysis of adaptation strategies to water stress has increased over the past two decades as growing water scarcity has prompted researchers to investigate how women and men perceive, experience, and respond to water scarcity differently. Several studies from around the world show that women and men respond differently to water stress, with gender-specific strategies being used to manage water resources (Huynh & Resurreccion, 2014; Schlamovitz, 2019).

In general, researchers have found that women play a more active role in adapting to water stress or scarcity (Su et al., 2017; Schlamovitz, 2019). Women typically take on the main responsibility for domestic and subsistence activities that require water, such as food preparation and the collection of drinking water (Singh & Dixit, 2020). As such, women are often the first to respond to water scarcity and employ short-term strategies of adaptation (Barrett & Bosak, 2018). In comparison, men may respond to water stress with longer-term strategies, such as livelihood diversification or migration (Simelton et al., 2021). For example, male farmers in South Africa were found to have shifted from small-scale commercial farming to more off-farm activities (Kom et al., 2020).

3. METHODOLOGY

3.1 Study area

This study was conducted in the Patigi Local Government Area (LGA) of Kwara State, Nigeria. It is an important agricultural area, serving as the administrative centre for ecological zone B of the Kwara Agricultural Development Project. As such, it is likely that the agricultural sector is a major contributor to the local economy. Its coordinates are 8.5–9.0° latitude and 5.6–6.0° longitude. Patigi LGA makes up about 5% of the state's total land area, with a total land area of about 2924.62 sq. km. The study area experiences a tropical climate with wet and dry seasons that last for six months each. Temperatures in the area are typically warm year-round, and average rainfall is between 800 and 1200 millimetres per year. However, climate change has caused a shift in the timing of the wet and dry seasons in the study area, resulting in more unpredictable weather patterns. This has further led to an increased risk of flooding and drought, as well as other climate-related hazards, and could have a serious impact on agricultural production and other activities that depend on predictable weather patterns. Agricultural practices in the region are quite diverse, and farmers cultivate a wide variety of crops depending on the type of land available. In the uplands, crops like cassava, millet, sorghum, groundnuts, and maize are grown, while in the lowlands, rice is the main crop cultivated. This diversity of crops allows farmers to take advantage of the different soils and climates available in the region.

a. Sampling technique and sampling size

A random selection of five villages was made. These towns were Sokingi, Gakpan, Kusogi, Kpada, Lade, and Ezighik. Twenty-eight arable farmers were chosen from each of the five villages, resulting in a total of 140 respondents. These respondents were then stratified (86 men and 54 women) so as to ensure a gender-representative sample of farmers of arable crops.

b. Measurement of variables

The farmers were interviewed using an interview guide in order to gather data on their socioeconomic characteristics (e.g., age, marital status, educational qualification, and farm size), crops cultivated, and level of vulnerability to water stress. The level of vulnerability to water stress was assessed using a three-point scale that ranged from "very serious" to "not serious," and scores of 2, 1, and 0 were assigned to each, respectively. The severity of constraints to arable crop farming was assessed using a three-point scale, with scores of 2, 1, and 0 assigned to major, mild, and no constraints, respectively. The adaptation strategies to water stress were assessed using a four-point scale, with scores of 3, 2, 1, and 0 assigned to always, sometimes, rarely, and never, respectively. Descriptive analysis was conducted using frequency counts, percentages, means, and standard deviations, while inferential statistics were conducted using Pearson Product Moment Correlation and t-tests.

4. RESULTS AND DISCUSSION

4.1 Socioeconomic characteristics of respondents

Table 1 shows that a large proportion of sampled male farmers (54.1%) were between 41 and 60 years of age, while 65.2% of sampled female farmers were between 21 and 40 years of age.

Table 1. Distribution based on respondents' socioeconomic characteristics

	Male (N= 74)			**Female (N = 66)**		
Variables	Freq.	%	Mean	Freq.	%	Mean
Age						
21-40 years	31	41.9	42.6	43	65.2	32.5
41-60 years	40	54.1		21	31.8	
61-80 years	2	2.7		2	3.0	
>80 years	1	1.3		-	-	
Marital status						
Single	02	2.7		04	6.2	
Married	69	93.2		60	93.8	

Journal of Integrated Sciences
Volume 3, Issue 4, September 2023
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Widowed/widower	03	4.1		02	3.0	
Education						
No formal	12	16.2		38	57.6	
Primary	44	59.4		18	27.3	
Secondary	15	20.3		9	13.6	
Tertiary	03	4.1		01	1.5	
Farm size						
1-3 acres	13	17.6		47	71.2	
4-6 acres	45	60.8	4.9	11	16.7	2.1
7-9 acres	10	13.5		08	12.1	
10 and above	6	8.1		-		

Source: Author's data analysis

This implies that male farmers tend to be older than female farmers in the sample population. This could reflect the traditional gender roles in society, where men are expected to be the primary breadwinners and women are expected to be more involved in domestic duties. Table 1 reveals that most of the male (93.2%) and female (93.8%) farmers were married. This implies that marriage is highly valued in the farming community and that farming is a family-oriented activity. It also suggests that the farming community is fairly traditional and conservative in their views on marriage and family. Further information shows that about 83.8% of male farmers reported having at least one type of formal education, while 57.6% of female farmers reported having only non-formal education. The implication of this is that there is a gender gap in access to formal education among farmers. Male farmers are more likely to have access to formal education than female farmers, which can lead to a disparity in opportunities and outcomes. This gender gap in education can be further exacerbated by other factors such as poverty and a lack of resources, creating further disparities between men and women in terms of access to resources and opportunities. In addition, the implication of this finding is that male farmers are more likely to have access to greater resources that can help them cope with water stress. With more formal education, they may have access to knowledge, resources, and technology that can help them better manage water resources. On the other hand, female farmers with non-formal education are more likely to be vulnerable to water stress due to a lack of resources and knowledge. This finding agrees with Ikeoji (2000), who discovered that the literacy rate was significantly high for men and women in Nigeria. The high level of literacy among the male farmers could influence their receptivity to improved agricultural technologies. Table 1 also indicates that the average farm size for male respondents was 4.9 acres, whereas the average farm size for female respondents was 2.1 acres. This implies that male farmers had more access to farmland than female farmers. This finding agrees with Akinbile *et al.* (2012) finding that male arable crop farmers had better access to farmland than female arable crop farmers.

4.2 Relationship between age, farm size and adaptation strategies employed by respondents

Table 2 reveals that age is negative and significantly related to adaptive strategies to water stress employed by both male ($r = -0.174$, $p \leq 0.05$) and female arable crop farmers ($r = -0.188$, $p \leq 0.05$) in the study area.

Table 2. Distribution based on the relationship between age, farm size and adaptation strategies employed by respondents

	Male farmers		Female farmers	
Variable	r	P	r	P
Age	-0.174	0.003	-0.188	0.000
Farm size	-0.168	0.000	0.095	0.254

Source: Author's data analysis

This implies that the probability of adaptation significantly decreases as farmers grow older. It can be predicted that such farmers have less interest in or incentives to take water stress adaptation measures. The rationale behind this could be that older farmers do not see the need to adapt to water stress. There are a few possible reasons why older farmers may not feel the need to adapt to water stress. This could include a lack of awareness of the issue, a lack of access to resources and technology, or a lack of motivation to make changes. More so, if an older farmer has been using the same farming practices for a long period of time, they may be reluctant to make changes to their methods. Farm size was significantly related to adaptive strategies to water stress among male farmers (r = - 0.168 p 0.05), while there was no significant relationship between farm size and adaptive strategies to water stress employed by female arable crop farmers. This implies that the size of a farm may determine the type of strategies a male farmer may employ to adapt to water stress, while female arable crop farmers may employ different strategies regardless of the size of their farm. This could be due to differences in access to resources or knowledge or in the way that male and female farmers approach agricultural challenges.

4.3 Crops cultivated along gender line

Table 3 showed that male farmers were mainly responsible for cultivating maize (94.6%), while female farmers cultivated more of sorghum (88.9%).

Table 3. Distribution based on Crops cultivated across gender

	Male (N =74)			**Female (N =66)**		
Arable crop	Freq.	%	Rank	Freq.	%	Rank
Rice	21	28.4	7th	28	42.4	6th
Maize	70	94.6	1st	58	87.9	1st
Yam	42	56.8	5th	15	22.7	7th
Cassava	40	54.1	6th	42	63.6	4th
Sorghum	62	83.8	2nd	49	74.2	2nd
Vegetable	45	60.8	4th	44	66.7	3rd
Sweet potatoes	54	73.0	3rd	36	54.5	5th

Source: Author's data analysis

The gender roles and cultural norms in the region could be responsible for the differences in the crops that male and female farmers were responsible for cultivating. In some areas, it is traditionally expected for men to take on roles related to agriculture and for women to take on roles related to cooking and childcare. This could explain why male farmers were mainly responsible for cultivating maize, while female farmers cultivated more sorghum. Additionally, the crops may have been chosen based on labour requirements. Maize is often seen as a crop that requires more labour and is better suited for more temperate climates, while sorghum is seen as a crop that requires less labour. This could also explain the differences in the crops that male and female farmers were responsible for cultivating. The availability of water in the soil is also one of the most important requirements for these crops. Other crops cultivated by the respondents in the study area are vegetables, cassava, sweet potatoes, yams, and rice. This implies that both men and women are equally involved in arable crop farming in the study area, suggesting that women are playing an important role in the agricultural sector.

4.4 Level of vulnerability to water stress across gender

Table 4 shows that both male and female arable crop farmers in the study area were vulnerable to water stress. However, female arable crop farmers (1.13±0.46) were more vulnerable to water stress than male arable crop farmers (0.87±0.39).

Table 4. Level of vulnerability to water stress across gender

	Male (n = 74)		**Mean**	**Female (N =66)**		**Mean**
Level of experience	Freq.	%	0.87±0.39	Freq.	%	1.13±0.46
Very serious	9	12.2		34	51.5	
Serious	50	67.6		28	42.4	
Not serious	15	20.2		04	6.1	

Source: Author’s data analysis

The plausible reason for this could be attributed to the roles and responsibilities of women in using and managing water since they often cook, clean, farm, and provide healthcare for their households. Also, women arable crop farmers may be more vulnerable to water stress than their male counterparts due to several factors, such as lack of access to resources and technology, limited decision-making authority, and limited access to financial resources. Women farmers typically have less access to irrigation systems, making them more reliant on rain-fed agriculture, which is more susceptible to water stress. Women also face greater restrictions on their mobility, making it difficult for them to access faraway water sources. In addition, women farmers typically have fewer resources to invest in soil and water conservation measures, making them especially vulnerable to water stress. This finding agrees with the findings of Dankelman (2010) that women are particularly vulnerable to climate stress. This could lead to greater health risks, fewer educational opportunities, and more difficult and time-consuming tasks for women, such as collecting water for their families. This finding highlights the need to ensure that female arable crop farmers have access to resources and support to help them cope with water stress.

4.5 Constraints to arable crop farming

Table 5 shows that both male and female respondents were faced with similar constraints ranging from lack of credit facilities ($\bar{x} = 1.14$; $\bar{x} = 1.27$), insufficient water supply ($\bar{x} = 1.03$; $\bar{x} = 1.09$), and inadequate farm inputs ($\bar{x} = 0.92$; $\bar{x} = 0.91$).

Journal of Integrated Sciences
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Table 5. Distribution according to the constraints faced by arable crop farming

	Male				Female			
Constraints	Major constraint	Mild	Not a constraint	Mean	Major constraint	Mild	Not a constraint	Mean
Inadequate contact with extension agents	26.0	36.5	37.5	0.89	20.5	43.1	36.4	0.84
Inadequate farm inputs	9.4	72.9	17.7	0.92	6.8	77.3	15.9	0.91
High cost of farm labour	14.6	55.2	30.2	0.84	13.6	61.4	25.0	0.89
Insufficient water supply	33.3	36.5	30.2	1.03	34.1	40.9	25.0	1.09
inadequate credit	37.5	38.5	24.0	1.14	36.4	54.5	9.1	1.27

Source: Author's data analysis

Lack of credit facilities can affect both male and female arable crop farmers by limiting their access to money to purchase necessary inputs, such as fertilizers, pesticides, and improved seeds. This can lead to decreased yields and profits, making it difficult to support their families and invest in their farms.

Journal of Integrated Sciences
Volume 3, Issue 4, September 2023
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Insufficient water supply can also affect male and female arable crop farmers by limiting their access to water, which is essential for plant growth. This can lead to poor crop yields, making it difficult to earn an income. Inadequate farm inputs, such as fertilizers, pesticides, and improved seeds, can also limit crop yields, leaving farmers with low yields and profits. All these factors can have a negative impact on male and female arable crop farmers, leading to decreased yields, decreased profits, and difficulty supporting their families. This suggests that male and female arable crop farmers are facing significant difficulties in accessing the resources they need to be successful in their farming operations. It is also important to note that these constraints disproportionately impact female farmers, making it even more difficult for them to succeed. That is, female arable crop farmers are at an even greater disadvantage when it comes to accessing the necessary resources to support their farming operations. Without access to credits, inputs, and adequate water supplies, female farmers are more likely to struggle to make their operations profitable. This further perpetuates the gender gap in agriculture and highlights the need for policies and initiatives that can help level the playing field.

4.6 Adaptation to water stress utilized across gender

Table 6 reveals farmers' adaptation to water stress across gender. Result from the table shows that large proportion of the females employed the use of mulching ($\bar{x} = 2.44$), rain water harvest ($\bar{x}= 2.32$) and planting of shed trees ($\bar{x}= 1.79$), while most of the male arable crop farmers made use of contour planting ($\bar{x}= 2.49$), cultivation of cover crops to retain moisture ($\bar{x}= 2.09$) and migration to other farm lands ($\bar{x} = 2.05$).

Journal of Integrated Sciences
Volume 3, Issue 4, September 2023
ISSN: 2806-4801

Table 6. Distribution based on the adaptation to water stress utilized across gender

	Male		Female	
Adaptation strategies	**Mean**	**SD**	**Mean**	**SD**
Cultivation of cover crops to retain soil and moisture	2.09	1.12	1.08	1.47
Use of irrigation facilities	1.97	1.41	1.34	1.45
Contour planting	2.49	0.84	1.39	0.79
Rain water harvest	2.13	1.33	2.32	1.34
Adoption of drainage or ditches	1.67	1.37	1.75	1.35
Planting of shed trees	1.33	1.51	1.79	1.50
Migration to another area	2.05	0.84	1.09	0.93
Changed crop variety	1.54	1.26	1.75	1.37
Changed from crop to livestock production	1.42	1.01	1.02	1.32
Mulching	1.98	1.56	2.44	1.31

Source: Author's data analysis

This suggests that females were more likely to use strategies that are less expensive and more easily accessible, such as mulching and planting shade trees, while males were more likely to use more expensive and difficult strategies, such as contour planting, cover crops, and irrigation. This may indicate that female farmers have fewer resources and less access to more advanced technologies. In addition, gender differences in adaptation to water stress may be due to a variety of factors. For example, women may have less access to resources that would enable them to employ more complex and expensive adaptation strategies, such as irrigation and migration to other farmlands. Additionally, gender roles and expectations may play a role in the strategies chosen, as women are often responsible for crop cultivation and may be more likely to employ strategies such as mulching and planting shade trees, which are more labour-intensive. Also, cultural beliefs and norms may influence the adaptation strategies chosen, as different societies may place greater emphasis on certain strategies for men or women.

4.7 Difference in the level of adaptation strategies to water stress utilized along gender line

Table 7 shows that there is a significant difference with respect to the adaptation strategies employed along gender line. Table 7 further shows that male arable farmers invested more of the adaptation strategies considering the difference in the mean values obtained (10.46, 8.99).

Table 7. Test of difference showing the difference in the level of adaptation strategies to water stress utilized along gender line

Cases	N	Mean	Standard deviation	Standard error	Df	T	Sig-value
Female	66	8.99	1.6185	0.16420	139	6.462	0.000
Male	74	10.46	1.9316	0.14221			

Source: Author's data analysis

This could be due to a variety of factors, such as access to resources, power dynamics, or a lack of recognition of the needs of female arable crop farmers. It could also be because of a difference in the level of education or knowledge about adaptation strategies. In addition, this could also be due to gender roles and responsibilities, as male farmers may be more likely to take the lead in implementing these strategies due to their perceived roles as the head of the household.

5. CONCLUSION AND RECOMMENDATION

The study has clearly revealed the difference between men and women's adaptation options, as male arable crop farmers had higher adaptation strategies than their female counterparts. This suggests that there is a gender gap in terms of access to resources and opportunities for adaptation strategies among arable crop farmers. It suggests that men are more likely to have access to resources and opportunities that enable them to adapt to water stress than women. Moreover, it suggests that more should be done to provide equal access to these resources and opportunities so that both male and female arable crop farmers can equally adapt to water stress. It is therefore recommended that local adaptation strategies such as planting indigenous trees and fencing the planting site with heaps of sand be built on in order to strengthen underlying systems and support the capacities of women and men to adapt. In addition, there is a need for donor organizations to increase funding for gender-sensitive agricultural research and development initiatives to improve access to resources, education, and technology for women arable farmers. Additionally, there is a need to implement targeted training programs and technical assistance to improve agricultural knowledge and skills among women arable farmers. Finally, investment in integrated water supply and demand management that considers gendered roles and responsibilities for water management is critical to enhancing the sustainability of water resources.

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