OPEN ACCESS

Kashf Journal of Multidisciplinary Research
Vol: 03 - Issue 05 (2026)
P-ISSN: 3007-1992 E-ISSN: 3007-200X
https://kjmr.com.pk

IMPACT OF MOTT GRASS ON LIVESTOCK NUTRITION, FARM ECONOMICS AND HOUSEHOLD RESILIENCE IN DISTRICT KHYBER, PAKISTAN

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DOI:(*https://doi.org/10.71146/kjmr939*)

Article Info

Abstract

Livestock production in Pakistan is constrained by chronic fodder shortages, poor quality feed resources and rising feeding costs, especially in smallholder mixed farming systems. To address these challenges, a community-based intervention introducing Mott grass (Napier hybrid) was implemented in District Khyber, Khyber Pakhtunkhwa. The study aimed to evaluate the impact of Mott grass cultivation on fodder availability, livestock productivity, economic returns and household resilience. A quantitative method was adopted involving structured questionnaires and field observations with 50 beneficiary households selected through Community Based Organizations. Results indicated a high establishment success rate, with 92% of farmers successfully cultivating Mott grass and 88% fully adopting it within their livestock systems. Post intervention findings showed a substantial improvement in fodder availability, with 86% of farmers reporting adequate supply compared to 22% before the intervention. Improvements were also observed in livestock performance, as 82% of farmers reported better body condition and 76% observed increased milk yield. Economic analysis revealed a significant reduction in feeding costs, with 68% of farmers reporting decreased expenditures and 66% showing reduced dependency on purchased feed. Furthermore, 78% of respondents reported improved farm profitability. Farmer perceptions were overwhelmingly positive, with 72% expressing high satisfaction and 92% recommending future scale up of the intervention. Moreover, 84% of households reported improved resilience during fodder scarce periods. The study demonstrates that Mott grass is a highly effective perennial fodder option for improving livestock nutrition and reducing economic stress in smallholder systems. The findings conclude that integrating Mott grass into livestock production systems can significantly enhance fodder security, improve productivity and strengthen household resilience under resource limited and climate vulnerable conditions in Pakistan.

Keywords: *Adoption, Fodder security, Household resilience, Livestock productivity, Mott grass, Napier hybrid.*

Introduction

Livestock plays a fundamental role in the agricultural economy of Pakistan and serves as an important source of income, food security and livelihood support for rural communities. The livestock sector contributes substantially to the national agricultural gross domestic product and supports millions of smallholder farmers through the provision of milk, meat, draft power and employment opportunities. In many rural household's livestock functions as a financial asset and a coping mechanism during periods of economic instability and crop failure. Despite its importance livestock productivity in Pakistan remains considerably below its potential due to inadequate feeding practices, poor quality fodder resources and weak management systems (Afzal and Naqvi, 2004). Among the various production constraints shortage of nutritious green fodder is considered one of the major factors limiting animal productivity, particularly in smallholder farming systems where livestock largely depend on seasonal fodder availability and crop residues (Sarwar et al., 2002).

Seasonal fodder scarcity has become a serious challenge in many agro ecological regions of Pakistan, especially in arid and semi-arid zones where climatic variability and limited irrigation resources restrict year-round fodder production. During lean periods, farmers often rely on low quality roughages and expensive commercial feed supplements that fail to meet the nutritional requirements of livestock. Poor nutrition ultimately results in lower milk yield, weak body condition, reduced reproductive performance and increased susceptibility to diseases (Iqbal et al., 2009). Rising feed prices further aggravate the economic burden on smallholder farmers, reducing profitability and threatening the sustainability of livestock-based livelihoods. In regions such as District Khyber, fodder shortages are intensified by land fragmentation, erratic rainfall patterns and limited access to improved fodder technologies. These challenges highlight the urgent need for sustainable fodder production strategies capable of improving livestock nutrition while enhancing resilience to climate related stresses.

Perennial fodder crops such as Mott grass or Napier hybrid grass have emerged as promising alternatives for addressing fodder insecurity in smallholder farming systems. Mott grass is a high yielding perennial fodder known for its rapid growth, repeated harvesting ability, high biomass production and adaptability to diverse environmental conditions. The crop provides a continuous supply of green fodder throughout much of the year and possesses good nutritional quality, making it highly suitable for dairy and meat producing animals (Jalal et al., 2012). In addition, perennial fodder systems contribute to improved soil conservation, efficient land utilization and reduced dependency on external feed markets. Previous studies have reported that Napier grass-based fodder systems can significantly improve livestock productivity and reduce feeding costs while strengthening household resilience under changing climatic conditions (Habte et al., 2020). Due to these advantages, the promotion of Mott grass cultivation among smallholder livestock farmers has gained increasing attention as a climate smart agricultural intervention.

Although several studies have documented the agronomic and nutritional benefits of perennial fodder crops, limited research has focused on the integrated evaluation of field level adoption, livestock performance and socio-economic impacts of Mott grass interventions in vulnerable rural communities. Most previous studies primarily emphasized biomass production and fodder quality, while farmer perceptions, adoption behavior,

economic benefits and resilience outcomes received comparatively less attention. Therefore, there is a need for comprehensive studies that combine agronomic observations with socio economic assessments to better understand the effectiveness of fodder-based interventions under real farming conditions. In this context, the present study was conducted under the PAK 1136 project, "Building Resilience Through Improved Nutrition in Sub Urban Food Systems in KP," to evaluate the impact of Mott grass fodder intervention on fodder availability, livestock nutrition, feeding costs and household resilience among smallholder farmers in District Khyber.

2. Materials and Methods

2.1 Study Area

The study was conducted in selected tehsil Bara of District Khyber, Khyber Pakhtunkhwa (KP), Pakistan under the PAK 1136 project titled "Building Resilience Through Improved Nutrition in Sub Urban Food Systems in KP." The approximate location of area is 33° 55′ N latitude, 71° 27′ longitude (Figure 1) that is characterized by semiarid climatic conditions and seasonal shortages of green fodder which adversely affect livestock productivity and household livelihoods.

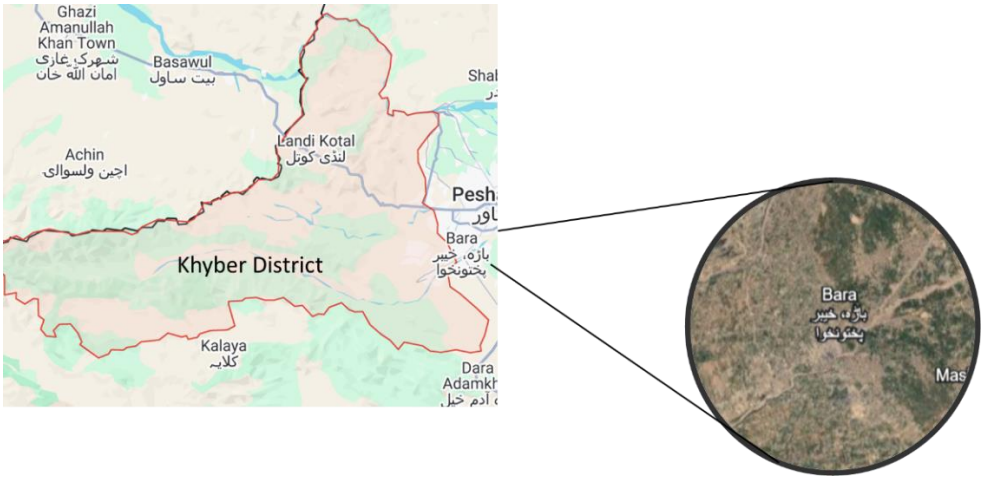

Figure 1. Map of Tehsil Bara in Khyber District Khyber Pakhtunkhwa (Google Earth).

2.2 Study Design

The intervention was implemented using a community based participatory approach aimed at promoting Mott grass cultivation to improve livestock nutrition and farm resilience. A quantitative approach was adopted in which data were collected through questionnaire surveys and field observations to evaluate the impact of the intervention at household level.

2.3 Sample Size and Beneficiary Selection

A total of 50 livestock owning households were selected as beneficiaries of the intervention through Community Based Organizations (CBOs) and Village Committees (VCs). Selection criteria included livestock ownership, household vulnerability, land availability for fodder cultivation and willingness to adopt improved fodder management practices.

2.4 Intervention Package

Each beneficiary received certified Mott grass cuttings, DAP fertilizer and basic agricultural tools including spades, sickles, hand hoes and diggers to support fodder establishment and management as shown in Figure 2.

Figure 2. Distribution of Mott grass cuttings, DAP fertilizer and basic agricultural tools with 50 farmers in Bara Tehsil.

2.5 Training and Extension Services

Training sessions were organized before input distribution to improve farmer awareness regarding Mott grass plantation, irrigation, fertilizer application, fodder management and utilization practices. Farmers were also informed about the Feedback and Complaint Response Mechanism (FCRM). Continuous technical support was provided through agriculture extension department staff and field visits during the implementation period.

2.6 Data Collection Methods

2.6.1 Questionnaire Survey

A structured questionnaire was used to collect information regarding household fodder availability, livestock productivity, feeding costs, adoption level and farmer satisfaction related to Mott grass cultivation.

2.6.2 Field Observation

Field visits were conducted to assess Mott grass establishment, plant survival, growth performance and management practices under field conditions.

2.7 Variables and Indicators

The study evaluated fodder availability, livestock productivity, feeding cost reduction, adoption level, plant survival and farmer satisfaction regarding Mott grass cultivation.

2.8 Data Analysis

Quantitative data were analyzed using SPSS (version 2015) via descriptive statistics and percentage comparisons.

3. Results and Discussion

3.1 Socio Economic characteristics of beneficiary farmers

The socio-economic profile of the surveyed farmers shows that the majority of respondents (62%) were in the 30-50 years age group, followed by 20% above 50 years and 18% below 30 years (Table 1). Regarding education level, a considerable proportion of farmers were illiterate (48%), while 32% had primary education and only 20% had attained middle level or above. In terms of household structure, most respondents (56%) reported a family size of 7-10 members, followed by 24% having six or fewer members and 20% having more than 10 members. Landholding size was predominantly small, with 54% of farmers owning up to 2 acres, 30% owning 2.1-4 acres and only 16% possessing more than 4 acres.

Livestock ownership data revealed that 46% of farmers kept 6-10 animals, 40% had up to 5 animals and only 14% owned more than 10 animals, showing moderate scale livestock rearing practices. Farming experience was relatively high, with 44% of respondents having 11–20 years of experience, 34% having more than 20 years and 22% having up to 10 years of experience. Finally, the main livelihood source was predominantly crop and livestock mixed farming (44%), followed by livestock only households (38%), while 18% depended on labor or other income sources.

The socio-economic profile of the surveyed farmers reflects a demographic and livelihood structure characteristic of smallholder agricultural systems in developing regions marked by an aging yet experienced workforce, limited formal education and a strong reliance on integrated crop livestock enterprises. The concentration of middle aged and older farmers with extensive field experience aligns with global agricultural demographic shifts, where accumulated traditional knowledge coexists with potential hesitancy toward rapid technological change (FAO, 2014; World Bank, 2021). Coupled with high illiteracy rates, this pattern underscores the necessity for extension approaches that prioritize participatory, visual and field demonstration methodologies over text dependent dissemination, as formal education consistently mediates

farmers' capacity to access, interpret and apply modern agronomic information (Wossen et al., 2017). Furthermore, the predominance of small landholdings alongside moderate livestock ownership and mixed farming livelihoods highlights the strategic role of integrated systems in risk diversification, nutrient cycling and income stabilization—practices widely documented as essential resilience mechanisms for resource constrained households facing climatic and market volatility (Hazell et al., 2010; Thornton & Herrero, 2015).

Table 1. Socio economic characteristics of beneficiary livestock farmers in District Khyber (n = 50).

Variables	Category	Frequency (%)
Age of respondents	< 30 years	9 (18)
	30–50 years	31 (62)
	> 50 years	10 (20)
Education level	Illiterate	24 (48)
	Primary	16 (32)
	≥ Middle	10 (20)
Family size	≤ 6 members	12 (24)
	7–10 members	28 (56)
	> 10 members	10 (20)
Landholding size	≤ 2 acres	27 (54)
	2.1–4 acres	15 (30)
	> 4 acres	8 (16)
Livestock ownership	≤ 5 animals	20 (40)
	6–10 animals	23 (46)
	> 10 animals	7 (14)
Farming experience	≤ 10 years	11 (22)
	11–20 years	22 (44)
	> 20 years	17 (34)
Main livelihood source	Livestock only	19 (38)
	Crop + livestock	22 (44)
	Labor/other	9 (18)

3.2 Establishment and adoption of mott grass intervention

The establishment and adoption of Mott grass among beneficiary households remained highly successful under field conditions. Out of 50 farmers, 46 farmers (92%) successfully established Mott grass plots, while only 4 farmers (8%) experienced partial establishment failure. Plant survival was generally high, with 42 farmers (84%) reporting survival rates above 85%, whereas 6 farmers (12%) recorded survival between 70–85%and only 2 farmers (4%) reported survival below 70%.

Regarding irrigation management, weekly irrigation was practiced by 28 farmers (56%), followed by bi weekly irrigation by 17 farmers (34%), while only 5 farmers (10%) reported irregular irrigation practices. Similarly, the majority of respondents, 30 farmers (60%), harvested Mott grass after every 30–40 days, whereas 15 farmers (30%) followed a cutting interval of 40–60 days and only 5 farmers (10%) harvested after more than 60 days.

The adoption level of the intervention was also encouraging, as 44 farmers (88%) fully adopted Mott grass cultivation within their livestock feeding systems, while 6 farmers (12%) partially adopted the technology. Farmer interest in future expansion remained very high, with 45 respondents (90%) expressing willingness to expand Mott grass cultivation in the future. In addition, training participation was recorded among 48 farmers (96%), while only 2 farmers (4%) did not attend training activities.

The high establishment success and strong adoption behavior observed in this study reflect the suitability of Napier hybrid (Mott grass) under smallholder farming systems in semi-arid environments. The strong plant survival and successful field establishment are consistent with findings that perennial tropical grasses exhibit high adaptability and resilience when provided with minimal agronomic inputs and proper initial establishment support (Khan et al., 2019; Anwar et al., 2021). The relatively high adoption rate and farmer willingness for expansion indicate that once farmers observe visible benefits such as rapid biomass regeneration and continuous fodder supply, the likelihood of sustained adoption increases significantly, supporting the diffusion of innovation theory which emphasizes observable relative advantage as a key driver of adoption (Rogers, 2003).

Similar results were reported by Hassan et al. (2020), who found that improved fodder technologies in Pakistan achieved high farmer acceptance when linked with extension services and practical training. The strong irrigation and cutting management practices observed among beneficiaries further highlight that farmers were able to integrate Mott grass into existing livestock systems with minimal disruption, which aligns with earlier studies showing that Napier grass performs well under flexible management regimes in resource limited settings (Methu et al., 2013). Moreover, the high training participation rate underscores the importance of extension led interventions in enhancing farmer knowledge, confidence and technology uptake, as documented in integrated livestock fodder programs across South Asia (Iqbal et al., 2018).

Table 2. Establishment, management and adoption status of Mott grass among beneficiary households (n = 50)

Variable	Category	Frequency (%)
Mott grass establishment success	Successful establishment	46 (92)
	Partial failure	4 (8)
Plant survival rate	> 85% survival	42 (84)
	70–85% survival	6 (12)
	< 70% survival	2 (4)
Irrigation frequency	Weekly irrigation	28 (56)

	Bi weekly irrigation	17 (34)
	Irregular irrigation	5 (10)
Cutting frequency	Every 30–40 days	30 (60)
	40–60 days	15 (30)
	> 60 days	5 (10)
Adoption rate	Full adoption	44 (88)
	Partial adoption	6 (12)
Farmer willingness for expansion	Yes	45 (90)
	No/uncertain	5 (10)
Training participation	Attended training	48 (96)
	Not attended	2 (4)

3.3 Impact of mott grass on fodder availability and livestock productivity

The effect of Mott grass intervention on fodder availability and livestock productivity showed a clear improvement after implementation. Before the intervention, only 11 farmers (22%) reported adequate household fodder availability, while 39 farmers (78%) indicated that fodder supply was inadequate. After the introduction of Mott grass, the situation improved significantly, as 43 farmers (86%) reported adequate fodder availability, whereas only 7 farmers (14%) still faced inadequacy.

A marked reduction in seasonal fodder shortage was also observed, with 37 farmers (74%) reporting a significant reduction, 10 farmers (20%) reporting a moderate reduction and only 3 farmers (6%) indicating no noticeable change. Improvements in livestock body condition were reported by 41 farmers (82%), while 9 farmers (18%) observed no change. Similarly, 38 farmers (76%) reported an increase in milk yield, whereas 12 farmers (24%) observed no change.

Animal health also improved, as reported by 40 farmers (80%), while 10 farmers (20%) noted no noticeable improvement. In terms of feeding practices, 35 farmers (70%) were able to provide green fodder daily, 11 farmers (22%) fed it 3 4 times per week and only 4 farmers (8%) reported occasional feeding.

The substantial shift from inadequate to adequate fodder availability reflects the ability of Napier hybrid grass to provide continuous biomass production throughout the year, thereby stabilizing feed supply during lean periods. Similar improvements in fodder security under perennial forage interventions have been reported in semi-arid regions where feed shortages are a major constraint to livestock productivity (Devendra & Thomas, 2002; Ayele et al., 2012). The reduction in seasonal fodder scarcity observed among the majority of farmers is particularly important because seasonal feed gaps are widely recognized as a primary driver of low milk productivity and poor animal condition in South Asian mixed farming systems (FAO, 2019). The positive changes in livestock body condition and milk yield reported by farmers align with previous studies showing that increased availability of green fodder improves digestibility, nutrient intake and overall

productive performance of ruminants (Cook et al., 2005). Improved animal health further reflects better nutritional balance and reduced reliance on low quality crop residues, which are typically deficient in crude protein and digestible energy.

Table 3. Effect of Mott grass intervention on fodder availability and livestock productivity (n = 50)

Variables	Category	Frequency (%)
Household fodder availability before intervention	Adequate	11 (22)
	Inadequate	39 (78)
Household fodder availability after intervention	Adequate	43 (86)
	Inadequate	7 (14)
Reduction in seasonal fodder shortage	Significant reduction	37 (74)
	Moderate reduction	10 (20)
	No noticeable reduction	3 (6)
Improvement in livestock body condition	Improved	41 (82)
	No change	9 (18)
Change in milk yield	Increased	38 (76)
	No change	12 (24)
Improvement in animal health	Improved	40 (80)
	No noticeable change	10 (20)
Feeding frequency of green fodder	Daily	35 (70)
	3–4 times per week	11 (22)
	Occasionally	4 (8)

3.4 Economic Benefits of the Intervention

The economic impact of Mott grass cultivation on livestock feeding costs indicated a clear reduction in overall feed expenditure among beneficiary households. Before the intervention, 36 farmers (72%) reported high feed costs, 11 farmers (22%) reported moderate costs and only 3 farmers (6%) experienced low feed costs.

After the introduction of Mott grass, a considerable reduction in feeding costs was observed. A total of 34 farmers (68%) reported a significant reduction in feed costs, 12 farmers (24%) reported a moderate reduction, while only 4 farmers (8%) observed no noticeable reduction. Similarly, dependence on purchased feed decreased substantially, with 33 farmers (66%) reporting high reduction, 13 farmers (26%) reporting moderate reduction and 4 farmers (8%) reporting no reduction.

Regarding economic perception, 42 farmers (84%) reported clear financial savings due to reduced feed purchases, 6 farmers (12%) observed slight savings and only 2 farmers (4%) reported no economic benefit. Overall, 39 farmers (78%) indicated an improvement in farm profitability following the intervention, while 11 farmers (22%) reported no significant change.

The observed reduction in livestock feeding costs and decreased dependence on purchased feed following Mott grass cultivation is strongly supported by livestock fodder studies conducted in Pakistan, where feed expenses constitute one of the highest variable costs in smallholder livestock systems. The shift from market-based feed to home grown perennial fodder reflects a well-documented pattern in Pakistani mixed farming systems, where fodder scarcity and high commercial feed prices directly constrain profitability. Studies from Ayub Agricultural Research Institute (AARI), Faisalabad have emphasized that Napier based fodder systems significantly reduce dependency on expensive concentrates and crop residues while ensuring continuous biomass availability for livestock feeding, thereby improving farm level economic efficiency (Shakil et al., 2023; AARI Fodder Reports, 2022). Similarly, research conducted in Punjab agro ecological zones has shown that improved fodder grasses such as Mott grass enhance milk production efficiency while lowering feeding costs through substitution of purchased feed with on farm green fodder resources (Harun et al., 2017; Chaudhry et al., 2022). The increased farmer perception of economic savings aligns with findings from Pakistan Agricultural Research Council (PARC) and provincial livestock departments, which report that adoption of improved fodder technologies can reduce feed expenditures substantially while increasing net returns in dairy based systems (PARC Livestock Strategy Reports, 2021). Moreover, similar interventions in rainfed and semi-arid regions of Pakistan have demonstrated that Napier grass cultivation improves farm profitability by stabilizing feed supply and reducing seasonal reliance on costly market fodder, particularly during winter fodder gaps (Umair et al., 2022).

Table 4. Economic impact of Mott grass cultivation on livestock feeding costs (n = 50)

Variable	**Category**	**Frequency (%)**
Feed cost before intervention	High	36 (72)
	Moderate	11 (22)
	Low	3 (6)
Feed cost after intervention	Reduced significantly	34 (68)
	Reduced moderately	12 (24)
	No noticeable reduction	4 (8)
Reduction in purchased feed dependency	High reduction	33 (66)
	Moderate reduction	13 (26)
	No reduction	4 (8)
Farmer perception regarding economic savings	Positive savings observed	42 (84)
	Slight savings observed	6 (12)

	No savings observed	2 (4)
Overall improvement in farm profitability	Improved	39 (78)
	No noticeable change	11 (22)

3.5 Farmer Perceptions and Overall Impact on Farm Resilience

The farmer perception regarding the Mott grass intervention was highly positive, reflecting strong acceptance and perceived benefits among beneficiary households. Most farmers reported high satisfaction with the intervention, with 36 respondents (72%) expressing high satisfaction, 11 respondents (22%) reporting satisfaction and only 3 respondents (6%) remaining neutral. The perceived benefits were widely acknowledged, as 44 farmers (88%) reported improved fodder availability, 39 farmers (78%) indicated reduced feed costs and 37 farmers (74%) observed improved livestock health.

Regarding ease of cultivation, 41 farmers (82%) considered Mott grass easy to grow, while 7 farmers (14%) reported moderate difficulty and only 2 farmers (4%) found it difficult to manage. A large majority, 43 farmers (86%), showed willingness to share planting material with other farmers, whereas 7 farmers (14%) were not willing to do so.

In terms of resilience, 42 farmers (84%) reported improved household resilience during fodder scarcity periods, while 8 farmers (16%) observed no noticeable improvement. Furthermore, 46 farmers (92%) recommended the future scale up of the intervention, while only 4 farmers (8%) did not support further expansion. The major challenges identified included water shortage reported by 15 farmers (30%), limited land availability reported by 11 farmers (22%), while 24 farmers (48%) reported no major challenges.

The overwhelmingly positive farmer perceptions regarding Mott grass cultivation indicate strong social acceptance and successful embedding of the intervention within local livestock systems. High satisfaction levels reflect that farmers directly associated the intervention with tangible improvements in fodder availability, feed cost reduction and livestock health, which are key decision-making factors in technology adoption in smallholder agriculture. Similar patterns have been reported in fodder development programs in Pakistan, where farmer satisfaction is strongly linked to visible and rapid benefits in livestock performance and reduced dependency on purchased feed resources (PARC, 2021; Ashraf et al., 2020). The strong perception of improved fodder availability and animal health suggests that farmers were able to observe immediate functional benefits, reinforcing long term adoption behavior.

The ease of cultivation reported by the majority of farmers further strengthens the sustainability potential of Mott grass in resource limited environments. Low management complexity is a critical factor in adoption of perennial fodder technologies, particularly among smallholders with limited access to extension services and inputs. Studies conducted in Punjab and Khyber Pakhtunkhwa have similarly shown that Napier based fodder systems are preferred by farmers due to their minimal input requirements, rapid regrowth after cutting and adaptability to local conditions (Iqbal et al., 2019; Hussain et al., 2022). The willingness of farmers to

share planting material reflects strong community level diffusion, which is an important indicator of endogenous scaling beyond project boundaries and aligns with diffusion of innovation principles in agricultural extension systems (Rogers, 2003).

The improvement in perceived household resilience during fodder scarcity periods highlights the role of Mott grass as a climate adaptive intervention. In semi-arid regions of Pakistan, fodder scarcity during winter and dry spells is a persistent constraint that reduces livestock productivity and increases vulnerability of rural households. Similar findings from livestock development initiatives in Pakistan have shown that perennial fodder systems enhance resilience by stabilizing feed supply and reducing seasonal shocks in animal nutrition (Chaudhry et al., 2022; PARC, 2021). The high recommendation rate for scaling up the intervention indicates strong farmer confidence in its long-term benefits and suggests institutional readiness for broader dissemination.

Table 5. Farmer perceptions and overall impact of Mott grass intervention on household resilience (n = 50)

Variables	**Category**	**Frequency (%)**
Farmer satisfaction level	Highly satisfied	36 (72)
	Satisfied	11 (22)
	Neutral	3 (6)
Perceived benefits of Mott grass	Improved fodder availability	44 (88)
	Reduced feed cost	39 (78)
	Improved livestock health	37 (74)
Ease of cultivation	Easy	41 (82)
	Moderate difficulty	7 (14)
	Difficult	2 (4)
Willingness to share planting material	Yes	43 (86)
	No	7 (14)
Improvement in resilience during fodder scarcity	Improved	42 (84)
	No noticeable improvement	8 (16)
Recommendation for future scale up	Recommended	46 (92)
	Not recommended	4 (8)
Major challenges faced by farmers	Water shortage	15 (30)
	Limited land availability	11 (22)
	No major challenge	24 (48)

Conclusion

The Mott grass fodder intervention proved to be an effective and sustainable strategy for improving livestock nutrition, reducing feeding costs and enhancing household resilience in District Khyber. High adoption rates, improved fodder availability and positive livestock performance indicate its strong suitability for smallholder farming systems. The study confirms that integrating perennial fodder crops into existing

livestock systems can provide year-round feed security and strengthen rural livelihoods under resource limited conditions. Scaling up this intervention through continued extension support and farmer training can further improve livestock productivity and promote sustainable agricultural development in similar agro ecological regions of Pakistan.

Acknowledgement

The authors sincerely acknowledge the valuable support and contribution of Welthungerhilfe (WHH) as the donor organization for valuable technical guidance and continued support throughout this initiative. We express our deep gratitude to National Integrated Development Association (NIDA) Pakistan for its technical and implementation support throughout the study. We also extend our appreciation to the Agriculture Extension Department, Merged Areas, for their close collaboration and technical assistance, which greatly facilitated the successful execution of this work. Special thanks are extended to all field staff, community members, and participants whose cooperation, time and valuable insights contributed significantly to the completion of this research/article.

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