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Determinants of Fodder Production and Their Effect on Household Income among Pastoralist in Wajir County, Kenya

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Abstract

Purpose: This study has discussed the determinants of fodder production in reference to access to land, finance, extension services and input costs and its effect on the household income among pastoralists in Wajir County, Kenya.

Materials and Methods: The Sustainable Livelihoods Framework, Diffusion of Innovations Theory, and Social Exclusion Theory were used to inform the study. The descriptive survey design was used where the study population consisted of 357 people who comprised of livestock herders, fodder producers, extension officers, and community members. Gathering of data was via the use of structured questionnaires and subsequent analysis was done via descriptive statistics, correlation and multiple regression analysis with the help of SPSS.

Findings: The findings indicated that access to land, financial services and granting of extensions in a secure manner was significantly beneficial in the household income whereas high costs of inputs limited productivity. Together, the four factors had a significant share in the explanation of income fluctuation, which highlights the potential of fodder production as an effective diversification strategy of livelihood.

Unique Contribution to Practice and Policy: The study suggests the necessity to enhance land tenure security, increase access to affordable credit, improvement of delivery of extension services, and subsidizing the costs of inputs. The targeted interventions will support the development of strong household incomes and fodder systems in Wajir and other counties in the ASAL regions.

Keywords: *Fodder Production, Household Income, Pastoralists, Wajir County, ASALs*

JEL Codes: *Q12, Q13, O13, Q18*

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INTRODUCTION

The livestock production is a staple of world production, as it contributes to almost 40 percent of the global agricultural GDP and sustaining the livelihoods of more than 1.3 billion people across the globe (FAO, 2023). However, the shortage of animal food, especially in dry and semi-arid areas where natural grasses are not enough to feed large animals, is one of the most urgent problems that the industry is experiencing (Godde et al., 2021). Fodder production occupies about 400 million hectares of land in the globe, which constitutes an approximate of 20 percent of the total agricultural land. Nevertheless, this situation does not stop the increase in the demand of livestock feed relative to its supply, which contributes to the annual losses of over USD 35 billion because of the shortage of feed and the decreased production (UNEP, 2022). Increasing fodder demand through climate change, population increase, and growing demands on livestock products have aggravated the situation, and sustainable production of fodder is an important development goal worldwide (World Bank, 2022).

Production of fodder has become a prominent livelihood and mechanisms of resiliency regionally in Africa. Government and non-governmental programs in Ethiopia have enhanced productive activities of livestock and increased household incomes through the large-scale production of drought-tolerant forages (Mekonnen et al., 2022). Nigeria has encouraged the use of better pasture management and introduction of drought resistant germplasm in some states such as Kaduna and Kano in order to satisfy increasing beef and dairy products demand (Muoghalu & Akanwa, 2021). Conservation measures that have been implemented in Uganda include minimum tillage, legumes rotation and residue management to boost soil fertility and to increase the productivity of forage (Macfadyen et al., 2024). With these developments, fodder production continues to be hampered by low investment, high cost of inputs and poor policy structures in Africa leading to limited commercialization and low adoption by pastoral families.

The livestock industry in Kenya occupies 12 percent of the national GDP and 42 percent of agricultural GDP with about 89 percent of the total landmass in the country comprising of the arid and semi-arid lands (ASALS) (MoALFC, 2023). Such places, such as Wajir County, have the greatest livestock counts but are very susceptible to climatic changes, frequent droughts, and over grazing (NDMA, 2021). Discussing the initiatives made by the government, it is possible to mention subsidies, extension services, and the creation of community fodder banks which are aimed at the better availability of feed and the decrement of reliance on natural pastures (KALRO, 2023). Nevertheless, the fodder production is at the stage of subsistence production but lacks access to tenure, credit, and inputs (Awolala et al., 2023).

This fodder-livelihood nexus case study that is essential in the Wajir County. The county is home to the estimated 1.8 million sheep, 2.5 million cattle and 3.2 million goats (KNBS, 2019), making it one of the largest livestock-bearing areas in Kenya. However, Kenya has a feed shortfall of almost 50 percent of the total needs, especially during prolonged droughts (FAO, 2023; World Bank, 2022). Frequent droughts in ASAL counties including Wajir have decreased the availability of pasture, which causes feed deficits worth more than Ksh 35 billion in annual livestock losses at the national level (MoALFC, 2023). Pastoralist households depend nearly solely on livestock as their source of food and livelihood, rendering them very susceptible to climatic changes and deficiency of pastures. Small-scale implementation of drought resistant grasses, including Cenchrus ciliaris and Brachiaria, has been adopted but because of poor commercialization, high cost of inputs, and poor extension coverage, the

adoption is low (Wajir County Government, 2019; FAO, 2023). These have been causing a decrease in milk and meat production, household incomes, and increased food insecurity in the area.

The purpose of this paper, hence, is to examine the determinants of fodder production such as land access, finance, extension services and cost of inputs and how they have impacted on household income of pastoralists in Wajir County. These linkages make the study offer evidence to enhance policy and practice through strengthening livelihoods, improving resilience, and supporting sustainable fodder systems among the ASALs in Kenya.

Statement of the Problem

Fodder production has turned out to be a critical livelihood practice among pastoralist families in the Wajir County considering the susceptibility of the area to drought, shortages of foods, and reduced productivity of livestock. Even though fodder production has the benefit of diversifying incomes and increasing resilience, it is limited and irregular in arid and semi-arid areas (ASALs). Pastoralist families still experience frequent shortage of feeds which undermine food security of households and low incomes earned through livestock which is their main economic activity (FAO, 2022; NDMA, 2021).

Despite the opportunity of improving livestock health, increasing milk and meat quantities, and gaining income due to the sale of excess fodder, structural obstacles destroy the opportunities of fodder cultivation. Lack of insecure land tenure would deter long term investments in fodder plots whereas lack of access to cheap finance will limit access to seeds, irrigation and other vital inputs by farmers. The provision of extension services also lacks effectiveness, and as a result, many pastoralists are unable to pursue modern ways of operation like planting of drought-resistant grasses and fodder conservation during dry seasons due to lack of technical knowledge (Place et al., 2004; Kariuki and Ngugi, 2020). Meanwhile, costly inputs particularly the seeds, fertilizers, and labor also deter adoption leading to reduced productivity and commercialization (Barrett et al., 2020; Kyalo, 2024).

Consequently, low and unstable household incomes, food insecurity, and access to education and healthcare remain a problem facing many households. The periodical character of the shortages of feeds in long dry seasons compel pastoralists to sell their animals at low prices, which exacerbate poverty and vulnerability (Omollo, 2018; Ndungu & Wario, 2020). Although some researches have been carried out on livestock production and environmental stressor, not many have been able to multidimensionally examine the direct effects of land and finance determinant, the extension services and input costs determinant on the household income of pastoral context of Wajir.

Further, there have been policy and institutional flaws including lax regulation, insufficient government subsidies and ineffective investment in fodder values chains in order to sustain systemic problems. Earlier research in Kenya and the ASAL area has been dominated by looking at livestock production under climate stress (Omollo, 2018; Ndungu and Wario, 2020), adoption of certain types of fodder like Brachiaria (Njarui et al., 2016) or how savings groups and microfinance can support pastoral livelihoods (Wambugu et al., 2021). Although useful, these studies have not specifically investigated the measured socio-economic impacts of institutional constraints including insecure land tenure, restricted finance, poor extension, and high input prices on the household income outcomes in Wajir County.

This gap in the literature causes an essential gap in knowledge concerning the importance of using fodder production as an avenue of income diversification and resilience building among pastoral households. The present research addresses this gap by incorporating the multidimensional perspective that includes land access, financial access, extension services, input costs as the determinants of fodder production and empirically conducting their joint and separate effects on household income. In so doing, it provides context-specific evidence on how to inform interventions and policymaking to improve sustainable livelihood within Wajir and other the ASAL counties.

Justification of the Study

Fodder production can provide pastoralist families of the Wajir County with a valid opportunity to boost the level of livestock productivity and income and to create more resilience to drought. Its uptake, however, is still limited by poor land tenure, access to finance, poor extension service and high cost of inputs. Since households greatly depend on livestock to provide food and income, it is important to know the effect of these determinants on fodder production and household welfare. This study is thus valid since it empowers the policy and interventions that can be taken to fortify the fodder systems, sustainable livelihoods, and minimizing vulnerability in the arid and semi-arid areas of Kenya.

Scope of the Study

This research was based in Wajir County which is in the northeastern part of Kenya and it forms one of the largest counties in arid and semi-arid areas in Kenya. The 2019 Kenya Population and Housing Census estimates the population of the county to be 781,263 individuals, with majority of them depending on pastoralism as their main source of livelihood. The study targeted Wajir East and Elda's sub counties since they were chosen purposely due to their reliance on livestock production and their newfound interest in the fodder cultivation as climate change adaptation method.

The research was directed at pastoralist families that deal directly with the production of fodder and pastoralists and pastoralist extension officers and community members directly impacted by the practice or indirectly since they are influenced by extension officers. Multi-stage sampling techniques were used to sample a total of 357 respondents to make the sample representative. Structured questionnaires were used to gather data which were analyzed using descriptive and inferential statistics such as correlation and regression analysis.

The research particularly assessed the major factors influencing fodder production, land access, financial access, extension services, and the cost of inputs and how they impact on household income. It aimed at the mechanisms of how these social-economic and institutional structures influence the pastoralist livelihoods in Wajir County, and the larger aim of the study was to inform practices on how to build resilience and sustainability of resource management in arid and semi-arid areas.

LITERATURE REVIEW

The section is a literature review about the current literature on the topic of fodder production, and its impact on the income earned by pastoralists in arid and semi-arid areas (ASALs). The review is comprised of three broads, which are as follows: theoretical framework directing the study, global, regional, and local empiric evidences, and conceptual framework that connects the determinants of fodder production with the household income.

Theoretical Framework

Sustainable Livelihoods Framework

In the 1990s, the Institute of Development Studies has presented the Sustainable Livelihoods Framework (SLF), which uses the work of Chambers and Conway (1992) to take a holistic view of how households sustain their living in vulnerable conditions. It establishes five main capitals, which include natural, financial, human, physical, and social, which define livelihood strategies in particular situations (Scoones, 2009). The reasons are that poverty and well-being are perceived not just through income but also through the available and consumed assets (Serrat, 2017).

SLF is very applicable in production of fodder in Wajir County. Natural capital is reflected in access to land and water resources for fodder cultivation; financial capital in the availability of credit and savings to support investment; human capital in skills and knowledge acquired through extension services; and physical capital in the use of inputs such as seeds, tools, and irrigation equipment. Social capital is also critical, as collective action and membership in producer groups influence adoption of fodder practices. Within the vulnerability context of Wajir, recurrent drought, insecure land tenure, and weak institutional support exacerbate risks, limiting the sustainability of fodder production. Although the SLF has been critiqued for underemphasizing politics and power dynamics (de Haan, 2012), it remains an essential tool for analyzing how households in arid regions balance assets and constraints to secure resilient livelihoods.

Diffusion of Innovations Theory

Diffusion of Innovations Theory was developed by Rogers (1962) and it is used to explain the spread of new ideas and technologies through a social system with time. Relative advantage, compatibility with the existing practices, simplicity, trial ability and observability influence adoption. This theory can be applied in the case of fodder production whereby some pastoralists are willing to adopt better fodder production techniques like planting drought-resistant grasses (Cenchrus ciliaris, Brachiaria) and some are still dependent on natural pastures. The farmer-to-farmer networks, the extension, and demonstration sites are highly significant because they are channels of communication and thus quicken the adoption process. Nevertheless, limited access to information and low literacy and cultural conformity to the traditional grazing systems are also sources of diffusion barriers. The research paper has showed how institutional support and social forces contribute towards the spread of fodder innovations among the pastoralists in Wajir using this theory.

Social Exclusion Theory

According to Social Exclusion Theory, institutional barriers and structural inequalities (Silver, 1994) also play a role in depriving some groups of resources and opportunities. In pastoralist areas, the exclusion is in form of insecure land tenure, poor access to cheap credit and insufficient coverage of extensions. These obstacles do not allow households to engage in fodder production and enjoy its potential income and resilience advantages to the full extent. In Wajir County, exclusion is not a homogeneous one but it is strongly intertwined with gender and clan identity. Although women play a leading role in controlling the products of livestock including milk and fodder use, the system has disenfranchised them with regard to ownership of land, decision-making, and access to credit facilities (Ali & Adan, 2019). This

marginalization limits their engagement in fodder ventures and their capacity to affect the household livelihood planning.

In the same light, inter-clan relations are also very important in accessing resources. The dominant clans tend to have a stronger control in common grazing grounds, water points, whereas the marginalized clans are subjected to more exclusion and ineffective representation in the local institutions as well as less access to government or other non-governmental organizations. This inequality of power distribution continues to propagate inequalities of fodder production opportunities and household welfare. In such a way, the Social Exclusion Theory is particularly applicable in providing explanations on how gendered and clan-based inequalities in Wajir County perpetuate poverty and food insecurity. Through the lightened layers of exclusions, the theory reinforces the conception of how the structural barriers, which are not solely economic, would influence the livelihood outcomes. Despite its criticisms of being general in scope (Levitas et al., 2007) its implementation in this context offers a valuable framework through which the agency of both gendered and inter-clan exclusions in restricting the extent to which pastoralists can participate in fodder markets, as well as the wider potential of fodder production as a resilience strategy, can be examined.

Empirical Review

Determinants of Fodder Production

Secure access to land has been established in the world as a major factor in achieving sustainable fodder production. In India, Rao et al. (2020) discovered that the secure land tenure households were more prone to invest on the perennial fodder grasses, which resulted in higher livestock productivity and household income. In Ethiopia, Mekonnen et al. (2022) found that fodder adoption through the Africa RISING project was greater among larger-scale farmers as they had more acreage which they could devote to forage crops without reducing food crops. On the same note, in Nigeria, Muoghalu and Akanwa (2021) noted that the scaling of improved pastures was limited by the lack of land access. Njarui et al. (2016) conducted a study in Kenya that managed to determine that families that had secure tenure in both Machakos and Kitui counties were most likely to adopt Brachiaria grasses. But in arid counties such as Wajir tenure system of communal tenure usually deters investment in fodder farming as there is the fear of encroachment and conflict of resources. This implies that land security is the center of influence on the level and sustainability of fodder production.

Easy access to cheap credit and savings has been generally identified as a very important facilitator of fodder production. According to FAO (2023), farmers in Asia who could access microfinance purchased inputs including seeds and irrigation equipment which led to a significant improvement of yields. Macfadyen et al. (2024) established in Uganda that saving and credit association had an effect of increasing the use of conservation fodder practices by smallholders. Mekonnen et al. (2022) found that credit access had a positive impact on the use of the fodder storage method including silage and haymaking in Ethiopia. Wambugu et al. (2021) found in Kenya that community-based savings groups neutralized financial shocks that helped households in Baringo remain in fodder businesses. Nonetheless, Kyalo (2024) has observed that the fodder production cannot be widely invested because of high interest rates and the few financial institutions that access ASAL areas. In the area of Wajir County with few formal financial services, the use of informal savings groups and livestock markets tend to limit the shift in investment in fodder, and therefore, inhibits income security.

The diffusion of the fodder innovations is based on the extension services. Sinisterra-Solis et al. (2023) in Latin America established that those farmers who had been trained in extensions were more likely than their counterparts to use better silage practices by a factor of two. In Ethiopia, Mekonnen et al. (2022) demonstrated the importance of extension to enhance the adoption of drought-tolerant grasses, and in Kenya, Gichuki et al. (2021) demonstrated the value of demonstration plots in enhancing the knowledge and adoption of Cenchrus ciliaris by farmers. Kariuki and Ngugi (2020) found that household access to regular communication with extension agents in the counties of Isiolo and Marsabit were highly associated with a high probability of adopting climate-smart fodder innovations, especially Brachiaria and fodder conservation techniques. There was however patchy coverage with women and poorer households frequently missing out on extension outreach.

Similar patterns have been identified in the Somali Region of Ethiopia, where Yusuf et al. (2021) discovered that pastoralists who had access to participatory extension programs were better placed to apply fodder plots in their herding systems and experience quantifiable increase in the milk yields and family food security. However, institutional ability and inadequate infrastructure prevented the expansion of these initiatives. Along with these positive instances, extension cover in ASALs is usually very low because of understaffing, gendered barriers, and logistical problems of accessing sparsely populated locations (MoALFC, 2023).

High input cost is also a major impediment in other environments. According to Rao et al. (2020), the prices of seed and fertilizers in India were very high that people could not have the chance to invest in using better fodder varieties. According to Kyalo (2024), smallholders were discouraged by the high prices of the seeds and irrigation facilities in the semi-arid counties in Kenya. Macfadyen et al. (2024) found out that in Uganda, the cost of labor was a limitation to fodder conservation. In an analysis by Ndungu and Wario (2020), the price of water to irrigate fodder plots in Marsabit, Northern Kenya was prohibitive to households. Similarly, in Wajir County, the excessive cost of seeds, water and labor and the duration of time to achieve returns persist to discourage any fodder business scale-up, despite the visible livelihood benefits.

Although there has been a gradual increase in advocacy of fodder production as a resilience measure, no economic aspects have been conducted in a comprehensive manner to establish the long term economically viable viability and sustainability of different fodder production models in ASAL environments. Similarly, the factors of production have been studied without much consideration of market linkages, commercialization avenues and forms of collusion that can transform fodder into a consistent source of livelihood. In addition, although it is admitted that the extension services provide the keys to the spread of fodder technologies, insufficient research has been conducted on the effectiveness of new patterns of service provision, such as digital advisory centers, community-based instructors, or networks of pastoralists demonstrations.

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Conceptual Framework

The conceptual framework of this study shows the association between the determinants of fodder production (independent variable) and household income (dependent variable) in pastoralists of Wajir County. The determinants can be summed up in four main constructs and these are: access to land, access to finance, extension services and input costs.

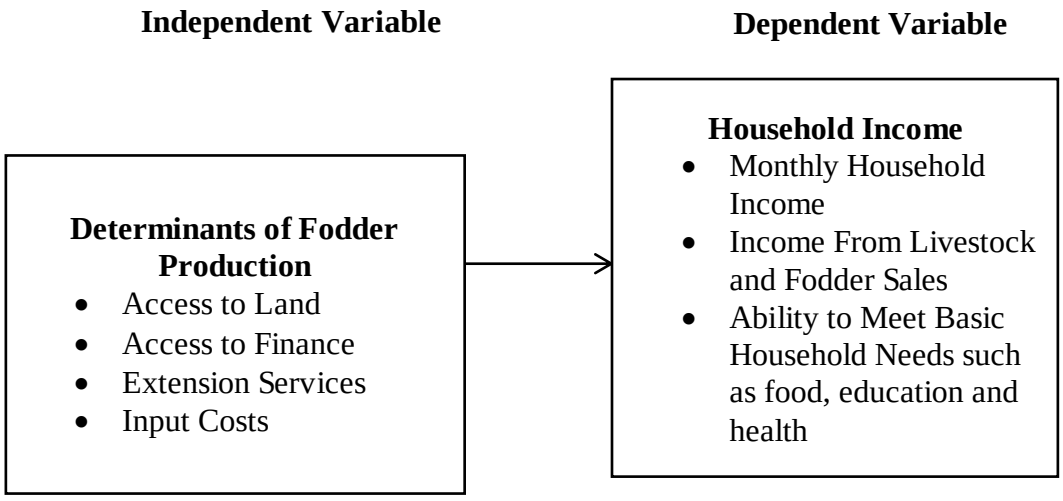

Figure 1: Conceptual Framework

METHODOLOGY

The research design followed in this paper was descriptive because it aimed to investigate the determinants of fodder production and its effect on the household income of pastoralist families in Wajir County, Kenya. In this section, the research design, target population, sampling procedures, instruments, methods of data collection, pilot testing and methods of data analysis that will be used to present the study findings will be described.

Research Design

Kothari (2020) views a research design as a rough map against which the operations of the research are conducted and how the data will be collected, measured, and analyzed. The research design that was used in this study was a descriptive research design, which studied the determinants of fodder production and its impact on household income among pastoralist households in Wajir County in Kenya.

The descriptive design was deemed as the most suitable design given that it gave an overall picture of the socio-economic and institutional conditions affecting the production of fodder. Descriptive designs are effective in gathering objective data concerning large, diverse, and representative populations because they are effective in generating reliable data and reducing bias (Abutabenjeh and Jaradat, 2018). This design allowed the study to test relationships between the independent variables; access to land, finance, extension services and input costs and the dependent variable, household income.

In addition, the design helped in gathering valid and detailed data on the perception, attitudes and experiences of pastoralist households with regard to fodder production. Through the use

of the descriptive statistics, as well as inferential analysis, the methodology increased the insight on the effects of fodder production on household welfare in the arid and semi-arid setting of Wajir. This is in line with Rahi (2022) who is emphatic on the importance of descriptive surveys in studying the real-life livelihood issues and producing the evidence to inform policy and practice.

Target Population

A population is considered to be the total amount of people or objects that share similar characteristics based on which a sample can be chosen (Orodho & Kombo, 2022). Mugenda and Mugenda (2003) define the target population to be any group of cases sharing a specific attribute of interest. Kombo and Tromp (2019) state its nature as the overall one on which measurements are based on.

In this study, the target population will be pastoralist households that were involved in fodder production, extension officers, and community members in Wajir East and Eldas sub-counties. The reason why these groups were chosen was the fact that they directly or indirectly engage in fodder production and the livelihood outcomes that follow. To make this population heterogeneous, all the groups of stakeholders were represented so that the number of participants could be representative (Etikan & Bala, 2023).

Sample Technique and Sample

Sampling refers to the process of making a representative part of a population representative to study them (Kumar, 2018). The research adopted multi-stage and stratified random sampling in order to be inclusive. To begin with, purposive sampling was done on Wajir East and Eldas sub-counties. Sub-counties under these villages were then stratified and the respondents sampled randomly within the stratum so that pastoralist households, extension officers and community members could be proportionally presented. The stratification played a vital role in minimizing sampling bias and having sufficient representation of every group (Taherdoost, 2020).

Yamane (1967) came up with the following formula that was used to compute the sample size:

$$n = \frac{N}{1+N(e)2}$$

Where n= Sample size

N = Total population size (3,330)

e = Margin of error (assumed at 5% or 0.05)

n = 3,330 / (1 + 3,330(0.05) ^2)

n ≈ 357

Therefore, the total sample size for the study was 357 respondents. Therefore, the sample size was representative and statistically eligible to investigate the determinants of fodder production and their effect on the household income in Wajir County.

Data Collection Tools

The data collection instruments refer to the means with the help of which the relevant information could be collected among the respondents (Kombo & Tromp, 2022). Structured questionnaires with both closed and open-ended questions were used in this study. The choice

of questionnaires was influenced by their positive attributes of gathering data of a comparatively large sample in a limited time (Kabir, 2022).

The closed-ended questions were planned to help gather measurable data on access to land, finance, extension services, cost of inputs, and household income, whereas the open-ended questions were meant to enable the respondents to shed more light on their experiences and perceptions, thus adding more qualitative perspectives to the study (Mahon and Joyce, 2023). The questionnaire was designed in such a way that it was organized into sections according to the study objectives so that every determinant of fodder production and its impact on the income would be given sufficient attention.

Data Processing and Analysis

According to Anderson and Thompson (2023), data analysis is the act of organizing, structuring, and interpreting unprocessed data in order to identify patterns and make important deductions. There was first a check of the data collected using the questionnaires on completeness, consistency and accuracy and subsequently coded to be analyzed. The data was processed in Statistical Package of Social Sciences (SPSS) because it is capable of working with massive amount of data and applying a large variety of statistical methods (Martinez & Chen, 2024). Frequencies, percentages, and means were used in a descriptive discussion to give a summary of the demographic factors and fodder production behavior of respondents.

The relationships between the independent variables (access to land, access to finance, extension services and input costs) and the dependent variable (household income) were tested with the help of inferential statistics namely correlation and multiple regression analysis. The regression equation adopted in the research was:

$$Y=\beta0+\beta1X1+\beta2X2+\beta3X3+\beta4X4+ e$$

Where:

Y = Household income

$\beta0$ = Intercept coefficient

$\beta1 \ldots \beta4$ = Regression coefficients of the independent variables

$X1$ = Access to land

$X2$ = Access to finance

$X3$ = Extension services

$X4$ = Input costs

e = Error term

Analysis of Variance (ANOVA) was applied to test the statistical significance of the model, as it effectively compares mean differences and evaluates whether the independent variables collectively influence household income (Thompson & Garcia, 2023).

RESULTS AND DISCUSSION

Demographic Characteristics

The demographic pattern of the respondents in Wajir County reveals trends that directly influence fodder production and household income as shown in Table 1. The gender distribution suggests that men (53.4%) are more engaged in formal participation in fodder

enterprises, driven by cultural beliefs about land and livestock ownership, whereas women (46.6%) are actively involved; however, the inaccessibility of productive resources limits their participation. The age distribution indicates that fodder production is centered on the economically active middle-aged groups (31-50 years), as they have the capacity to work in large numbers and are also endowed with the resources to work, but the youth have not participated at a high rate; this is because out-migration and constraints to land and credit severely limit their participation.

Patterns of livelihood reveal that livestock herding (58.2%) is at the center of the local economy, and that mixed farming (29%) and fodder farming (12.8%) indicate an increasing diversification of practices to enhance resilience to climatic shocks. The level of education is relatively low, with the majority of respondents having only primary education (38.2%), which restricts the use of sophisticated fodder technology and access to finance. However, the availability of tertiary-educated farmers (20.7%) can serve as a gateway to knowledge transfer. The dynamics of household size serve to emphasize opportunities and challenges: the larger the household, the more labour can be allocated to fodder work, although a larger household also has more consumption needs, which reduces the benefit of higher income.

All in all, the demographic trends indicate that the production of fodder in Wajir County is influenced by gender disparities, the predominance of a middle-aged workforce, dependence on livestock agriculture, low levels of education, and the household-size factor all of which affect access to finance, innovations, and income.

Table 1: Demographic Information

Variable	Category	Frequency	Percent (%)
Gender	Male	175	53.4
	Female	153	46.6
Age	18–30 years	90	27.4
	31–40 years	110	33.5
	41–50 years	75	22.9
	51–60 years	53	16.2
Primary Livelihood	Livestock Herding	191	58.2
	Mixed Farming	95	29
	Fodder Farming	42	12.8
Education Level	No formal education	38	11.7
	Primary education	126	38.2
	Secondary education	97	29.4
	Tertiary education	67	20.7
Household Size	1–3 members	82	25
	4–6 members	126	38.3
	7–9 members	73	22.5
	10 or more members	47	14.2

Source: Researcher, 2025

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Determinants of Fodder Production

This study employed binary logit model in order to determine the factors that affect the production of fodder. The fodder production was the dependent variable in the binary logit model. The sample was separated into fodder producers and non-producers whereby 1 was used to indicate the producers and 0 non-producers.

Table 2: Binary logit results for determinants of fodder production

Variable	Coefficient	Standard error	P-value
Age	-0.43	0.025	0.133
Gender	0.671***	0.987	0.001
Education level	0.768***	0.123	0.001
Household size	0.131**	0.768	0.006
Access to finance	0.006**	0.234	0.002
Access to land	0.013*	0.141	0.051
Access to extension services	1.516***	1.034	0.001
Input costs	-1.333***	0.987	0.000
Constant	**-1.213**	**1.198**	**-**

Source: Researcher, 2025 Sign 1% ***, 5%**, 10% *

The findings indicate that gender was positively significant in the production of fodder such that the male headed families were more likely to be engaged into the production of fodder as compared to their female counterparts. This has been blamed on the fact that women are more active in household duties particularly in this community (Ali and Adan, 2019). Moreover, the production of fodder is a labour-intensive process that women might not be capable of doing (FAO, 2022).

Alternatively, the level of education also influenced the household involvement in producing fodder in the perspective that the better the household was educated the greater they are likely to produce fodder than their counterparts. The higher education rates elevate the level of knowledge and awareness of the value of farm technologies and innovations, hence, boosting the household fodder production (Odhiambo, 2016).

The presence of the household was found to have a positive and significant influence on household fodder production. The implication of the finding is that the larger the household sizes, the better the households were likely to participate in the fodder production. The extended family sizes present labour which is required in the manufacture of fodder which otherwise is quite expensive and labor-intensive (Wambugu et al. (2021).

Moreover, the poor involvement of households in the production of fodder was positively and significantly impacted by the extension services. It implies that the households involved in fodder production increased because of the availability of extension services as opposed to households with no access to fodder production (Gichuki et al., 2021).

Production of fodder was positively significant due to the availability of finance. This means that those households that access financial resources had increased opportunities of undertaking fodder production compared to those households that did not receive financial resources. The fodder production is an expensive process and therefore lack of money denies the households the ability to produce fodder. The findings are in line with the rest of the literature, which found that the availability of money stimulated households to produce fodder (Wambugu et al. (2021).

The households also benefited with land access in the fodder production. Availability of land offered more opportunities that the households could produce fodder as opposed to households that lacked access to land. The fodder production requires space to be ready and this may be a limitation to the households who may not have land available to them. The other fact that can be compared to the findings is that access to land was a major factor that played a positive part in the activity of the households in fodder production (Njarui et al. (2016).

The households were negatively affected by the cost of inputs in terms of their participation in fodder production. This means that, the higher the cost of inputs, the less the fodder production will be done by the households. The results agree with other reports that indicated that the cost of inputs adversely influenced the participation of the households in the production of fodder in an immense manner (Barrett et al. (2020).

Effects of Determinants of Fodder Production on Household Income

Table 3 presents the results of multiple linear regression of the impacts of the determinants of fodder production on household income.

Table 3: Multiple Regression Results

Variable	Unstandardized Coefficient (B)	Std. Error	Standardized Coefficient (β)	t-Value	Sig. (p-value)
(Constant)	1.150	1.010	-	7.963	0.000
Access to Land	0.123	0.050	0.48	1.228	0.001
Access to Finance	0.413	0.250	0.41	1.177	0.050
Extension Services	0.254	0.150	0.45	1.235	0.003
Input Costs	-0.506	0.40	-0.17	-4.853	0.020
R^2	**0.8520**	-	-	-	-
Adjusted R^2	**0.8496**	-	-	-	-

Dependent Variable (Y): Household Income among pastoralists in Wajir County, Kenya. (In Kshs)

Source: Researcher, 2025

The regression equation was as follows:

$$Y = 1.150 + 0.123X_1 + 0.413X_2 + 0.254X_3 - 0.506X_4 + \varepsilon$$

These findings reveal that R squared value of all variables was 0.8520 which means that the model could explain 85.2 percent of any variation in the dependent variable, the income of households whenever there is an increment or reduction by one percent in the independent variables. It implies that the model achieved the 0.7 level of significance of the R Square value as suggested by Hamilton, Ghert and Simpson (2015). This shows that the goodness of fit of the regression model is quite high.

The regression disclosed that access to land, finance, and extension services had a strong but positive effect on the income of the household and input cost had a weak negative effect. Such results justify the use of specific interventions to improve land use, access to finances and training, and cost management, in order to maximize the economic results of pastoralists in Wajir County.

The regression model revealed that the statistically significant positive effects were on the household income through access to land, access to finance and extension service whereas the negative effects were statistically significant through input costs. R-squared value indicated that high percentage of the change in household income was due to these four predictors implying the model is robust. This demonstrates how land tenure, financial inclusion, and extension service initiatives in Wajir County positively predict the adoption of fodder and household income resilience.

Moreover, the study results indicate that holding everything else constant, an increase in land access by a unit will result in an increase in household income of 0.123. Moreover, other factors remaining unchanged, one unit of improvement in access to finance will only result in a 0.413 growth in household income. Other factors held constant, the 0.254 increase in household income will be caused by an increase in access in extension services. But other factors being equal, a one unit rise in the cost of input will contribute to a -0.506 fall in the household income.

Kyalo (2024) noticed that input cost efficiency explained more than 60 percent of the difference in household welfare outcomes in ASALs of Kenya that backed the stance of the affordability of inputs. In Uganda, Oduor et al. (2023), developed that the predictors of fodder innovations practices and improved household income were largely the extension services and access to credit assets. Moreover, a cross-country study by Kiplagat et al., (2025), found out that in East Africa drylands, land right and access to finance were the most effective predictors of household income growth.

Summary

This study has involved the analysis of the determinants of fodder production and the impact on the household income of pastoralist households in Wajir County, Kenya. The results of 357 respondents gave a full picture of the level, opportunities, and limitations of fodder production in the area. The results found that land, finance, and extension services had a significant and positive effect on household income and high input costs were a hindrance to production scale up. The study also established that pastoralist families that had access to secure land were more likely to invest in fodder plots, households which had access to credit and savings had access to purchase inputs to maintain production and households which received access to extension services embraced better practices like planting of drought tolerant grasses. On the other hand, the prices of seeds, labor and irrigation were very high and prevented mass adoption which reduced the potential of fodder production. Although fodder production is a significant diversification approach to livelihood and a resilience avenue to pastoralists in Wajir, structural constraints still erode its full potential to the overall well-being of the household. This brings about a paradox in which it is the same households which realize the usefulness of fodder cultivation which are limited by systemic issues which reduce the growth and commercialization of fodder cultivation.

Determinants of Fodder Production on Household Income

The research discovered that land access was a key factor of fodder production and household income in the Wajir County. The secure tenure and size of plots increased the likelihood of the respondents to use the land to produce fodder, to use better grasses and to ensure year-round production, which boosted livestock productivity and household income. On the other hand, families with a limited land area (or obligated by communal tenure systems) experienced problems investing in fodder production, since the threat of trespass and of being pushed out

of grazing areas prevented any long-term planning. The access to land was limited and insecure and, therefore, limited the scaling of fodder enterprises, and consequently, possible contribution to income and resilience.

The study found that finance had a great impact on fodder production and household earnings in Wajir County. Those households that had access to microfinance, savings groups or cooperative credit could more easily buy seeds, hire labor and invest in water harvesting technologies which raised productivity and livestock returns. On the other hand, with expensive interest rates, no collateral, and inaccessibility of most financial institutions to dry regions many households could not access affordable credit and instead had to use informal borrowing or sell their livestock to finance production. This source of financial marginalization limited the extent to which fodder farming could be done, and this depicts that affordable and easily accessible finance is very important in unlocking the full potential livelihoods of fodder production.

The extension services were identified to have a positive influence on the fodder adoption and income results. An access to the training, demonstration sites, and advisory services proved to be more likely to get drought-tolerant grasses, enhance storage techniques, and use soil conservation techniques, leading to the improved livestock productivity and increased household income. The extension services in Wajir County were however not adequately covered through understaffing, expansive areas covered and also the logistical factors. This left a lot of households unable to access technical knowledge necessary to increase production of fodder. To maximize the benefits of fodder production on pastoralist households, it is therefore necessary to improve extension outreach, whether digital or community-based trainers.

The key constraint was the cost of inputs which was high and hampered fodder production in the study area. The expensive cost of seeds, fertilizer, irrigation systems and labor discouraged families to maintain or increase production and the expense of water in dry seasons was very prohibitive. This made most households reduce or abandon fodder plots, making them less productive and less income-producing with increased reliance on unprotected natural pastures that are very susceptible to drought. The results highlight the need to implement those interventions that include subsidies, cooperative buying, and joint ventures to reduce the input prices and transform fodder production into a sustainable and feasible livelihood approach by pastoralists.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study concludes that fodder production is a new, but a critical livelihood approach to pastoralist households in Wajir County. The paper has found that availability of land, finance and extension services had a positive impact on the uptake of fodder and household earnings whereas high cost of inputs greatly limited production. Even though fodder farming boosted animal output, food security and an extra source of income, structural impediments, including unstable tenure ownership, restricted monetary inclusion, indifferent extension accessibility, and unaffordable inputs curtailed its potential. In general, these results confirm that fodder production can play a significant role in resilience and diversification of the activities of pastoralists, and structural limitations should be resolved to open its potential advantages in the long-term.

Recommendations

The paper recommends several interventions that can be used to reinforce fodder production and its role in supporting household income in Wajir County:

- Land Tenure Security: Put in place policies to assure access to land to pastoralist households such as community land allocation systems that promote the cultivation of fodder.
- Improved Access to Finance: Low-cost credit products, savings groups, microfinance, and scale-up programs that are suited to pastoralist settings and allow people to invest in irrigation and inputs.
- Strengthen Extension Services: extend the coverage of the extension officers, assist farmer-to-farmer training, and disseminate information on fodder practices on the digital platform.
- Cutting down the cost of inputs: Introduce subsidies, purchase in bulk via cooperatives and the joint venture between the public and privates with an aim of lowering the cost of inputs in terms of seeds, fertilizers and irrigation facilities.
- Secure Commercialization and Market Connections Cooperatives and producer groups are stimulated to sell their fodder in a way that they can create lasting sources of income that are independent of subsistence production.

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