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Research Report

From Design to Impact: Insights from WMfEP's Gender-Responsive Initiatives for Women and Youth in Tank and D.I. Khan Districts, Pakistan

Khadija Begum, Nouman Ilyas, and Kashif Hussain

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Project

WMfEP addressed persistent challenges in agricultural water governance in Khyber Pakhtunkhwa (KP). The project focused on improving the productive and sustainable use of water resources through better governance, farm-level practices, and capacity building.

Spanning 2018–2025, WMfEP worked across four pillars: operationalizing the Gomal Zam Dam Command Area, strengthening the capacity of KP government institutions, improving agricultural water governance, and enhancing transboundary cooperation with Afghanistan. A cross-cutting priority was the inclusion of women and youth in water and agriculture decision-making. By promoting inclusive, context-sensitive approaches, WMfEP fostered local ownership, trust, and readiness to scale innovations—demonstrating the impact of co-design and co-learning in development programming.

Collaborators

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Acronyms and Abbreviations

AZRC	Arid Zone Research Center
D.I. Khan	Dera Ismail Khan
FGD	Focus Group Discussion
FY	Financial year. Where a year numeral is prefixed by FY this indicates USG fiscal year e.g., FY2018 is October 1, 2017, to September 30, 2018. USG fiscal year, calendar or project year quarters are indicated by the suffix Q1, Q2, Q3 and Q4, e.g., FY2018 Q1 represents USG fiscal year 2018 quarter 1 (Oct. 2017, Nov. 2017, Dec.2017). Where a year numeral is not prefixed this indicates calendar year which also corresponds to IWMI fiscal year/fiscal quarter e.g., 2018 or 2018Q1.
GZDCA	Gomal Zam Dam Command Area
IWMI	International Water Management Institute
KP	Khyber Pakhtunkhwa
NARC	National Agriculture Research Center
PARC	Pakistan Agricultural Research Center
PC-1	Planning Commission Proforma Number 1
WMfEP	Water Management for Enhanced Productivity
WUA	Water Users Association

Glossary[1]

Gender roles identification/triple role: The triple role for women consists of productive, reproductive, and community-managing activities. Men primarily undertake productive and community politics activities. Women are more visible in reproductive and community managing roles.

Productive work: Productive roles include all tasks which contribute to the income and economic welfare of the household and community. This involves the production of goods and services for consumption and trade (in employment and self-employment). Both women and men can be involved in productive activities, but their functions and responsibilities often differ. For example, in agriculture, productive activities include planting/ cultivation and livestock rearing. Women's productive work is often less visible and less valued than men's.

Reproductive work: Reproductive work involves the care and maintenance of the household and its members, including bearing and caring for children, all household chores, preparing food, collecting water and fuel, housekeeping, and family healthcare. In rural communities, reproductive work is often labor-intensive and time-consuming. Mostly, it is always the responsibility of women and girls.

Community management work: Community roles are those activities undertaken at the community level to meet the communities' basic needs. Community-managing activities are undertaken primarily by women as an extension of their reproductive role. Such activities ensure the provision and maintenance of scarce resources which everyone uses, such as water, healthcare, and education. Participation in weddings, funerals and other social events within the extended family and community is also a part of community management work. This is voluntary, unpaid work, carried out during women's free time.

Community roles also include social and political activities at the communal and local levels. This also includes social events such as ceremonies and celebrations where communities participate in groups. Most of these activities are dominated by men.

[1] Glossary adopted from 'A Guide to Gender Analysis Frameworks' by Oxfam GB and 'Manual on Gender Analysis Tools' by CASCAPE

Summary

The Water Management for Enhanced Productivity (WMfEP) project, implemented in the Gomal Zam Dam Command Area of Dera Ismail Khan (D.I. Khan) and Tank districts, aimed to meaningfully engage women and youth in climate-smart agriculture while respecting cultural norms and local dynamics. In a context where socio-cultural constraints limit women's access to resources, mobility, and decision-making, WMfEP adopted a participatory, inclusive, and context-responsive approach to strengthen their role in agricultural production and water management.

Beginning in 2018, the project conducted extensive consultations to identify priority needs and barriers for women and youth. Based on these insights, locally manufactured and culturally appropriate technologies including solar-powered micro-drip irrigation systems, tunnel farming structures, and solar-powered smart sprayers were introduced. From 2020 to 2024, these technologies were transferred to women and youth farmers across multiple villages, supported by gender- and age-segregated capacity-building activities and continuous field engagement.

A comprehensive suite of interventions ranging from micro-irrigation operation and maintenance, vegetable nursery production, livestock management, and climate-smart agronomic practices equipped over 300 women and youth with the skills and confidence to adopt and manage modern agricultural technologies. Exposure visits, farmer field days, and targeted follow-ups strengthened learning and helped beneficiaries translate training into practice.

Early evidence from field monitoring and surveys indicates that participating women reduced their household vegetable expenses, increased surplus production for market sale, and reported greater confidence, mobility, and involvement in household decision-making. Youth beneficiaries demonstrated increased interest in agriculture, improved skills in technology operation, and greater willingness to explore farm-based entrepreneurship.

Beyond increased productivity and improved food and nutrition security at a household level, the project contributed to positive shifts in gender norms, with women and youth taking on more visible roles in farm management and local learning spaces. These changes highlight the transformative potential of intentional, locally grounded approaches in underserved rural areas.

While early impacts are promising, sustaining this progress requires continued support, including market linkages, technical follow-up, and institutional mechanisms that maintain momentum in gender-responsive and youth-centered agricultural development. Long-term shifts in social norms will also require ongoing community engagement and reinforcement beyond the project duration.

From Design to Impact: Insights from WMfEP's Gender-Responsive Initiatives for Women and Youth in Tank and D.I. Khan Districts, Pakistan

Khadija Begum, Nouman Ilyas, and Kashif Hussain

Introduction

Gender-based disparities in Pakistan are deeply entrenched, limiting women's access to economic and educational opportunities. Cultural norms, including parda (veil) and notions of honor, impose restrictions on women's mobility and decision-making power (Rehman and Roomi 2012; Drucza and Peveri 2018). These societal constraints reinforce traditional gender roles, where men are expected to be the primary earners while women are confined to household and caregiving responsibilities. As a result, development initiatives often fail to address women's needs effectively, further widening the gender gap and limiting their participation in socio-economic progress.

This systemic exclusion is reflected in Pakistan's Global Gender Gap Index ranking—145th out of 146 countries. The country ranks especially low in economic participation (143rd), educational attainment (139th), health and survival (132nd), and political empowerment (112th) (World Economic Forum 2024). Although women constitute 48.4% of the population, their employment-to-population ratio is just 19.4%, compared to 64.1% for men (Pakistan Bureau of Statistics 2021a), highlighting their marginalization from the formal economy and leadership roles.

Despite barriers to mobility and formal employment, women play a significant role in Pakistan's agriculture sector. They account for 67.9% of the agricultural workforce (Pakistan Bureau of Statistics 2021a). However, most of these women are engaged in low-paid, unpaid, or informal labor, with limited access to land ownership, financial services, modern technology, and market linkages (Khan et al. 2014; Lanz et al. 2012; SMEDA, n.d.). This lack of investment in women's agricultural capacity not only reduces productivity but also reinforces their economic dependence on male household members.

Pakistan's youth demographic presents another pressing challenge and opportunity. Over 60% of the working-age population are between the ages of 10 and 34 (Pakistan Bureau of Statistics 2021a), positioning youth as a potential engine for economic growth. However, employment barriers persist, especially for young women. Youth aged 15–29 represent the largest working age group (26.3%) (Pakistan Bureau of Statistics 2023) yet face the highest unemployment rate at 11.1% with a gender breakdown of 10.0% for males and 14.4% for females. These figures reveal the intersection of age and gender in labor market exclusion.

The unemployment rate for women is consistently higher across all provinces, with Khyber Pakhtunkwa (KP) recording the highest overall unemployment (8.8%), followed by Punjab (6.8%), Balochistan (4.3%), and Sindh (3.9%). The employment-to-population ratio remains heavily skewed, with 67.9% for males, over three times higher than the 21.3% recorded for females (Pakistan Bureau of Statistics 2021a). These patterns highlight how gender and age combine to exclude young people especially young women from employment, pointing to an urgent need for targeted investments in youth especially young women, to unlock their economic potential and ensure equitable national development.

In rural areas of KP including the Gomal Zam Dam Command Area (GZDCA) these challenges are further compounded by deeply entrenched socio-cultural norms. Women are largely confined to domestic roles, with limited access to education, vocational training, or public spaces (Safdar et al. 2021; FAO 2011; Muhammad et al. 2020). These restrictions perpetuate cycles of poverty and dependency, undermining both individual agency and community development (Drucza and Peveri 2018; Doss 2013).

To address these intersecting barriers, the Water Management for Enhanced Productivity (WMfEP) project, implemented by the International Water Management Institute (IWMI), introduced gender-responsive approaches in agriculture and water resource management. By recognizing the often-overlooked contributions of women and youth, the project promoted their inclusion while respecting local cultural norms. Through participatory and context-specific interventions in technology adoption, capacity building, and decision-making, WMfEP helped empower marginalized groups as active agents of change in enhancing agricultural productivity and water sustainability.

1. The Process: From Design to Action – Implementing Gender-Responsive Agricultural Practices

This section outlines the process through which WMfEP translated its gender and youth inclusion strategies into actionable interventions. Grounded in the Reach–Benefit–Empower–Transform (RBET) framework and informed by a comprehensive gender assessment in the GZDCA, it demonstrates how evidence-based insights into local social structures shaped the project's design and implementation.

The assessment provided a critical understanding of the socio-economic and cultural dynamics influencing agricultural engagement. It examined men's and women's roles in crop production, livestock management, and community activities—identifying key barriers such as limited access to resources, mobility restrictions, and entrenched gender divisions of labor. It also explored youth aspirations, skills, and opportunities in agriculture, revealing untapped potential for their engagement.

By uncovering the gendered realities of agricultural production, livestock care, and community participation, this section establishes the evidence base for WMfEP's inclusive intervention design. The findings not only highlighted existing inequalities, but also identified pathways to engage women and youth more effectively in agricultural development, laying the foundation for the co-design and implementation strategies detailed in section 2.

1.1 Key Elements of the Gender and Social Inclusion Approach in Agricultural Interventions

WMfEP is committed to engaging women and youth, ensuring their meaningful participation in all project activities while respecting cultural norms. Operating in the GZDCA—specifically in Dera Ismail Khan (D.I. Khan) and Tank districts—the project recognizes the entrenched gender roles that dictate labor division, where men typically undertake mechanical tasks, while women are often confined to labor-intensive manual work. These long-standing stereotypes have historically limited women's ability to acquire new skills and adopt advanced agricultural technologies.

To address these barriers, WMfEP employs a holistic gender and social inclusion approach, integrating biophysical and social sciences to design interventions that are locally relevant, culturally acceptable, and inclusive. The approach is built on three key pillars:

a. Community consultation and co-design

- Extensive consultations were conducted with community members (both men and women) to identify needs, priorities, and socio-cultural constraints.
- This participatory process ensured that interventions were demand-driven, inclusive, and aligned with community values.
- Involving men in the design phase fostered broader community support for women's participation, increasing acceptance and sustainability of the interventions.

b. Women-centered technology development and capacity-building

- Technologies introduced under the project were co-developed to be accessible, affordable, and user-friendly for women and youth, with a focus on local fabrication.
- Women and youth were trained in the operation, maintenance, and repair of irrigation technologies, alongside capacity-building sessions on improved crop production practices.
- This targeted support enabled women to adopt technologies with confidence, increasing their agricultural productivity and reducing dependency on male household members.

c. Applying the Reach–Benefit–Empower–Transform (RBET) framework

WMfEP adopted the Reach–Benefit–Empower–Transform (RBET) framework (Larson et al. 2024) as a guiding approach to integrate gender and social inclusion within its interventions. In practice, the project placed particular emphasis on the first two components, Reach and Benefit as direct and measurable targets. The subsequent stages of Empower and Transform were considered as emerging, indirect outcomes of increased participation, capacity building, and shifts in community attitudes.

- Reach: The project deliberately identified and engaged women, youth, and smallholder farmers; groups often excluded from formal agricultural support systems. Tailored outreach strategies ensured their inclusion in training sessions, exposure visits, and demonstrations.

- Benefit: Participants accessed practical, context-specific agricultural knowledge and technologies, including water-efficient practices and locally fabricated, women-friendly tools. These inputs enhanced productivity and increased participants' confidence and decision-making capacity in farm-related tasks.
- Empower (indirect outcome): As women and youth built technical skills and gained access to productive resources, they began to participate more actively in household and farming decisions. This gradual shift marked the beginning of empowerment through increased visibility and recognition of their roles in agriculture.
- Transform (indirect outcome): While not a primary focus, signs of transformation emerged through increased male support for women's involvement, community acceptance of inclusive training formats, and the slow erosion of traditional barriers to women's mobility and participation.

1.2 Key Enablers for Participation

- Gender-responsive knowledge sharing: Women researchers and trainers were engaged to facilitate learning in a socially acceptable manner, ensuring that women farmers felt comfortable accessing knowledge and new technologies.
- Engaging men and boys: The project actively worked with men and boys to gain their support for women's participation, fostering community-wide acceptance of gender-inclusive agricultural practices.
- Youth engagement: Young farmers, both male and female, were targeted for training, as they are often more receptive to new techniques and innovations than older generations.
- Facilitating women's mobility: Recognizing the mobility restrictions women face, WMfEP provided transport and travel cost support, including for chaperones, to enable women to attend training sessions and exposure visits.

By applying these elements, WMfEP not only ensured equitable access to agricultural resources and knowledge but also created pathways for long-term empowerment and incremental social change, laying the groundwork for more inclusive and resilient farming systems.

The process of implementing gender-inclusive agricultural interventions follows a structured, multi-step approach (see Figure 1). This diagram outlines the critical stages, from initial planning to the assessment and scaling of gender-intentional strategies. The process depicted ensures that both women's empowerment and social inclusion are integrated at the core of each phase.

Figure 1. Implementation process - gender inclusive agriculture interventions (*Source*: authors' creation)

1.3 Understanding the Realities: Gender Assessment in Gomal Zam Dam Command Area

The GZDCA, covering D.I. Khan and Tank districts, represents the southernmost agricultural belt of KP. The region experiences hot summers and moderately cold winters, creating seasonal variations in farming conditions. Agriculture here depends on spate irrigation, locally known as *Rod-Kohi* farming, which relies on floodwater generated from hill torrents in the Gomal Zam catchment area. However, the unpredictability and unreliability of these flows pose significant challenges, affecting agricultural productivity and farmers' livelihoods.

Farming in the region follows two cropping seasons: *Rabi* and *Kharif*, with the potential to introduce a third short-duration crop—particularly vegetables—if water availability improves. The major crops grown include wheat, gram, sorghum, millets, oilseeds, and melons. However, due to water scarcity and unreliable spate flows, fruit and vegetable cultivation remains limited, except in areas where perennial water sources allow for more diverse cropping. Strengthening water management and introducing climate-smart irrigation technologies could significantly enhance productivity and resilience.

Livestock plays an equally vital role in sustaining rural livelihoods, serving as both an economic asset and a buffer in times of hardship. If a crop fails, livestock can be sold or consumed to support household food security. Farmers raise cattle and buffalo primarily for milk, while camels and non-milch cattle are used for ploughing, bund-making, and transportation, in addition to meeting meat consumption needs. Sheep and goats are reared for meat, milk, wool, and hides. Despite its significance, the livestock sector remains underdeveloped, with limited awareness of improved feeding and breeding practices. Farmers traditionally do not cultivate fodder crops, preferring to grow wheat, sugarcane, and other high-value crops. As a result, livestock depend on crop residues, stalks, shrubs, and bushes for feed, contributing to low productivity. Expanding access to improved livestock management practices and promoting sustainable fodder cultivation could enhance the sector's economic viability. As shown in Figure 2, the study area includes the GZDCA and the villages targeted under WMfEP.

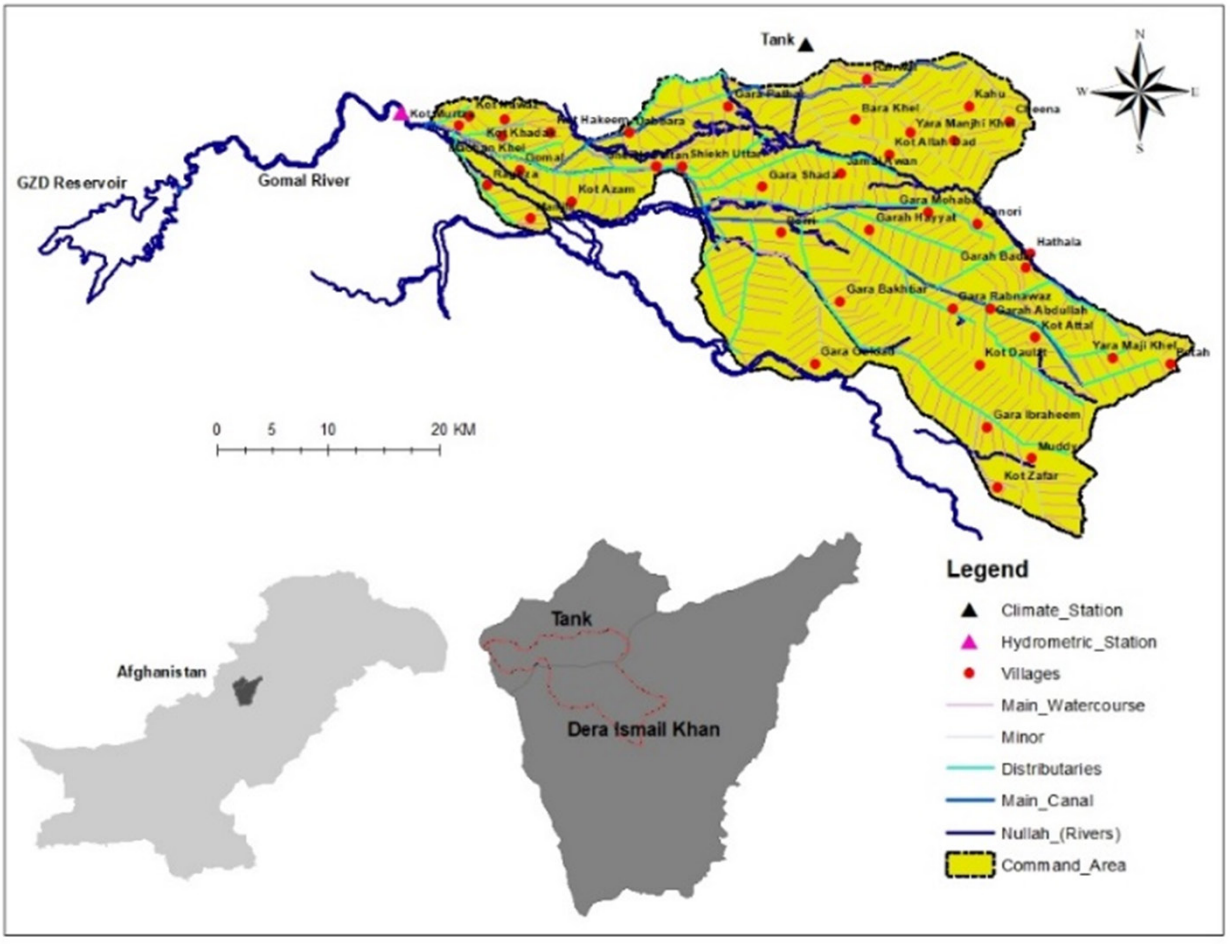

Figure 2. Map of the study area (*Source*: Kashif Hussain's creation).

1.3.1 Gender needs assessment

To ensure that gender-inclusive agricultural interventions effectively address local needs, a gender needs assessment, and situational analysis was conducted in the GZDCA, covering Tank and D.I. Khan districts. This assessment served as a critical first step in the structured process of implementing gender-responsive strategies, aligning with the principles outlined in the previous section. The project adopted the co-investigation and co-design of activities for sharing equitable benefit to women and youth. By identifying the roles, responsibilities, constraints, and aspirations of women and youth in agriculture, livestock, and community management, the assessment provided evidence-based insights to guide the gender and youth action plan and ensure that interventions were context-specific and demand-driven.

Recognizing that gender roles shape access to resources, decision-making, and labor distribution, the needs assessment focused on three key dimensions:

1. Women's and youth's roles in productive, reproductive, and community management activities.

2. Their existing knowledge, skills, and challenges in agriculture and livestock management.

3. Their priorities and aspirations for capacity-building and skill enhancement.

The assessment was conducted using participatory gender analysis tools from the Moser Framework and the Harvard Analytical Framework. The findings from this assessment informed the design of interventions that promote equitable access to resources, skill development, and participation in decision-making within the agriculture and livestock sectors.

1.3.2 Methodology and approach

The needs assessment was carried out through focus group discussions (FGDs) and participatory exercises with women, men, and youth in the GZDCA. The villages were chosen to represent different socio-economic and agricultural conditions within the command area. The discussions aimed to explore:

- Who does what in agriculture? Mapping gender roles in crop cultivation, division of labor, and decision-making.

- Who does what in livestock management? Women's roles in livestock management: identifying their responsibilities, knowledge, and skill levels.

- Other productive activities undertaken by women and girls, including income-generating work beyond agriculture.

- Women's skill development priorities in agriculture and livestock management.

- Women's and men's engagement in community management activities.

1.3.3 Contribution of women in productive activities

Understanding the agricultural and livestock landscape is key to identifying gender-specific roles, constraints, and opportunities. Women and youth significantly contribute to productive, reproductive, and community-management activities; however, their labor largely remains unrecognized and unpaid. They continue to face barriers related to accessing productive resources, training, decision-making, and mobility.

Importantly, these experiences are not uniform. Women's agricultural roles and decision-making power vary significantly by age and marital status, even within a context of extremely low female literacy. The assessment revealed that almost all women and even most young girls are illiterate, reflecting limited access to education and mobility constraints. Younger women (typically aged 18–30), including newly married women, reported lower participation in farm decisions and restricted mobility due to household hierarchy and social expectations. In contrast, older (generally 40 years and above), especially widowed or senior women in the household, often play a more active role in farm management and demonstrate greater influence over decisions related to crop production and resource use. The few young girls who were attending school expressed aspirations to support their families in agriculture, indicating that even minimal educational exposure can enhance confidence and future agency.

The gender needs assessment builds on these intersectional insights, examining how social structures shape the roles, challenges, and aspirations of women and youth in agriculture and livestock. These findings informed the design of targeted interventions under the gender and youth action plan of WMfEP, ensuring that program actions respond directly to the lived realities of diverse groups within the community.

Agriculture

Table 1 highlights the gendered division of labor in crop production as described during the needs assessment exercise. While many tasks are shared, men dominate mechanized and market-related activities, emphasizing the need to strengthen women's access to agricultural technologies and market linkages.

Table 1. Gender division of crop production activities.

Crop production activities	Who does what	
	Women/Girls	Men/Boys
Land preparation	✓	✓
Ploughing	-	✓
Seed selection	-	✓
Sowing	-	✓
Weeding	✓	✓
Use of fertilizers	-	✓
Use pesticides	-	✓
Irrigation	✓	✓
Winnowing	✓	✓
Harvesting	✓	✓
Threshing	-	✓
Drying	✓	-
Cleaning	✓	-
Post-harvest Storage	✓	-
Selling of the crops	-	✓

Discussions with women's groups confirmed that agricultural work is shared across genders, though responsibilities differ based on physical labor requirements, access to machinery, and social norms. Both women and men contribute from land preparation to post-harvest storage.

Land preparation is primarily undertaken by men; however, women assist with clearing fields and weeding during initial stages. Notably, women demonstrated strong knowledge of all cultivation stages, including land preparation, seed sowing, fertilizer application, irrigation, and harvesting, despite limited hands-on access to mechanized tasks.

Women explained that tractor-based land preparation involves ploughing, harrowing, and tilling; activities performed by men. However, weeding during crop growth is predominantly carried out by women. Irrigation responsibilities largely fall to men, yet women shoulder this task during daytime hours when men are absent. Decision-making on seed selection remains male-dominated, although women share their opinions and advise on traditional varieties.

Women play a central role in harvesting, often mobilizing all household members for collective effort. While men handle threshing and market sales, women manage post-harvest processing, drying, cleaning, storage, and household consumption. Their knowledge and labor are essential in determining food security at the household level.

Despite their extensive contributions and detailed understanding of technical processes, women are often excluded from mechanized activities due to social perceptions that consider machinery and field decision-making as male domains. This reinforces the need for skill-building, confidence-building, and technology training tailored to women, especially younger and less-educated women who face compounded constraints.

1.3.4 Women's role and interest in crop productivity enhancement

Despite their substantial role in crop cultivation, most women do not identify themselves as farmers as this is socially viewed as a male domain. Limited mobility, lack of land ownership, and low literacy particularly among young women and girls further restrict their access to agricultural knowledge and training.

Women's interest and participation in agricultural learning is shaped by age and household position. Younger women often experience greater mobility constraints and have limited decision-making authority within extended households. Older women—particularly those with long-term involvement in farming—demonstrated greater confidence and influence in crop-related decisions. Across groups, women noted that while men interact with markets, they themselves handle considerable farm labor and household-level crop management.

Despite these barriers, women expressed a strong desire to improve their agricultural knowledge and productivity. Many showed particular interest in home-based agricultural activities such as vegetable gardening, small fruit nurseries, and floriculture. However, water scarcity and limited irrigation infrastructure have restricted these activities. Women in several villages indicated specific interest in cultivating lemons, citrus, and peaches, reflecting both nutritional and economic aspirations.

Strengthening women's technical capacity in agriculture would enhance productivity, increase adoption of improved practices, and support shared household decision-making. However, shifts in traditionally male-dominated roles may also create social tensions if not approached carefully. Capacitating women without the parallel engagement of men could unintentionally affect household dynamics or expose women to criticism. To mitigate this, interventions should involve men as allies, emphasize benefits to the household rather than individual empowerment, and promote joint training sessions that reinforce cooperation rather than competition. It is also essential to ensure that women's increased participation does not add to their workload or create additional burdens. Joint learning opportunities for men and women can help ensure that both have access to reliable information, enabling families to evaluate and adopt improved agricultural technologies together.

> "I have a large piece of land within my house. I grow a few seasonal vegetables, but I can't fully use the space due to water scarcity. If I knew any techniques, I would cultivate the entire 10-marla plot with vegetables." — Mir Janey, Nadar Badar village

Engaging youth, particularly young men, in complementary roles such as marketing, transport, and nursery development could support women's economic participation while addressing local labor constraints and mobility challenges. Expanding home-based agriculture and small-scale enterprises could improve household food security, generate supplementary income, and bolster women's confidence and agency in agricultural decisions.

Women also emphasized challenges in irrigation access. Many currently rely on *kachha* (unlined) watercourses while awaiting the completion of distributaries and outlets (mogas). Improving water access and supporting small-scale irrigation solutions is therefore critical to strengthening women's agricultural engagement and productivity.

1.3.5 Women's role and interest in livestock management

Livestock plays a crucial role in the rural economy, serving as a primary source of livelihood and income for most households in D.I. Khan and Tank. Nearly every household keeps some form of livestock, with cows and goats being the most common. The responsibility of managing livestock largely falls on women, who are actively involved in every aspect of cattle rearing (see Table 2). Their daily tasks include cutting fodder from the fields and transporting it home, feeding the animals, cleaning cattle sheds, collecting and disposing of dung, and milking.

Their traditional knowledge gained through years of hands-on experience, intergenerational learning from mothers and elder women, and careful observation of common livestock ailments enables them to use home remedies to treat sick animals. They rely on locally available materials, such as herbs, household ingredients, or simple treatments passed down through families, to manage minor illnesses. Veterinary assistance is sought only when symptoms persist or animals show signs of severe illness, reflecting both limited access to formal services and reliance on customary practices.

While men provide support when needed, young boys are typically responsible for taking cattle out for grazing. Poultry rearing is another essential element of household livestock management, with most families keeping birds primarily for egg and meat production. Indigenous poultry breeds, commonly known as desi, remain the most widely raised in the region.

Milk, meat, and eggs serve as vital sources of nutrition, fulfilling the daily dietary needs of families. However, due to the lack of proper milk storage facilities and an underdeveloped dairy value chain, surplus milk is often processed into yogurt, lassi, cottage cheese, and traditional sweets like *Sohan Halwa*.

Table 2. Gender division of livestock management activities.

Livestock management activities	Who does what	
	Women/Girls	Men/Boys
Fodder cutting	✓	-
Feeding the animal	✓	-
Fetching water for animals	✓	-
Shed building	✓	-
Shed cleaning	✓	✓
Grazing	✓	-
Bathing	✓	-
Dung collection	✓	-
Dung cake making	✓	-
Milking	✓	-
Making products from the milk	✓	-
Selling the milk	✓	✓
Poultry management	✓	-

The gender assessment revealed that livestock management is a key area of interest for women, who consider it their primary responsibility. Women are deeply engaged in caring for livestock and processing milk into value-added products. Poultry management and vaccination were also highlighted as significant areas of interest. In particular, women in Kanori, where livestock rearing is a common small business, showed strong enthusiasm for livestock-related activities, including poultry management.

Given that women play a central role in household-level livestock management, enhancing their skills is essential for improving productivity and minimizing losses. Basic livestock management training would equip them with better practices, while more advanced training could prepare select women to serve as village-level livestock extension workers. Community sessions on livestock management would also be beneficial, ensuring that a larger number of women gain essential knowledge to improve overall livestock practices. Additionally, providing information on the dairy value chain would help women refine their dairy products in alignment with market demands, ultimately increasing their income.

Women also expressed interest in scaling up their household-level poultry rearing into small-scale poultry farming. They were eager to learn more about poultry farming techniques and the establishment of poultry farms. Small-scale, particularly organic, poultry farming presents a promising and profitable opportunity for women, offering both economic benefits and a reliable source of nutritious food. Engaging not just women and girls but also young boys in poultry farming could further enhance household food security and income generation.

> *"Livestock is our only livelihood as we have no land. I use traditional knowledge from my parents to care for our cows and goats, as vets are far and costly. I'm eager to learn how to treat sick animals and increase milk production, because more milk means a better life for us."* — Siraj Bibi, Kanori village

To ensure the long-term sustainability of these activities, it is crucial to strengthen market linkages for women and youth engaged in livestock and poultry management. Connecting them with relevant networks, markets, private sector actors, and government departments would support their transition from subsistence-level activities to more commercially viable enterprises, creating sustained economic opportunities for rural communities.

1.3.6 Off-farm productive activities

In addition to their contributions to agriculture and livestock management, women in the study villages engage in a range of off-farm productive activities. Common income-generating pursuits include embroidery, stitching, and weaving baskets from wheat straw. These products are typically sold within the village, as women have limited mobility and minimal access to external markets.

The assessment revealed that many women, particularly those with lower literacy levels and younger women with restricted mobility, have limited knowledge of livelihood options beyond tailoring, due to low exposure to skill development opportunities and limited access to information sources such as television, radio, or vocational networks. Consequently, their economic activities remain informal, small-scale, and constrained by weak market linkages.

However, women expressed interest in expanding their income-generating activities if provided with appropriate training and market access. Strengthening their exposure to diverse vocational skills, providing entrepreneurial and financial literacy training, and connecting them with buyers and private-sector actors would enable women to transition from localized household-based production to more sustainable and profitable off-farm enterprises. Enhancing mobility through community-linked market facilitation and engaging young men and women as intermediaries could further support women's participation in wider markets.

1.3.7 Contribution of women in reproductive activities

Women in the study villages carry a disproportionate share of reproductive and household labor, performing tasks essential to the wellbeing and survival of their families (see Table 3). Their daily responsibilities include fetching water for domestic use and livestock, collecting fuelwood, gathering green fodder, and preparing meals. Women also manage household cleaning, dishwashing, laundry, childcare, and family caregiving. In addition, they ensure food is delivered to men working in the fields, further extending their labor beyond the home.

A unique but significant responsibility identified during the assessment is the maintenance of mud-constructed homes. Women collect clay from areas outside the village and plaster house walls twice a year to preserve structural stability an intensive task rarely acknowledged in traditional labor accounts.

Girls assist mothers with many of these duties from a young age, reinforcing gendered labor norms and limiting their time for education or skills development. Men and boys participate minimally in domestic responsibilities, often only assisting occasionally with physically intensive tasks such as carrying water or collecting fuelwood.

Despite being critical to household functioning and community wellbeing, this labor remains largely invisible, unpaid, and undervalued. Recognizing and reducing women's unpaid care burden is essential for enabling their participation in livelihood activities, skills development, and decision-making processes.

Table 3. Gender division of reproductive activities.

Reproductive Activities	**Who does what**	
	Women/Girls	Men/Boys
Household chores	✓	
Family /Childcare	✓	
Fetching water	✓	
Fuel wood collection	✓	
Community management	✓	✓
Take food to the field for men	✓	✓
Collection of clay for repair & maintenance of mud houses	✓	
Repair of the mud houses with clay	✓	

1.3.8 Community management activities

Discussions with women revealed that they perceive home and family-related responsibilities as their primary domain. They highlighted their role in maintaining social ties by visiting relatives for weddings, childbirth, and illness, as well as hosting guests at home. Women considered these activities an extension of their reproductive responsibilities, reinforcing their role as caregivers within both their immediate and extended families. These responsibilities are socially expected and culturally reinforced, limiting women's time, mobility, and opportunities to participate in public or formal community activities.

In contrast, men dominate public, social and political spaces. They participate in community-level decision-making platforms such as Jirgas, water user association meetings, local dispute resolution gatherings, and public ceremonies, including funerals. Men dominate these spaces because social and cultural norms assign authority and public leadership to men, restrict women's presence in mixed-gender forums due to practices such as parda, and legitimize men's participation while discouraging women from engaging in decision-making beyond the household. These spaces enable men to build social networks, access information, influence local decisions, and maintain leadership roles within the community. Women's involvement in collective decision-making remains limited, informal, and largely confined to domestic settings, reinforcing existing gender hierarchies and restricting their voice in public affairs.

1.3.9 Youth needs and interests

FGDs with young men highlighted significant challenges related to education and access to information. The majority reported having little to no formal schooling, reflecting the low literacy levels in the region. Limited infrastructure further compounds these barriers, some villages lack electricity entirely, while others experience prolonged load-shedding of 14–16 hours per day. With minimal access to television, radio, or digital platforms, youth remain largely unaware of government programs such as the Kamyab Jawan Program and other public or private sector development initiatives. This limited exposure restricts their ability to tap into employment, entrepreneurship, and learning opportunities.

Most youth (aged 15-29) are engaged in agriculture and livestock management, supporting family farms, grazing animals, or working as casual laborers. Many are unemployed or reliant on irregular daily-wage work, underscoring how low educational attainment and limited vocational skills contribute to economic insecurity. These field observations are consistent with broader district-level trends: PSLM 2019–20 data shows that D.I. Khan and Tank districts rank among the lowest in KP for key development indicators, including education and food security, and that men dominate agricultural employment, with over 97% of own-account agricultural workers in both districts being male (Pakistan Bureau of Statistics 2021b).

During discussions, youth expressed strong interest in vocational centers and skill-building programs, particularly in trades such as vehicle mechanics, electrical work, tailoring, and mobile repair; skills their peers have successfully used to earn income. Beyond agricultural capacity-building, there is a clear need to expand economic pathways for rural youth.

Opportunities include:

- Linkages with technical and vocational training institutes for certification in trades and services.
- Entrepreneurship support programs, including business development training, access to microfinance, and mentoring for small enterprise development (e.g., farm services, input supply, repair shops, agribusiness services).
- Digital literacy and technology access initiatives to improve youth familiarity with mobile applications, online learning platforms, digital payments, and e-extension services.
- Career counseling and job placement linkages with public and private sector organizations.

Limited access to information also restricts youth awareness of innovations in water management, agricultural productivity, and climate-smart practices. To address this, youth suggested hosting youth technology and innovation festivals within the GZDCA. Such events could showcase modern irrigation systems, climate-smart agriculture practices, and livestock innovations while connecting young people with government agencies, research institutions, academia, and private sector actors. These platforms would foster learning, build networks, and strengthen pathways for technology adoption, entrepreneurship, and skills development, positioning youth as active contributors to local economic growth.

1.4 Key Takeaways

This section demonstrates how a carefully structured, evidence-based approach can translate gender and youth inclusion strategies into actionable agricultural interventions. The gender assessment revealed the complex realities shaping women's and youth's engagement in agriculture, livestock management, and community activities, including entrenched social norms, restricted mobility, and unequal access to resources and decision-making.

Key insights include:

- Women's contributions are extensive but often unrecognized: Women play central roles in crop production, livestock care, and household food security, yet social perceptions frequently exclude them from mechanized or market-facing activities.
- Youth are an untapped resource: Young men and women demonstrate interest and potential in both agricultural and off-farm economic activities, but the lack of skills, vocational training, and access to information limits their engagement.
- Barriers are multidimensional: Beyond physical labor, patriarchal norms and household dynamics restrict women's self-identification as farmers, mobility, and participation in decision-making.
- Targeted interventions can foster inclusion: Co-designed technologies, capacity building, and the engagement of men as allies can create pathways for women and youth to participate meaningfully without exacerbating workloads or household tensions.
- Intersectional factors matter: Age, marital status, education, and household position influence women's agency and opportunities, highlighting the need for context-specific approaches.

These insights lay the foundation for section 2, where the focus shifts to the co-design, implementation, and scaling of gender-intentional interventions. By understanding the lived realities of women and youth, the WMfEP project can design strategies that are culturally sensitive, equitable, and sustainable, ultimately fostering empowerment and inclusive agricultural development.

2. The Progress: Breaking Barriers – Strengthening Inclusion

This section outlines the progress achieved through the translation of WMfEP's gender-responsive design into tangible actions on the ground. It highlights how innovative technologies and inclusive capacity-building initiatives enabled women and youth to actively participate in and benefit from improved agricultural practices.

Through the introduction of solar-powered micro-drip irrigation, tunnel farming, and smart spraying technologies, the project demonstrated how climate-smart solutions can enhance productivity and water-use efficiency.

More than 100 women and youth across D.I. Khan and Tank were trained in irrigation system management, crop productivity enhancement, livestock care, and silage-making techniques thus strengthening both technical capacity and self-confidence. Culturally sensitive approaches ensured women's participation at every stage of training and technology adoption. Farmer field schools and exposure visits further reinforced peer learning, strengthened linkages with private-sector manufacturers, and encouraged collective problem-solving at the community level.

By breaking traditional barriers and fostering inclusive learning environments, section 2 demonstrates how WMfEP's interventions moved beyond awareness-building toward meaningful participation, empowerment, and leadership of women and youth in sustainable agriculture.

Translating gender-responsive design into action

To address persistent gender and youth disparities in agriculture, the WMfEP adopted an inclusive, community-driven approach. The process began with extensive consultations to understand local priorities, gender roles, youth aspirations, and socio-cultural norms. Insights from these engagements informed joint planning between WMfEP's biophysical and social scientists, resulting in the introduction of women-friendly, affordable, and locally fabricable technologies tailored to community needs.

To ensure meaningful participation and sustained impact, a comprehensive support package was implemented, including:

- Community consultations to understand needs and build trust.
- Engagement with men and community leaders to secure social acceptance and buy-in.
- Introduction of appropriate technologies aligned with the needs of women and youth, with local farming systems.
- Targeted capacity-building on technical skills, entrepreneurship, and climate-smart practices.
- Exposure visits encourage peer-to-peer learning and inspire adoption.

Figure 3 illustrates the key achievements in technology adoption and capacity building among women and youth farmers under WMfEP.

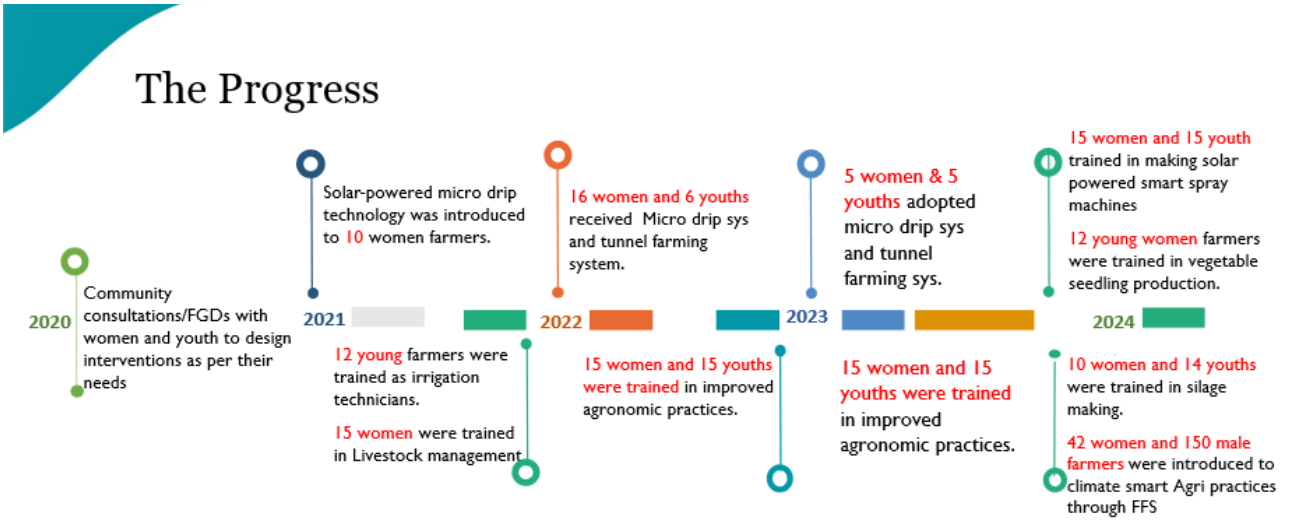

Figure 3. Achievements in technology adoption and capacity building for women and youth farmers (*Source*: author's creation)

The following sections present how these activities were rolled out on the ground and highlight the transformative outcomes achieved through gender and youth-responsive innovations and capacity development efforts.

2.1 Introducing Innovations and Technologies to Women Farmers[2] and Youth

2.1.1 Solar-powered micro drip-irrigation technology

To enhance women's access to productive resources and climate-smart technologies, WMfEP introduced solar-powered micro-drip irrigation systems customized for small farm plots near homesteads. This approach emerged from a gender analysis that highlighted women's limited mobility, time constraints, and preference for technologies manageable alongside household responsibilities. Introducing drip systems directly to women represented a strategic shift from traditional male-targeted technology dissemination, aiming to strengthen women's agency in agricultural decision-making. Although this approach was risky—given uncertainties about whether women would be interested in adopting the technology or capable of handling it, possible resistance from male family members, being overburdened with new responsibilities, or community pushback—it also presented a significant opportunity. These potential negative consequences were anticipated and addressed through inclusive planning, engaging male and female family members, culturally appropriate community involvement, trust-building, and tailored training for women. If successful, this initiative could pave the way for women farmers to access advanced water and agricultural technologies, improve their farming practices, and ultimately enhance their livelihoods.

A detailed assessment was conducted in March 2021 to identify suitable beneficiaries, while taking into account land availability, access to water, interest level, and willingness to co-invest in two solar panels. Beginning with 10 systems in 2021, demand grew rapidly as neighbours observed water savings, reduced labor burden, improved crop yields, and access to fresh vegetables. By 2023, 32 systems had been installed across multiple villages, benefiting women and youth, and enabling technology adoption at both kitchen garden and small orchard scales (see Figure 4).

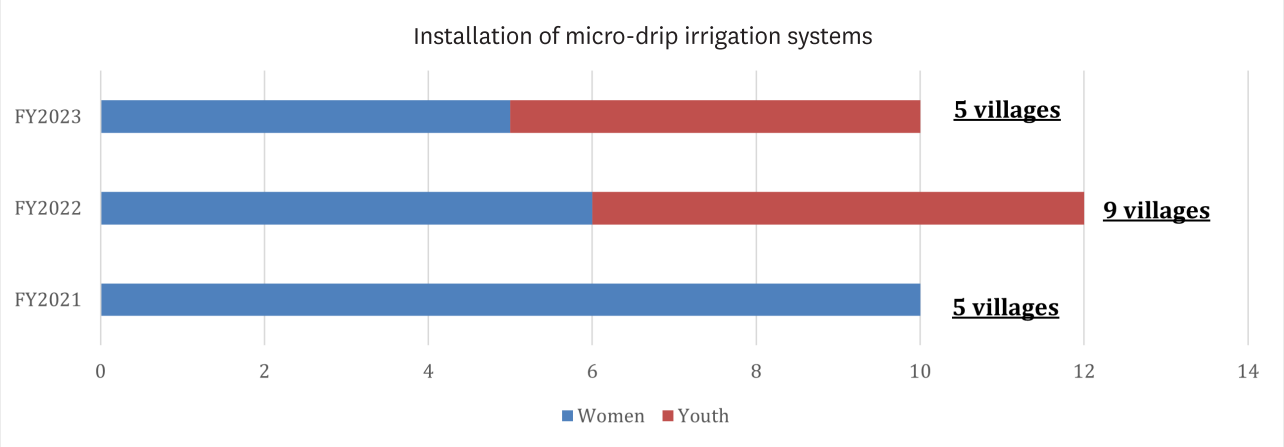

Figure 4. Micro-drip irrigation systems installation by fiscal year (*Source*: author's creation based on field survey data).

Systems were supported through regular field visits, hands-on demonstrations, and capacity building in improved agronomic practices and crop production, ensuring proper use and local troubleshooting. Women farmers successfully operated the systems, shared produce with community members, and motivated additional households to adopt the technology.

The solar-powered micro-drip irrigation kits were designed using locally available components, ensuring affordability, easy maintenance, and scalability.

2.1.2 Tunnel farming technology

The successful adoption of micro-drip irrigation systems by women farmers created momentum for additional

[2] The term "women farmers" is used here for analytical purposes to recognize women's active roles in agricultural production, even though many women themselves do not identify as "farmers." Cultural norms, household hierarchies, and socially assigned labor roles often prevent women from claiming this label, despite their substantial contributions to crop cultivation, livestock management, and post-harvest activities. Recognizing women as farmers in the project context highlights both their productive contributions and the barriers; social, hierarchical, and institutional that limit their visibility and decision-making power in agriculture.

climate-smart innovations. During routine follow-ups, the WMfEP team observed women improvising by covering vegetable beds with plastic sheets to protect crops from harsh weather and birds, an early indicator of their willingness to adopt improved cultivation techniques.

To build on this initiative and strengthen year-round vegetable production, WMfEP introduced walk-in tunnel farming structures in FY 2022. Ten standardized tunnels, each covering 50 m², were installed for women and young farmers. These structures were designed to be low-cost, locally fabricable, and culturally appropriate, allowing women to manage protected cultivation near their homes.

Recognizing early success and community demand, an additional ten tunnels were established in 2023: five for women and five for youth across five villages (see Figure 5). In this second phase, the design was upgraded to include green covering sheets for improved temperature regulation and mulching sheets to minimize soil moisture loss and weed growth. The introduction of mulching was a first in the area and marked a key step in advancing climate-resilient and sustainable production practices.

Women and youth reported improved crop performance, greater confidence in handling advanced farming techniques, and increased recognition within their communities as capable farmers and innovators.

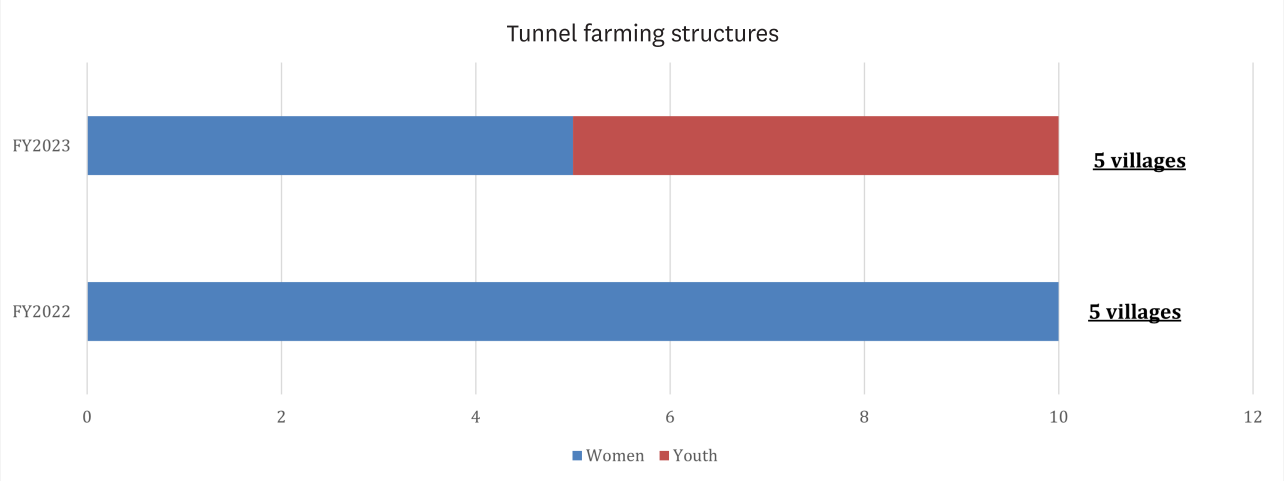

Figure 5. Installation of tunnel farming structures by Fiscal Year (*Source*: author's creation based on field survey data)

2.1.3 Solar-powered smart spray technology

Under WMfEP, a solar-powered smart pesticide spray technology was introduced to reduce women's farm workload and improve productivity on small vegetable farms. Separate training sessions were organized, engaging 15 women (including 5 young women farmers) from 7 villages and 15 young men from 12 villages.

The training emphasized practical learning on the assembly, maintenance, and operation of the solar-powered spray units. Women participants showed strong motivation and quickly grasped technical skills, independently assembling and testing the machines. Their innovative use of available household materials to secure machine components highlighted their resourcefulness and ability to solve technical challenges.

This intervention not only enabled women to adopt a labor-saving agricultural technology but also strengthened their confidence, mechanical skills, and participation in climate-smart agriculture practices.

2.2 Training and Capacity-Building

Transferring new technologies to women and youth was only the first step; equipping them with the necessary skills to effectively use these innovations was equally essential. Technology introduction was paired with tailored capacity-building sessions, enabling participants to operate new equipment, apply improved agronomic techniques, and engage confidently in modern farming. WMfEP implemented a range of capacity-building initiatives in the GZDCA. The details of these training programs are outlined in Table 4.

Table 4. Capacity-building initiatives in the GZDCA

Training Title	Key themes	Participants	
		Female	Youth
Training in innovative techniques for crop productivity enhancement	Crop production techniques and efficient irrigation practices. Preparation and management of seedlings for better crop establishment/ Timely weed control using pesticides during seed sowing. Compost making to enhance soil productivity, addressing acidity and salinity. Introduction of hydroponics technology and solar-powered smart pesticides spray technology for small vegetable gardens.	30	30
Irrigation technicians training	Drip irrigation system design and installation – theoretical and physical introduction of components, fittings, and drip manifold system. Solar-powered water management – technical training on solar panel installation, voltage control, and integration with irrigation systems. Measurement and calibration techniques – land area measurement, pressure gauge reading, and volume calculations. Hands-on technical skills development – practical sessions on assembling/dismantling systems and connecting tools and equipment.	-	12
Training in silage processing and management skills	Climate-smart crop selection – choosing forage crops suited to local soil and climate for optimal yield and nutrition. Efficient harvesting and handling – timing and techniques to preserve nutritional value before silage preparation. Silage production and silo management – step-by-step silage making and maintaining anaerobic conditions for proper fermentation. Quality control and nutritional assessment – methods to evaluate silage quality to ensure livestock dietary needs are met.	10	14
Training in improving livestock management skills for enhanced productivity	Animal health and welfare – Includes care of sick and pregnant animals, seasonal care, vaccination, deworming, and mastitis prevention. Nutrition and feeding practices – covers balanced diet, importance and types of fodder, UMMB use, and water access. Livestock management for productivity – emphasizes profitable farming, fattening at household level, and sustainable practices. Fodder production and storage – focuses on cultivation, preservation, and cost-effective access to quality feed.	15	-
Total		55	56

2.2.1 Irrigation technician training

To support the introduction of solar-powered micro-drip irrigation systems in the GZDCA, WMfEP identified a critical gap: the absence of locally skilled technicians for system installation and maintenance. To address this, WMfEP launched a practical, community-based irrigation technician training program targeting rural youth.

This initiative served a dual purpose, ensuring sustainable technical support for farmers and creating livelihood pathways for young men. Following the training, participants immediately applied their skills by installing drip systems for women farmers, earning income while contributing to climate-smart agriculture in their communities.

A total of 12 youth from 7 villages received training, which combined 20% theory and 80% hands-on practice. The curriculum covered:

- System design and components: structure, fittings, filters, drip manifolds.
- Solar-pump installation and voltage management.
- Land measurement, pressure gauge reading, and system calibration.
- Installation, flushing, troubleshooting, and maintenance of drip systems.
- Entrepreneurial guidance: vendor linkages, service provision, and component sales.

Through experiential learning and real-field practice, trainees are now equipped to operate as community-level irrigation service providers, supporting technology uptake while improving their own livelihood prospects.

2.2.2 Training women in innovative techniques for crop productivity enhancement

Following the introduction of solar-powered micro-drip irrigation systems, WMfEP observed that while the technology improved water efficiency, women farmers faced agronomic constraints such as low germination rates, pest attacks, and weak crop establishment. To address these challenges and strengthen productivity, WMfEP organized capacity-building trainings focused on climate-smart and improved agronomic practices for vegetable cultivation.

To ensure high-quality and context-appropriate training, WMfEP partnered with the National Agricultural Research Center (NARC) and its Arid Zone Research Center (AZRC) in D.I. Khan. This collaboration enabled access to national expertise, practical demonstration facilities, and experienced women trainers.

Over two training cycles (2022–2023), 30 women farmers, including 6 young women, participated in a three-day training program. The curriculum combined theory and hands-on learning, including:

- Improved crop establishment and seedling management.
- Integrated pest and disease management.
- Efficient irrigation and fertilizer application under drip systems.
- Compost preparation to enhance soil fertility.
- Climate-smart practices and introduction to hydroponics.
- Use of solar-powered smart pesticide sprayers.

Participants also received hybrid vegetable seeds for Rabi and Kharif seasons to support on-farm demonstration and adoption.

Gender-responsive training approach

Recognizing sociocultural norms and mobility constraints, the training was intentionally designed to be women-centered and culturally appropriate:

- Sessions were facilitated exclusively by highly qualified women trainers (PhD and MPhil), ensuring a comfortable learning environment.
- WMfEP engaged male family members to secure support for participation.
- Travel allowances, separate rest and refreshment arrangements, and space for accompanying children were provided to remove barriers to attendance.

This tailored approach strengthened women's confidence, participation, and ability to apply improved production practices, contributing to enhanced household nutrition, income prospects, and local leadership in climate-smart agriculture.

2.2.3 Training in innovative techniques for crop productivity enhancement for youth

To equip youth with knowledge and skills on new agricultural and irrigation technologies, WMfEP conducted two residential trainings focused on innovative techniques for crop productivity enhancement. The training aimed to improve the production technology of major crops in D.I. Khan and Tank, alongside efficient water use. A total of 30 young farmers from 10 villages in these districts participated in the training, which was held at the NARC facility in Islamabad.

One of the key advantages of conducting the training at NARC was the opportunity to access a diverse group of researchers specializing in various fields of agriculture and irrigation. Experienced scientists and trainers—particularly from crop sciences and water resources—led the sessions, offering both theoretical lectures and practical demonstrations at the farm.

The training covered crucial topics such as land preparation, raised bed planting, soil moisture monitoring and management, crop water

requirements, irrigation scheduling, and rainwater harvesting. The participants showed particular interest in climate-smart and water-efficient irrigation techniques, including drip and sprinkler irrigation systems, hydroponic farming systems, tunnel farming, and seedling preparation in tunnels.

At the end of the training, each participant received a certificate, and hybrid wheat seeds were provided by NARC. In addition to the technical knowledge gained, the youth established valuable connections with Pakistan Agricultural Research Council (PARC), AZRC, and the trainers, who encouraged ongoing communication for further guidance on crop production. The trainers also introduced participants to the PARC website, with a special focus on the Kisan Corner, a section dedicated to providing expert advice and solutions to agricultural challenges. This empowered the youth to utilize mobile technology for real-time crop management and leverage expert consultations and online resources to enhance their productivity.

2.2.4 Training in improved livestock management skills for enhanced productivity

Livestock serves as a primary livelihood source for women in rural areas of the GZDCA particularly in Kanori village, where women are responsible for daily animal care and management. To strengthen their technical capacity and enhance livestock productivity, WMfEP organized a three-day training for 15 women farmers, focused on improved livestock health, nutrition, and management practices.

Training approach and learning environment

To ensure a culturally supportive and effective learning experience, WMfEP partnered with the Faculty of Veterinary and Animal Sciences, Gomal University, D.I. Khan, engaging experienced female trainers and conducting sessions within a structured university setting. The training design prioritized:

- Practical and easy-to-understand content.
- Hands-on demonstrations and real-farm exposure.
- Interactive group learning to build confidence and peer support.

For many participants, this was their first exposure to a university setting and formal training, which significantly boosted their confidence and sense of empowerment. Women received hands-on practice at the university farm and visited the university veterinary clinic, gaining exposure to professional veterinary services and building linkages for ongoing support.

To reinforce adoption of improved practices:

- Each participant received five 40 kg bags of Wanda feed to demonstrate and apply enhanced nutrition techniques at home.
- A team of five veterinary doctors conducted deworming of livestock in the village, based on pre-identified animals.
- A follow-up vaccination drive was conducted three days later to improve herd health and productivity.

This integrated training and service delivery model strengthened women's technical skills, improved livestock health, boosted household nutrition and income prospects, and fostered long-term linkages with veterinary professionals.

2.2.5 Building resilience through silage-making training

To support climate-resilient livestock production and address seasonal fodder shortages, WMfEP organized specialized silage-making training for women and youth farmers. Silage ensures a reliable supply of nutritious feed during periods of scarcity such as floods, heavy rainfall, winter, and post-harvest months, ultimately improving animal health, milk production, and household income. The training responded directly to farmers' requests, reflecting strong community interest in adopting improved livestock practices.

The training was conducted at Gomal University, engaging 14 youth and 10 women from villages in D.I. Khan and Tank. The curriculum combined:

- Theoretical sessions on fodder selection, harvesting stages, and storage requirements.
- Hands-on demonstrations on cutting, chopping, compaction, and trench silo construction.
- Practical training for women on silage packing and sealing techniques to ensure proper fermentation and long-term storage.

This balanced approach enabled participants to not only understand the science behind silage production but also practice each step. To reinforce learning, participants visited Rizvi Dairy Farm in Layyah, Punjab, where they observed large-scale silage production operations. This exposure provided firsthand experience with mechanized processing, compaction systems, and efficient storage methods, inspiring farmers to adopt similar techniques at the household level.

2.2.6 Farmer field school

WMfEP has focused on making modern agricultural and irrigation techniques accessible, especially to women and youth. Building on the success of farmers who adopted solar-powered micro-drip irrigation, tunnel farming, raised bed planting, silage making, and improved livestock management, farmer field schools were organized in various villages. These sessions allowed successful farmers to share their experiences, as local, firsthand accounts are more credible in rural communities. The initiative aimed to reach more farmers and provide them with the knowledge and skills to sustain profitable agriculture amid changing climate patterns, including heatwaves and floods. Each session focused on a specific theme to address farmers' needs and promote sustainable practices. A total of 150 males and 42 females participated in these sessions.

Key themes of farmer field schools

a. Promoting vegetable nursery in tunnels

The non-availability of vegetable seedlings in local markets was a major challenge for farmers in D.I. Khan and Tank. To address this, WMfEP trained selected women and youth beneficiaries in vegetable nursery establishment using micro-drip irrigation and tunnel farming. These nurseries provided a controlled environment for faster seedling growth, protecting them from climatic shocks. Participants were trained in nursery management, seedling preparation, and market linkages, enabling them to establish small enterprises and improve access to high-quality seedlings in local markets. This initiative not only enhanced household food security but also created income-generating opportunities for women, particularly those constrained by cultural norms.

The first training session was conducted on the farm of Samreen Bibi, a female beneficiary in Kot Atal, allowing participants to observe a working system firsthand. However, due to security concerns, the second session was held at the D.I. Khan field office, ensuring a safe learning environment for women farmers. Both sessions combined theoretical discussions and hands-on practice, covering soil mixing, tray filling, seed sowing, and watering techniques. Women and young girls actively participated, showing enthusiasm in adopting climate-smart agricultural practices. Each participant received seedling trays and watering bottles to start their own nurseries, supporting their transition into self-sustaining vegetable producers.

b. Climate change awareness and adaptation techniques

WMfEP conducted awareness sessions and demonstrations on climate change adaptation through Farmer field schools and farmer field days in the GZDCA. These sessions focused on climate risk awareness, water-efficient irrigation, soil conservation, and sustainable cropping practices. Two FFDs in Ranwal and Kot Issa Khan villages highlighted practical adaptation techniques, with experienced farmers sharing success stories. A key demonstration was the raised bed planter, effective in managing heavy rainfall and floods. Participants showed strong interest in climate-smart technologies, indicating potential for wider adoption in the region.

c. Improving livestock management practices

WMfEP organized training sessions to enhance livestock management practices for both women and men in Pota, D.I. Khan. For women, Dr. Faiqa Ramzan from Gomal University focused on livestock diseases, remedies, and small-scale silage-making techniques. For men, Dr. Mohammad Yasir Khan covered advanced livestock management, with local farmers sharing silage-making success stories. The sessions emphasized silage-making as a cost-effective way to improve animal nutrition and milk production. Practical demonstrations and visual aids encouraged participants to adopt these techniques on their farms.

d. Automated solar-based micro-drip irrigation kit

WMfEP introduced automated solar-based micro-drip irrigation kits to young farmers in order to promote smart irrigation and enhance youth employment. These systems, controlled via smartphones, were demonstrated at Farmer field schools and through practical training. A farmers field day at IWMI field office in D.I. Khan trained 20 young participants in assembling, installing, and automating the drip kits using the Hunter BTT app. The practical, group-based training strengthened technical skills and confidence in developing automated irrigation solutions.

2.3 Exposure Visits

Exposure visits were a key component of WMfEP's capacity-building approach, designed to reinforce technical trainings through real-world learning. While farmers in the GZDCA were introduced to innovative irrigation and agricultural practices, seeing these technologies in operation was crucial to build confidence, trust, and interest in adoption. Guided by the principle that seeing is believing, visits were arranged to progressive farms applying drip irrigation, a drip-manufacturing facility, and a leading dairy farm specializing in silage-making. These experiences enabled farmers to observe practical benefits, engage in peer-to-peer discussions, and develop linkages with technology suppliers, motivating them to adopt tested solutions that enhance productivity and resilience.

2.3.1 Exposure visits for upscaling drip irrigation

To promote the uptake of drip irrigation, the WMfEP team organized a three-day exposure visit for progressive farmers both men and women, who had already invested in solar-powered tube wells and demonstrated interest in modern agricultural practices. The visit combined peer learning and industry engagement, featuring an on-farm demonstration by a woman farmer in Muzaffargarh and a tour of a drip irrigation manufacturing facility in Faisalabad.

Participants comprised of two women and eight men. Keeping in view the cultural context of D.I. Khan and Tank districts, the engagement of women in a three-day event outside of their city was an unusual activity and a significant success. It marked a step toward community acceptance and recognition of women farmers' roles in agriculture.

The group first visited the farm of Ms. Rabia Sultan, President of the Farmers Association of Pakistan in Muzaffargarh. Participants observed a fully operational drip irrigation system and engaged with her team on system components, water-use efficiency, installation procedures, labor requirements, and cost implications. They also explored complementary mechanized farming techniques, sparking discussions on scalability and long-term returns.

Farmers from D.I. Khan and Tank facing chronic water scarcity were particularly interested in the system's ability to optimize water and fertilizer use while reducing labor requirements. They also explored additional innovations in farm management and mechanization practices.

The visit was both educational and empowering, especially in highlighting the leadership role of women in modern farming. Seeing a successful, woman-led farm in action reinforced the message that with access to the right technologies and support, women farmers can effectively manage and scale agricultural enterprises.

2.3.2 Building farmer-manufacturer linkages for drip irrigation adoption

To strengthen access to irrigation technology, farmers visited the Mahar Irrigation System facility in Faisalabad. This exposure enabled them to learn about system production, quality standards, installation requirements, and pricing structures, directly from the manufacturer. They also observed a micro-drip system suitable for home-based vegetable gardening, generating strong interest, particularly among women participants.

Direct interaction with the manufacturer helped farmers understand procurement processes and build confidence in exploring investment options. WMfEP further committed to technical support including water quality testing, designing drip layouts, estimating costs, procurement facilitation, installation guidance, and on-farm troubleshooting through trained technicians.

During the debriefing session, participants emphasized how transformative the exposure visit had been; many noted they would have remained unaware of such solutions without it. They recognized the potential of drip irrigation to boost productivity while conserving water and reducing fertilizer use.

2.3.3 Exposure visit for upscaling silage making and processing

Silage preservation presents a vital opportunity to enhance the resilience and productivity of farming systems, particularly in water-scarce areas. To introduce this technology on a broader scale, the WMfEP team, in collaboration with Gomal University in D.I. Khan, organized an exposure visit to Rizvi Dairy Farm in Layyah. A total of 16 young men and 10 women farmers participated, gaining firsthand experience in innovative fodder preservation techniques.

The visit was especially significant for female farmers from the GZDCA, as it offered them rare exposure to modern livestock practices. Their active engagement highlighted the value of equipping women with technical skills to improve livestock management and farm productivity.

At Rizvi Dairy Farm, a pioneer in silage-making, participants observed the entire process, from forage crop selection and harvesting to chopping, compaction, and long-term preservation. Dr. Awais Adil provided an in-depth briefing, covering silage-making steps, machinery use, storage methods, and quality assessment. Farmers explored silage pits, examined equipment, and engaged in interactive discussions, gaining practical insights into cost-effective silage management.

The visit boosted farmers' technical understanding and confidence, inspiring them to adopt silage-making on their own farms. By replicating this model, farmers in D.I. Khan and Tank are now better positioned to ensure a consistent, nutrient-rich feed supply, reduce fodder shortages, and strengthen the resilience of their farming systems.

2.3.4 Practical demonstration of silage making and processing at a farm level in the Gomal Zam Dam Command Area

Following theoretical training and a visit to Rizvi's Dairy Farm, young farmers requested hands-on demonstrations of silage-making at the farm level. In response, the WMfEP team organized practical sessions at three sites; Kot Attal (D.I. Khan), Ranwal (Tank), and Gara Abdullah (Kulachi), providing support for maize cultivation on one hectare per site, silo construction using concrete bunkers, and step-by-step training in crop selection, sowing, monitoring, harvesting, chopping, compaction, and sealing. At Gara Abdullah, an additional silo was established to support Mr. Laiqat Khan, an enthusiastic farmer with 1.8 hectares under maize, to promote silage visibility in the region.

The WMfEP team closely monitored crop progress and ensured timely processing, with silage preserved within 16–18 hours of harvest in July 2023. After the 40-day fermentation period, silage samples from all three sites were collected, labeled, and analyzed by experts at Gomal University. Evaluations based on texture, color, smell, compaction, and moisture content confirmed excellent quality, making the silage suitable for livestock feed and enabling participating farmers to confidently adopt the practice on their own farms.

Farmer reflections

Farmers found the silage-making demonstrations highly beneficial. M. Rasheed, a livestock farmer, shared that during fodder shortages, he had relied on wheat straw, which weakened his livestock and reduced milk yield. He saw silage as a game-changer for maintaining animal health and productivity during dry periods. Majeebullah, a young farmer, admitted he previously viewed food preservation as relevant only to humans. The training shifted his perspective, helping him see silage as a solution to fodder scarcity and a potential business opportunity.

The WMfEP team initially planned demonstrations in Kot Attal (D.I. Khan) and Ranwal (Tank), supporting maize cultivation and constructing concrete bunker silos at both sites. An additional silo was later established in Gara Abdullah to support Mr. Liaqat Khan, an eager adopter from Kulachi with 1.8 hectares under maize. Through comprehensive support and active farmer involvement, the initiative built local capacity for silage production, offering a sustainable solution for livestock feed in the GZDCA.

2.4 Key Takeaways

Section 2 demonstrates how WMfEP translated gender-responsive design into concrete action on the ground, enabling women and youth to meaningfully engage in agriculture, strengthen their skills, and enhance their livelihoods. The key insights include:

Gender-responsive technology adoption

- Solar-powered micro-drip irrigation, tunnel farming, and solar smart spray systems were successfully introduced to women and youth, improving water-use efficiency, crop productivity, and climate resilience.
- Direct access to these technologies strengthened women's agency and decision-making in agricultural production.

Capacity building and technical skills development

- Tailored training programs, including irrigation technician training, crop productivity enhancement, livestock management, and silage-making, equipped women and youth with hands-on technical knowledge.
- Exposure visits and farmer field schools reinforced learning, encouraged peer-to-peer knowledge sharing, and connected participants with manufacturers, research institutions, and innovative farming practices.

Empowerment, confidence, and recognition

- Women participants reported increased confidence, technical skills, and recognition as capable farmers within their communities.
- Youth gained livelihood opportunities, entrepreneurship skills, and leadership experience in modern agricultural practices.

Culturally sensitive and inclusive approaches

- Engagement of male family members, use of women trainers, flexible scheduling, and support for mobility and childcare enabled meaningful participation and minimized social barriers.
- Community consultations, trust-building, and locally appropriate interventions ensured wider acceptance and sustainable adoption.

Climate-smart and resilient practices

- Interventions introduced sustainable solutions, including protected cultivation, improved irrigation, fodder preservation through silage-making, and mechanized farm practices.
- Farmers demonstrated resilience against climate shocks while maintaining year-round food and fodder security.

Attention to risks and unintended consequences

- Potential risks such as additional workload, unequal access, or social tension were identified and mitigated through inclusive planning, community engagement, and supportive measures.
- Proactive interventions ensured that technology adoption and capacity building reinforced empowerment without overburdening participants.

Community-wide impact and scaling potential

- Demonstration effects inspired broader community adoption, fostering peer learning and greater acceptance of women and youth as leaders in sustainable agriculture.
- Early successes created demand for additional technologies and generated pathways for scaling climate-smart, gender-responsive interventions across D.I. Khan and Tank.

Building on these inclusive processes, section 3 examines how WMfEP's interventions translated into measurable impacts; on productivity, empowerment, and social norms, highlighting pathways for sustainable, transformative change in communities.

3. The Impact: Catalyzing Change for Women And Youth

This section evaluates the impact of WMfEP's gender- and youth-responsive interventions, drawing on both quantitative survey data and qualitative field evidence. Building on the inclusive implementation processes outlined in the previous chapter, this section assesses how project activities translated into tangible improvements in agricultural productivity, empowerment, and shifts in gender and social norms.

Data was collected through household surveys, FGDs, and key informant interviews across the GZDCA. The findings capture progress in multiple dimensions; enhanced access to technologies, improved decision-making power, strengthened technical capacities, and increased recognition of women and youth as active contributors to agriculture.

Beyond numbers, section 3 also brings forward the lived experiences of women and youth who transformed these opportunities into meaningful change. Their stories illustrate how innovation, confidence, and collective support have catalyzed broader shifts in community perceptions, marking an important step toward equitable and sustainable agricultural development.

3.1 Data Collection

The study was carried out in the GZDCA (Tank and D.I. Khan districts). Data was collected directly from project beneficiaries, focusing particularly on women and youth.

Using a structured survey administered through the KoboToolbox platform, the study gathered detailed information on two key areas: the adoption and use of agricultural technologies; and gender dynamics shaping access, decision-making, and participation in agriculture. The questionnaire explored beneficiaries' experiences with newly introduced technologies, barriers to adoption, and the extent to which these innovations contributed to improving agricultural productivity and livelihoods. It also examined how gender roles and relations influenced technology uptake and agricultural practices.

The use of KoboToolbox ensured efficient data collection with real-time monitoring, enabling the research team to capture diverse perspectives from women and youth in the project areas. These insights provide critical evidence on how technology transfer initiatives are impacting gender equality and agricultural outcomes.

Between 2021 and 2023, 32 beneficiaries were initially supported with the provision of micro-drip irrigation systems and tunnel farming structures under the WMfEP project. The distribution of these technologies occurred as follows:

- 2021: 10 micro-drip irrigation systems and 2 tunnel farming structures.
- 2022: 12 additional micro-drip irrigation systems and 6 tunnel farming structures (with a focus on women beneficiaries).
- 2023: 10 micro-drip irrigation systems and 15 tunnel farming structures, distributed among women (5) and youth (5).

However, due to security situations in certain areas, we were unable to reach all the beneficiaries for the impact survey conducted in 2024. As a result, we successfully surveyed 26 beneficiaries out of the initial 32. This limitation in the sample size should be noted when interpreting the findings, as it reflects the responses of the 26 beneficiaries who were accessible under the prevailing conditions.

Despite the reduced sample size, the survey results provide valuable insights into the impacts of these technologies, and the data collected from these 26 beneficiaries remains representative of a significant portion of the project's target group.

3.2 Key Findings from the Impact Assessment Survey

Participant profile and type of intervention received

Out of the 26 respondents surveyed, 54% were male and 46% were female, indicating a relatively balanced gender representation. However, the gender of household heads reflected a significant disparity—96% of households were headed by men, with only 4% led by women, highlighting traditional household structures. Regarding the types of technologies received, a majority of participants (73%) benefited from both the solar-powered micro-drip irrigation technology and tunnel farming structures, indicating an integrated approach to technology dissemination. Among the rest, 23% received only the solar-powered micro-drip systems, while a single participant (4%) received only the tunnel farming intervention. This distribution illustrates the broad reach and diverse nature of the support provided under the project.

3.2.1 Before WMfEP interventions

Vegetable production practices before the WMfEP intervention

Prior to the WMfEP intervention, a significant majority of respondents (81%) reported that they were already growing vegetables, while 19% had not. Among those cultivating vegetables, the average land size used was 19.5 marlas[3], with variations ranging from small plots of 1 marla to larger ones of 120 marlas. However, those not engaged in vegetable production cited lack of access to adequate water (5 respondents), limited technical knowledge and skills (1 respondent), and lack of access to land (1 respondent) as primary barriers.

Vegetable cultivation was primarily driven by household consumption needs (19 respondents), followed by hobby gardening (4 respondents) and income generation (3 respondents). All respondents relied exclusively on manual irrigation before the intervention. When earnings were generated from vegetable sales, they were used for personal needs (2 respondents), children's education (2 respondent), health expenditures (1 respondent), or shared with a partner (1 respondent).

Support from household members played a crucial role in maintaining vegetable plots. Among those involved in production, 62% received assistance from partners or other household members, while 38% managed it alone. The main support they received was in irrigating the land (12 respondents). In some other cases this also included preparing the land (7 respondents), purchasing seeds (6 respondents) and selling produce in the market (2 respondents).

3.2.2 After WMfEP interventions

Impact and uptake of WMfEP intervention

Under the WMfEP project, most respondents received the solar-powered drip irrigation system in 2023 (13 respondents), while others received it in 2022 (7 respondents) and 2021 (5 respondents). Similarly, the tunnel farming structures were also primarily distributed in 2023 (15 respondents), with 6 receiving them in 2022 and 2 in 2021. On average, the intervention covered about 2.7 marlas of land per household, with most respondents reporting coverage between 2 and 3 marlas.

[3] 1 marla = approximately 25.29 m²

When asked about the current status of the system, 65% (17 respondents) confirmed it was still functional, while 35% (9 respondents) stated otherwise (see Figure 6). Among those with functioning systems, the majority had two production cycles in the last year (7 respondents), with others achieving one (6 respondents), three (2 respondents), or more cycles. The primary reason cited for systems' non functionality was the flooding event of 2022, mentioned by 6 respondents. Additionally, 3 respondents reported issues such as system clogging and highlighted their inability to carry out repairs due to a lack of financial resources and the unavailability of skilled labor in the area.

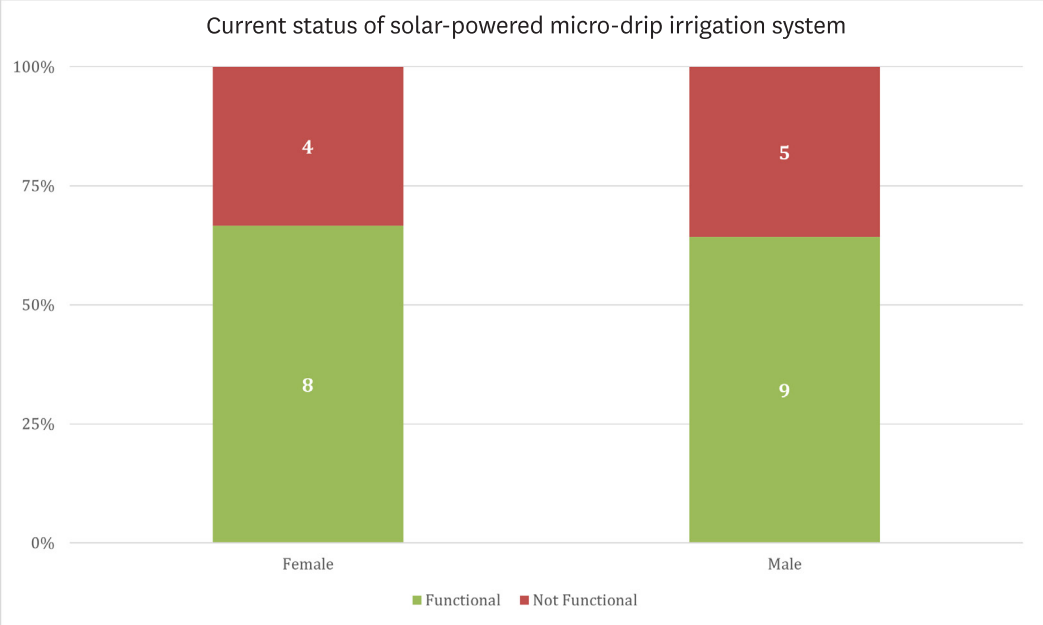

Figure 6. Current status of solar-powered micro-drip irrigation system by gender (*Source*: author's creation based on field survey data)

Type of vegetables produced

The variety of vegetables produced demonstrates diverse crops, with tomatoes being the most common (grown by 17 participants). Other commonly cultivated crops included carrots, onions, radishes, round melon, and sponge gourd (each grown by 5 participants), followed by okra and spinach (4 each), and smaller numbers growing gourd, bitter gourd, and cauliflower. These figures reflect the system's role in enabling year-round vegetable production on small plots, with clear benefits in crop diversity and productivity.

Production and income utilization

The data on production utilization shows that a majority of women (17 out of 26 respondents) primarily use the produce from their home gardens for household consumption, which highlights the role of home gardening in enhancing food security. Only 4 women reported selling their surplus produce in the market, showcasing the limited commercialization of these activities.

When looking at the average income from sales, the earnings from the 4 women who sold produce ranged from PKR 1,000 to PKR 40,000 per year (approximately USD 3 to USD 133)[4], with an average annual income of PKR 12,250 (approximately USD 41). This indicates that while some women manage to generate significant income, the overall scale of market sales is still small. The income from vegetable sales represents an important financial resource for these women, contributing to their economic independence.

The earnings utilization responses show how the income from these sales is used. The majority of women use the income to support their household, with some specifically directing it toward essential family needs, such as children's education and health expenditures. This reflects how women's economic empowerment through agricultural income directly benefits the well-being of the entire household.

[4] Approximate exchange rate – USD 1 = PKR 278 in June 2024

Vegetable purchases and market dependency

The data on vegetable purchases indicates that the majority of women (21 out of 26) still purchase vegetables from the market, while 5 women reported no need to buy vegetables. This suggests that while home gardening contributes to household food security, it is not yet sufficient to fully replace market purchases for many women.

The data reveals that majority of women were able to use vegetables from their home gardens for a considerable portion of the year (see Figure 7). On average, women used home-grown vegetables for approximately 6.6 months over the past year. Notably, 9 out of 26 women reported utilizing their home-grown vegetables during a complete year, while a smaller group (3 women) used them for 8 months. Usage varied among the rest, with some using them for shorter durations, ranging from one to six months. In these remote villages, access to fresh vegetables is limited, those available locally are often expensive and not fresh, while city markets require time and travel. For these households, home gardens provided a reliable source of fresh, nutritious vegetables at low cost. While usage varied across households, even partial-year access significantly improved dietary diversity and household nutrition, highlighting the potential for year-round food self-sufficiency if home gardens are supported and scaled further.

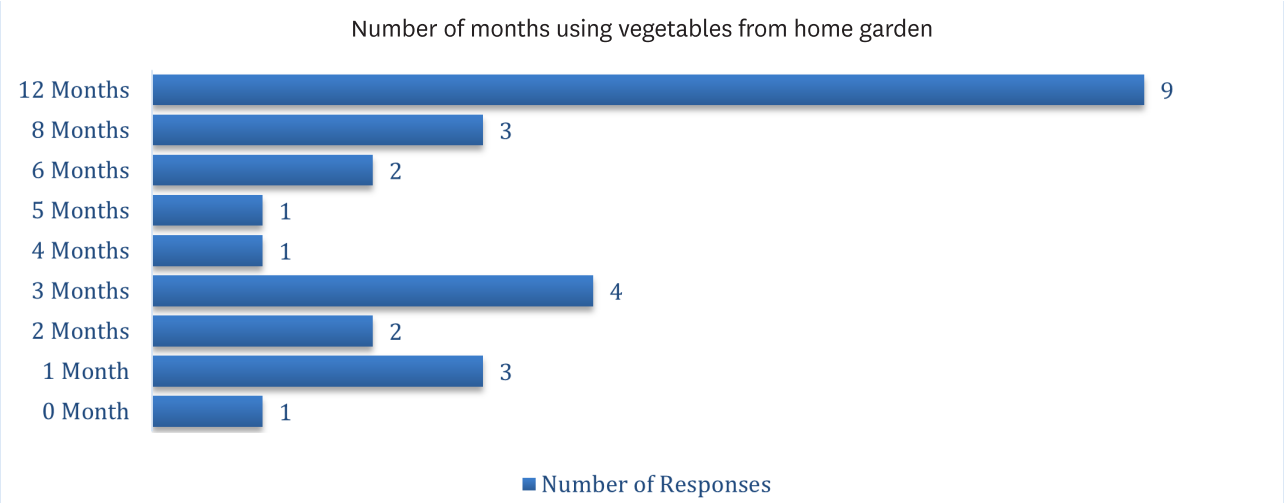

Figure 7. Duration of vegetables consumption from home garden production in months (*Source*: authors' creation based on field survey data)

All participating women reported that the micro-drip irrigation system was beneficial. A majority highlighted reduced water usage and labor savings as the most significant advantages, while many also noted improved yields.

These findings underscore the role of smart irrigation technology, not only in increasing agricultural output but also in easing women's physical workload and improving water-use efficiency—critical needs in water-scarce regions like Tank and D.I. Khan.

Perceived benefits of technology

All participants unanimously agreed that the introduced agricultural technology was beneficial for them. When asked to elaborate on how it had helped, the majority highlighted its contribution to reducing water requirements, with 23 out of 26 women identifying this as a key benefit. Additionally, 17 women also reported a reduction in labor workload, making farming more manageable and less physically demanding. There were 10 participants who observed an increase in yield, indicating enhanced productivity, and 3 participants also mentioned a positive impact on their income. These responses demonstrate that the technology not only addressed resource efficiency and labor concerns but also supported improvements in production and financial outcomes for the women involved.

Willingness to continue and future support needs

When asked about their future, 92% of beneficiaries (24 out of 26) expressed a strong willingness to continue vegetable production in the coming seasons (see Figure 8). This positive response reflects their satisfaction with the benefits experienced during the intervention, particularly improved food access, reduced workload, and, in some cases, income generation.

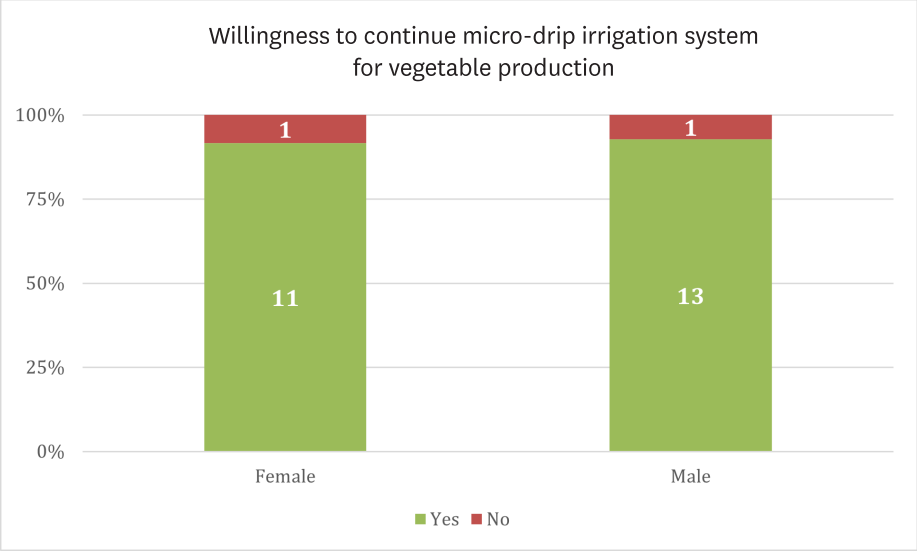

Figure 8. Willingness to continue using micro-drip irrigation system for vegetable production (*Source*: authors' creation based on field survey data)

However, sustaining and scaling this activity will require targeted support. Among those willing to continue, 14 women requested training for operation and maintenance (O&M) of the irrigation systems, indicating a need for continued capacity-building. There were 9 women who emphasized the need for financial assistance to manage recurring costs of system maintenance and inputs. Six women sought market linkages to sell their produce, suggesting an interest in moving toward more commercial production. One woman specifically asked for market linkages to support O&M, recognizing the potential of income from sales to cover system upkeep costs.

These findings highlight the critical importance of embedding sustainability measures—such as follow-up trainings, financial inclusion mechanisms, and improved market access—into the design of future programming. By addressing these needs, development efforts can ensure long-term impact and help rural women transition from subsistence gardening to more resilient and profitable agro-enterprises.

Household dynamics in agricultural decision-making

The graphs present insights into how men and women perceive their involvement in household decision-making across four key agricultural domains: what to grow, what to buy, when to conduct farming activities, and how to market the produce (see Figures 9 and 10).

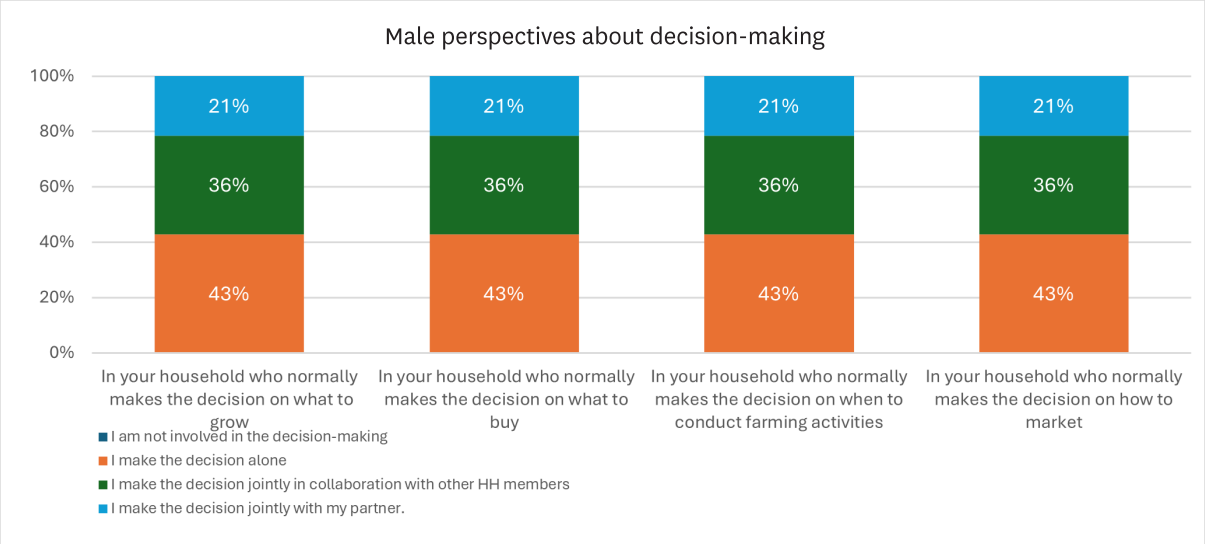

Figure 9. Decision-making around agriculture production - male perspectives (*Source*: authors' creation based on field survey data)

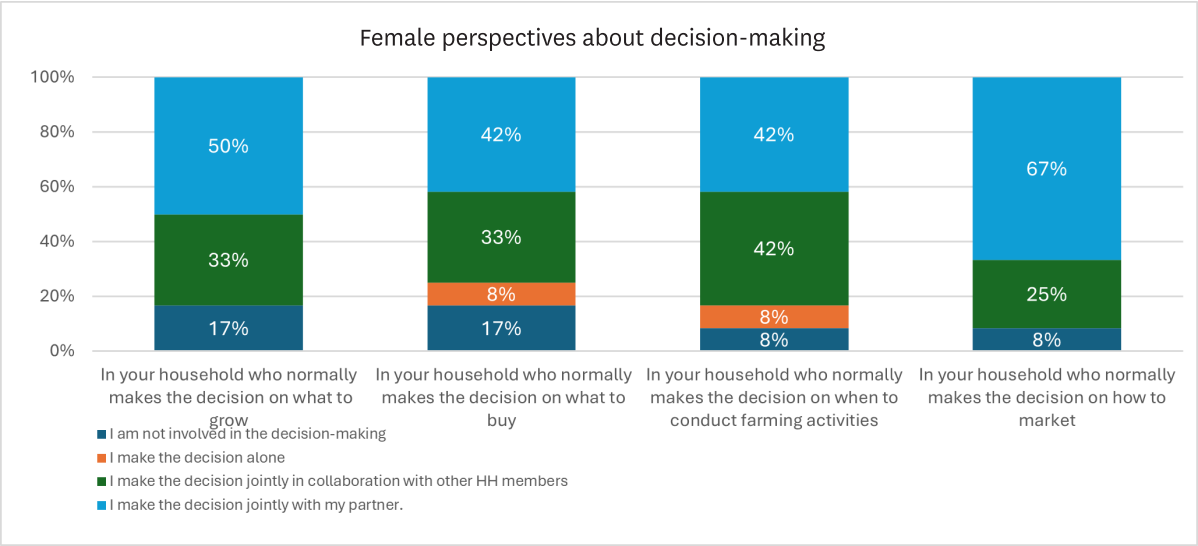

Figure 10. Decision-making around agriculture production - female perspectives (*Source*: authors' creation based on field survey data)

Men report a high level of involvement in decision-making. Across all four areas, 43% of men make decisions independently, while 36% are engaged in joint decision-making with other household members. Interestingly, 21% of men indicated that they are not involved in decision-making in these areas suggesting that even among men, roles can vary within households depending on context and family dynamics.

Women's responses reflect evolving patterns of engagement in household decisions. While a majority still report being less involved, particularly in decisions related to marketing (67%) and crop selection (50%)—there are encouraging signs of collaboration. One-third of women (33–42%) report participating in joint decision-making with other household members in areas like purchasing and farming schedules. A smaller but notable percentage also reported making decisions independently or with their partners. It is important to note, however, that even when joint decision-making is reported, the final word typically rests with the men, reflecting prevailing gender norms and power dynamics within these households. Figure 9 shows male perspectives on agricultural decision-making within households, while Figure 10 illustrates female perspectives.

Gendered perceptions of access and control over agricultural assets

The survey findings provide insights into how men and women perceive their access to and control over key productive assets— agricultural land, income, and farm equipment.

From the male perspective, there is a strong presence of joint ownership and control across all asset categories (see Figure 11). Half of the men surveyed reported that they share access and control of agricultural land with their partners. Additionally, 36% noted they own and control the land themselves, while only a small proportion (7%) indicated exclusive access. A similar pattern is seen in control over income and farm equipment, where 50% of men reported joint control with their partners, and 43% stated they independently own and manage these resources. Exclusive male control was minimal, with only 7% indicating sole access in each category.

The responses from female participants also indicate progress, though certain gaps remain (see Figure 12). In terms of agricultural land, 42% of women stated they do not own the land but have control over its use, which is a promising sign of increasing involvement in agricultural decision-making. One-third of the women (33%) reported having exclusive access to land, while 25% shared access and control with their partners. Regarding control over income, 58% of women reported full ownership and control, with another 25% sharing control jointly with their spouses. This suggests a notable level of financial agency among women. When asked about farm equipment, 67% of women indicated shared control with their spouses, and 33% reported having exclusive access, highlighting a growing recognition of women's role in productive farming activities.

Overall, the data illustrates a gradual yet meaningful shift in household dynamics. Men appear increasingly supportive of joint decision-making, while women are gaining greater autonomy, especially in income and equipment use. While land ownership still reflects a gendered pattern favoring men, women's active participation in managing land demonstrates positive movement toward more equitable resource control. Continued support for gender-inclusive programming will be essential to build on these gains and ensure both men and women can access and control the resources they need to thrive.

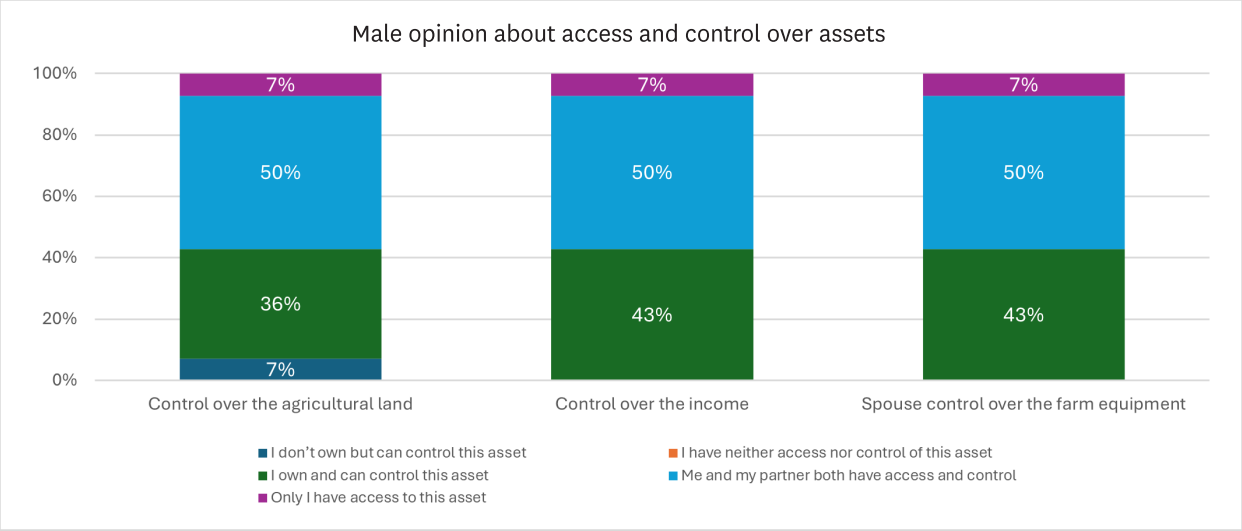

Figure 11. Access and control over assets - male perspectives (*Source*: authors' creation based on field survey data)

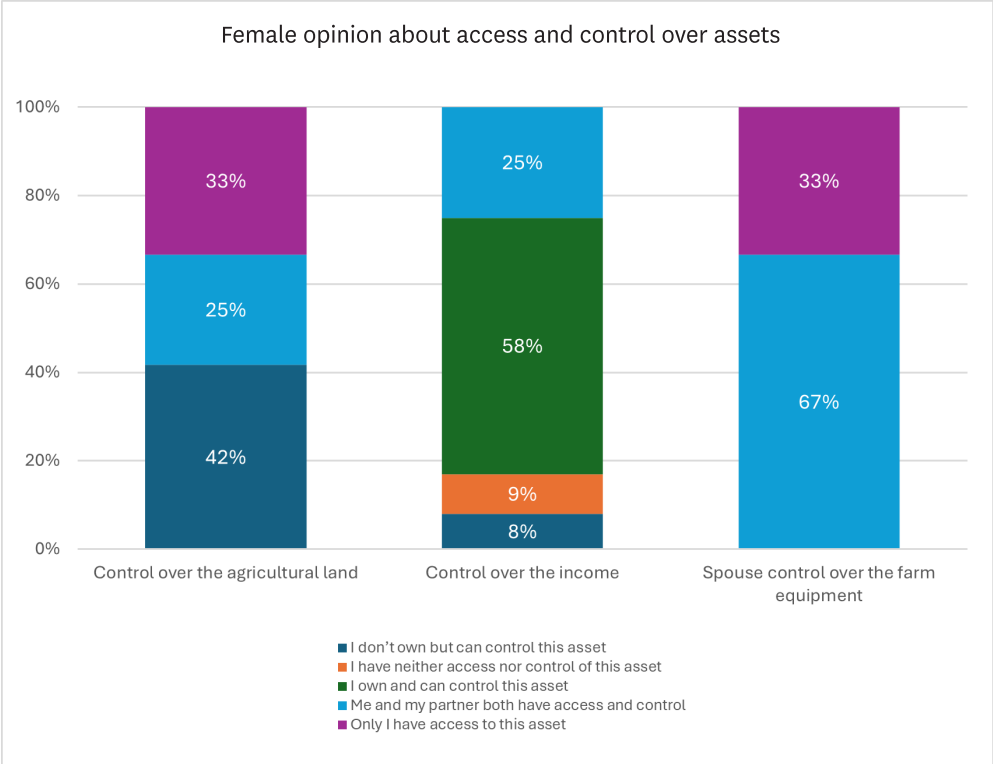

Figure 12. Access and control over assets - female perspectives (*Source:* authors' creation based on field survey data)

Beliefs and perceptions on women's roles in agriculture and technology adoption

The survey explored community beliefs and perceptions related to women's agency in agricultural decision-making, asset ownership, and technology adoption (see Figures 13 and 14).

Among male respondents, a strong majority expressed positive views on women's involvement in key areas of agricultural life. An overwhelming 93% agreed that women should be able to own land, and 86% strongly agreed that they personally have no issues with women adopting new technologies. Similarly, there was a high level of support (79%) for shared decision-making between husbands and wives on the use of savings in production and business, and the same percentage agreed that women should have a say in major production decisions.

Men also recognized women's agency in investment decisions, with 71% agreeing that women should have a say in farm equipment investments. Perceptions around women and technology are becoming more

favorable. For instance, 71% disagreed with the statement that it is difficult for women to adopt new technologies, and 79% rejected the notion that women are disinterested or restricted by men in adopting innovations. These views suggest growing acceptance and support for women's participation in both strategic and technical aspects of agriculture. Figure 13 shows male perspectives on community beliefs and perceptions regarding women's roles in agriculture and technology adoption.

Female respondents similarly expressed progressive views, as illustrated in Figure 14. A combined 83% either strongly agreed or agreed that women should be part of important production decisions, and 92% supported joint decision-making on the use of household savings for agricultural or business purposes. Regarding land ownership, 75% of women endorsed the idea that women should be able to own land, with 25% of responses being more cautious or noncommittal.

On the topic of farm equipment investments, 75% believed women should have a say. When it comes to women making independent decisions in agricultural activities, most women supported this, with only a small fraction expressing reservations. Moreover, 75% of female respondents disagreed with the idea that it is difficult for women to adopt new technologies, and 67% rejected the notion that male family members prevent women from doing so. While there is still some variability in how women view their own capacity or freedom regarding technology adoption, these results show growing confidence and awareness.

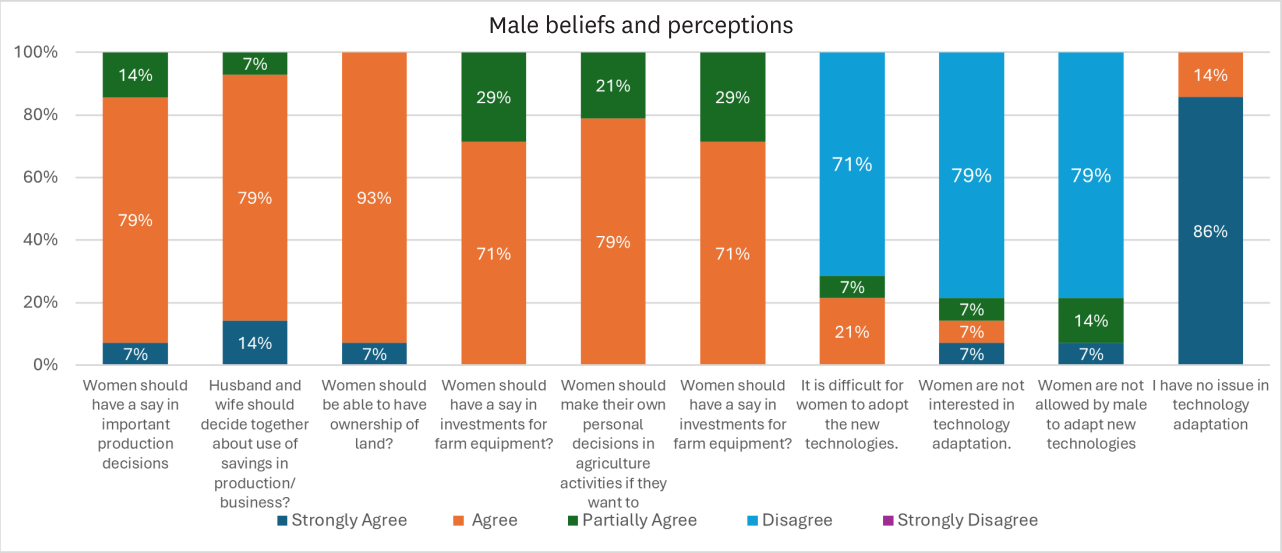

Figure 13. Beliefs and perceptions on women's roles in agriculture and technology adoption – male perspectives. (*Source*: authors' creation based on field survey data)

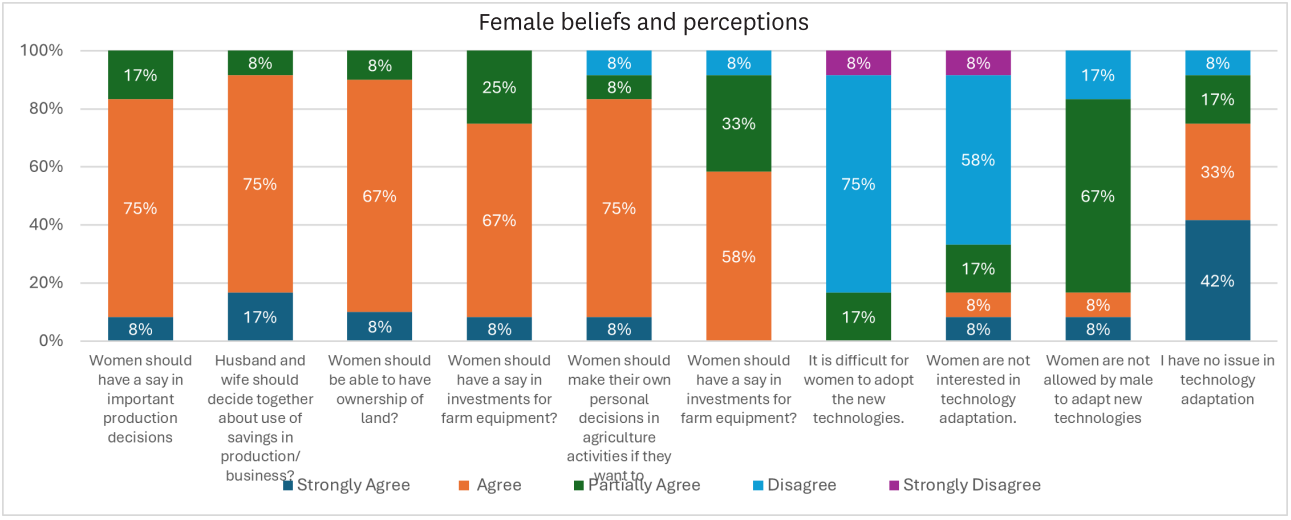

Figure 14. Beliefs and perceptions on women's roles in agriculture and technology adoption- female perspectives (*Source:* authors' creation based on field survey data)

3.3 From the Field: Women's Stories of Empowerment Through Innovation

While the survey findings provided valuable quantitative insights into gender roles, decision-making patterns, and perceptions around technology adoption in agriculture, they only tell part of the story. To capture the deeper, lived realities behind the numbers, qualitative narratives from the field offer powerful illustrations of how targeted interventions are reshaping women's roles in agriculture. The following testimonies and experiences highlight how access to innovations particularly smart irrigation solutions has not only enhanced productivity and food security but also transformed gender norms, empowered women economically, and strengthened their voices within households and communities.

Empowering women farmers with smart irrigation solutions

The introduction of micro-drip irrigation technology to women farmers has proven to be a highly effective intervention, not only improving agricultural productivity but also transforming socio-economic dynamics in rural communities. By successfully managing these systems, women have increased vegetable production from their home gardens, enhancing household food security and creating new economic opportunities.

For instance, Kulsoom Bibi from Ranwal, Tank District, shared how she cultivated garlic, okra, tomatoes, green chilies, and spinach. Not only did she use these vegetables at home, but she also shared them with neighbors and supported a poor household by providing them with daily vegetables. Selling her surplus garlic at the village shop allowed her to save money, which she planned to use for installing a water pipe from the canal near her home, ensuring easier access to water for her garden and livestock.

Similarly, Farzana Bibi from Gara Mohabat, Tank District, noted that for the first time, she did not have to purchase vegetables this season, as her home garden provided enough for her family and even for extended relatives. The money she saved was used to buy schoolbooks for her children, highlighting how this intervention has helped women redirect financial resources toward other household priorities.

Economic gains and household savings

Smart technology interventions are directly contributing to women's economic empowerment. During follow-up visits, many beneficiaries reported that their home gardens now produce enough vegetables, eliminating the need to buy from the market during the summer months. This availability of fresh and nutritious produce ensures improved food security and better nutrition for their families.

Some women have also taken the initiative to sell surplus vegetables in local village shops, generating their own income. This financial independence allows them to make decisions about spending, contributing to household expenses such as education, healthcare, and infrastructure improvements.

The impact of micro-drip irrigation extends beyond women farmers. For instance, a young farmer, inspired by the benefits of the technology, expanded its use to a 2-kanal[5] area and successfully cultivated vegetables. His summer harvest generated an income of PKR 40,000 (approximately USD 143), demonstrating the potential for scaling up such interventions for both women and youth.

Transforming gender norms and breaking social barriers

Beyond economic benefits, these interventions are gradually shifting deeply entrenched gender norms. Women, who were traditionally restricted from handling technology and participating in public life, are now recognized as capable farmers. They have gained confidence and self-esteem, with many speaking at public forums; an unprecedented step in a society where women's voices are often marginalized.

Sania, a young participant in the vegetable production training, shared how her participation built trust within her family, particularly with her father. Initially restricted from traveling beyond her village, she is now allowed to attend training sessions outside the city, marking a significant shift in mobility and decision-making autonomy.

Furthermore, men in their families and communities have started acknowledging and supporting women's roles in agriculture. Some men have even begun accompanying their wives and daughters to training sessions, helping to break the norm of restricting women's mobility.

Improved nutrition and quality of life

Before this intervention, women in remote areas had limited access to fresh vegetables. Many relied on purchasing old and sometimes rotten vegetables from local village shops due to the long distance to the

[5] 1 kanal = 505.86 m²

nearest market. This was both an inconvenience and a health risk.

Now, with home gardens thriving, families have access to fresh and diverse vegetables, including tomatoes, onions, garlic, carrots, bottle gourd, radishes, cauliflower, green chilies, spinach, and okra. The improved dietary diversity ensures better nutrition for households, contributing to overall well-being.

> *"Before, we used to rely on rotten vegetables from the shop. Now, we have fresh produce right at home, which has improved our diet and saved us money."* — Beneficiary from Jamal Awan

Regular follow-up visits by the WMfEP field team provided technical support and addressed concerns regarding the use of irrigation technology. Initially, some women doubted the efficiency of the micro-drip irrigation system, as they were accustomed to seeing their fields flooded with water. However, they took the risk and were encouraged by the results. With less water, fertilizers, and labor, they achieved higher yields.

> *"Water scarcity is a major issue, but I am amazed at how just a few drops have made my farm so green and productive. We no longer need to buy vegetables from the market."* — Mir Janay from Nadar Badar, D.I. Khan District,

> *"For three months, I haven't spent a single rupee on vegetables. We even share extra produce with our neighbors. Now, we plan to sell the surplus and use the earnings to buy school uniforms for our children."* — Kulsoom Bibi from Ranwal, Tank District

A path toward gender-transformative change

The introduction of solar-powered micro-drip irrigation technology to women—an initiative that challenged traditional norms—was a calculated risk. Would women be interested? Would they be able to manage the technology? Would there be social backlash? Despite these concerns, the intervention succeeded. Women not only adopted and managed the technology but also gained financial independence by selling their produce, used their earnings to meet essential household needs such as education and water infrastructure, and broke social barriers by stepping into roles traditionally reserved for men.

These small yet significant steps demonstrates that gender-responsive interventions in water and agriculture can serve as catalysts for broader societal transformation. They create opportunities for women to participate in agricultural innovation, challenge restrictive gender norms, and pave the way for a more inclusive, gender-equal future.

By equipping rural women with smart technologies and agricultural training, this initiative is not just about increasing production, it is about reshaping gender dynamics, fostering economic resilience, and empowering women to lead change in their communities.

Conclusion and Way Forward

This report has documented the process, progress, and outcomes of gender-responsive interventions implemented under the WMfEP project with a specific focus on women and youth in D.I. Khan and Tank districts. Drawing on both quantitative impact survey data and qualitative insights from field experiences, the findings demonstrate that targeted support—when rooted in local realities and inclusive engagement—can bring about meaningful change in rural agricultural systems.

By integrating climate-smart technologies such as micro-drip irrigation and providing capacity-building training, the project enabled women to increase agricultural productivity, reduce household expenditures, and generate income through surplus production. These innovations did more than improve yields; they reshaped household roles, opened pathways for decision-making, and challenged entrenched social norms that previously limited women's and youth's participation in agriculture and community leadership.

The empowerment outcomes go beyond economic gains. Women reported greater mobility, confidence in public speaking, and increased recognition within their families and communities. Youth also demonstrated leadership by adopting new practices and exploring entrepreneurship in farming. The interventions promoted equitable access to resources, improved food and nutrition security, and enhanced climate resilience at the household and community level.

However, while these shifts are promising, the journey toward gender-transformative and youth-inclusive agricultural development is ongoing.

Three key challenges remain:
Sustainability beyond the project period: Continued adoption of climate-smart technologies requires reliable access to inputs, after-sales technical support, and linkages to markets and financial institutions.

Long-term gender norm transformation: While women's participation and confidence have increased, changing deep-rooted social norms and power dynamics requires sustained community-level engagement, especially with men and decision-makers.

Institutional and system-level barriers: Structural constraints including limited extension outreach to women, restrictive mobility norms, and uneven policy implementation can hinder women and youth from fully leveraging opportunities created by the project.

Looking ahead, efforts must focus on strengthening community-based support systems, fostering women- and youth-led producer groups, and building institutional mechanisms that ensure continued advisory services, financial access, and policy-level backing. Embedding gender-intentional design and monitoring frameworks in agricultural programs will be essential to track progress and address barriers as they emerge.

In conclusion, the WMfEP activity reaffirms that when interventions are co-designed with women and youth in mind, they do more than improve productivity; they build agency, resilience, and pathways toward equitable rural development. Capitalizing on this momentum through sustained partnerships, market linkages, and institutional support will be critical to nurturing lasting empowerment and climate-resilient farming communities.

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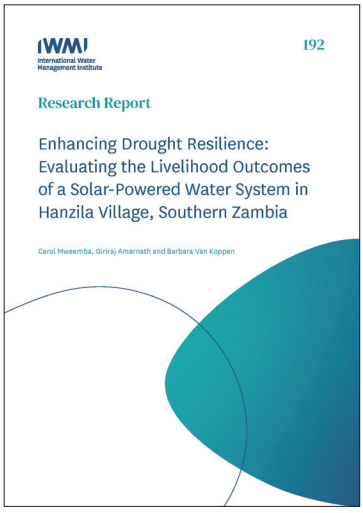

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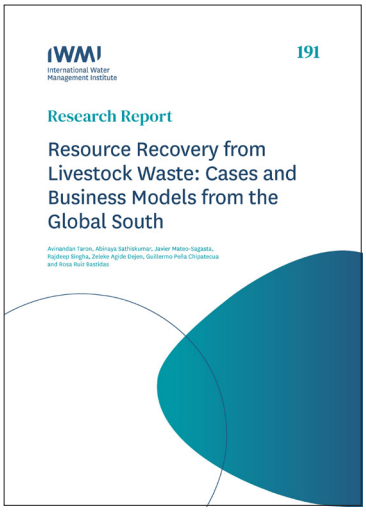

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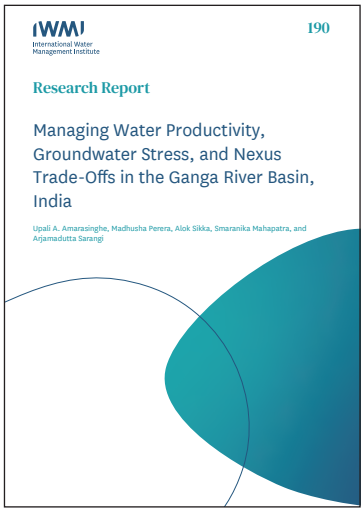

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