European Journal of Agriculture and Food Sciences
www.ejfood.org

Farmers' Awareness of and Attitude towards Diversified Legumes Production in Singida Region, Tanzania

Caroline Fredy Lema, Michael Kadigi, and Kim Abel Kayunze

ABSTRACT

For an extended period, legumes have served as nutritional sources in the diets of both humans and animals. Efforts have been made to increase the yield of the legume crops in Tanzania, but there is still low awareness of and unfavourable attitudes towards legume crop diversification among farmers. The study, on which this paper is based, aimed at investigating farmers' awareness of and attitude towards diversified legumes, specifically to analyze socio-demographic characteristics of the respondents, assess awareness of and attitude towards diversified legumes production, and determine effects of awareness of and attitude towards diversified legumes production on management practices of diversified legumes production. A cross-sectional survey was employed whereby primary data were collected from 204 legume farmers using a semi-structured questionnaire. Content analysis was conducted using Nvivo software to analyze qualitative data. For quantitative data, Likert scale analysis was employed as a method for descriptive statistics, and Principal Component Analysis was used as a method for inferential analysis. These analyses were performed using Smart PLS software. The findings of the study revealed that several factors significantly influenced smallholder farmers' awareness and perception of diversified legumes. These factors included ease of cultivation, fair distribution of seeds, food availability, increase in income level, high legume harvest, and higher profitability of legumes ($p < 0.05$). Furthermore, the statement "enough of information" did not show statistical significance ($p > 0.05$). However, it exhibited a positive association. Conclusively, criteria like "easy cultivation" and "fair seed distribution" had a big impact on how smallholder farmers perceived and knew about diverse legumes. However, "enough information" did not appear to have a major significance. In addition, it was found that major influences on farmers' attitudes and understanding of diversified legumes included the availability of food, rising income levels, high yields of legumes, and perceived profitability. The paper recommends for the improvement of farmers' awareness and perception of diversified legumes, fair seed distribution methods must be established that provide equal access to high-quality seeds with the help of government organizations, non-profit organizations, and seed businesses.

Keywords: Analysis of smallholder farmers, diversified legumes, principal component.

Submitted : June 29, 2023

Published : January 11, 2024

ISSN: 2684-1827

DOI: 10.24018/ejfood.2024.6.1.710

C. F. Lema*
Department of Policy Planning Management, Sokoine University of Agriculture, Tanzania.
(e-mail: carolinelema1997@ gmail.com)
M. Kadigi
Department of Policy Planning Management, Sokoine University of Agriculture, Tanzania.
(e-mail: Michael.kadigi@sua.ac.tz)
K. A. Kayunze
Department of Development and Strategic Studies, Sokoine University of Agriculture, Tanzania.
(e-mail: kayunze@sus.ac.tz)

****Corresponding Author***

I. Introduction

Food and nutrition insecurity and poverty are major challenges in developing countries, particularly in sub-Saharan Africa which require much more agricultural production and productivity to feed its expanding population [1]. Legume grains have long been key sources of nutrition for both human and animal diets. In many developing countries, where small-scale farming predominates, farmers' knowledge and perceptions of diversified legumes are often characterised by traditional practices and a lack of exposure to innovative farming techniques [2]. Farmers' knowledge and perceptions regarding diversified legumes play a very crucial role in shaping agricultural practices, sustainable farming systems, and food security at large. In developing countries, understanding farmers' perspectives on legume diversity, agronomic practices, access to improved varieties, and the socio-economic factors influencing their decisions is very essential for developing targeted interventions and more likely in promoting effective agricultural development strategies [3].

During their growth or after harvest, the majority of legumes produce multiple products or perform a variety of activities and are frequently referred to as being multifunctional. These purposes include producing money, supplying food, fuel, and livestock feeds, enhancing soil fertility through biological nitrogen fixation (BNF), preventing soil erosion, and a host of additional advantages [4]. In many developing countries, where small-scale farming predominates, farmers' knowledge and perceptions of diversified legumes are often limited by traditional practices and a lack of exposure to innovative farming techniques [2]. Kenya is the largest producer of a variety of legumes in East African nations, followed by Uganda and Tanzania in terms of area [5].

Singida Region, located in central Tanzania, is a region of

significant agricultural importance. It is characterized by small-scale farming systems, with agriculture serving as a primary source of livelihood for the majority of the population. Legumes are an integral part of the agricultural landscape in Singida, contributing to food security, soil fertility improvement, and income generation for farmers [6]. Obtaining comprehensive global statistics on farmers' knowledge and attitude towards diversified legumes is challenging due to variations in agricultural practices, cultural contexts, and available data. However, farmers' knowledge of and attitude towards diversified legumes have been subjects of several studies. However, some studies and reports provide insights into the overall trends. A study conducted by Haug *et al.* [7] assessed farmers' knowledge and perceptions on diversified legumes in Tanzania which revealed that farmers possessed varying levels of knowledge regarding different legume species, their benefits, and management practices. While some farmers had good knowledge of legumes like beans and cowpeas, they showed limited awareness of other legume species, their nutritional value, and their role in soil fertility improvement.

In a study conducted by FAO [8], it was found that farmers' knowledge and perceptions of diversified legumes are influenced by various factors, including cultural practices, availability of information, access to markets, and socio-economic conditions. The study emphasized the need for targeted capacity-building programmes and knowledge transfer initiatives to enhance farmers' understanding of the benefits and management practices associated with diversified legume production. Furthermore, studies by Udoh and Nwosu [9], Awiti *et al.* [2], and Muoni *et al.* [4] showed that farmers' knowledge and perceptions of diversified legumes were influenced by traditional farming practices, market demand, availability of support services, influenced by agro-ecological conditions, access to improved varieties, and market opportunities. The research undertakings stressed on the importance of farmer education and extension services in improving knowledge and promoting the adoption of diversified legume cropping systems.

However, the previous studies did not clearly establish the extent of knowledge of and attitude towards diversified legumes among smallholder farmers. This paper looks into key aspects which illustrate knowledge of and attitude towards diversified legumes in the Singida Region, Tanzania. This study's findings will contribute to the fight against food insecurity and poverty by identifying key factors that significantly impact the acceptance and utilization of various legumes. The study holds significance as its results will aid the government in raising awareness about diverse legume options. The research generated additional data valuable to development planners, decision-makers, and practitioners in relevant ministries and organizations seeking to enhance the adoption of legume varieties. Furthermore, this paper aligns with the Tanzania Development Vision (TDV) 2025, which aims to ensure high-quality livelihoods for individuals through food security and self-sufficiency. Additionally, the paper adheres to the Sustainable Development Goals (SDGs), specifically goals one and two, which concentrate on eliminating all forms of poverty and achieving food security and sustainable agriculture, respectively.

II. Theories Related To The Study

A. Social Learning Theory

This theory highlights the role of social interactions and learning processes in shaping individuals' knowledge and perceptions. This theory suggests that learning is not solely reliant on direct personal experiences but can also be facilitated through the observation of others' actions and the consequences that follow. By observing and imitating the behaviours, attitudes, and skills demonstrated by role models or peers, individuals can acquire new knowledge, develop new skills, and shape their own behaviour [10]. According to this theory, people learn through observing and imitating others, as well as through the consequences of their own actions [11].

The Social Learning Theory highlights the influence of social norms, role models, and social reinforcement on behaviour adoption. When farmers observe their peers adopting new agricultural practices or technologies, it can positively influence their own decision-making on the same practices. By witnessing the success and benefits experienced by others, farmers are more likely to adopt and integrate innovative techniques or technologies into their own farming systems [11]. Farmers often engage in knowledge-sharing networks and participate in farmer field schools or community-based organizations. Through these interactions, farmers exchange information and experiences related to diversified legumes, which can influence their knowledge, perceptions, and practices.

B. Social Construction of Technology

This theory suggests that technology is not just a neutral tool but is socially shaped and influenced by the values, knowledge, and perceptions of individuals and communities [12]. Farmers' knowledge, needs, and perceptions influence the development, modification, and implementation of technologies within their farming practices. Farmers' input, feedback, and interactions with technology developers and suppliers can shape the design and functionality of agricultural technologies, including those related to diversified legumes. In the context of diversified legumes, farmers' knowledge and perceptions can influence the development and adoption of appropriate technologies, such as improved seed varieties, agro-ecological practices, or post-harvest processing methods that are suitable for local conditions and meet farmers' needs with regard to the promotion and preservation of diverse legume varieties.

C. Conceptual Framework

The conceptual framework (Fig. 1) for farmers' knowledge and perceptions on diversified legumes provides a structure for understanding various factors which influence farmers' decision-making processes, attitudes, and practices related to diversified legumes. Here's a brief explanation of each component: The socio-cultural factors on the left-hand side explain cultural beliefs and traditions, social networks, and farmer communities together with gender roles and dynamics. The knowledge and information in the middle, with an arrow pointing to the FRN project, comprises existing knowledge of legume crops and cultivation practices, access to agricultural extension services, training programmes, indigenous knowledge systems and local ecological knowledge that farmers experience.

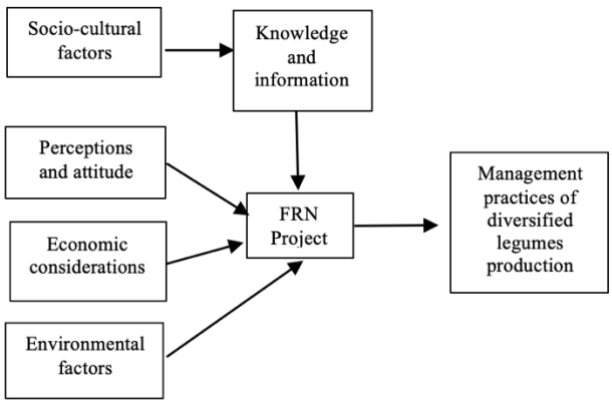

Fig. 1. Conceptual framework on farmers' knowledge and attitudes towards diversified legumes.

The other aspects on the left-hand side, perception and attitude, economic considerations, and environmental factors, point to the FRN projects, which are responsible for aligning farmers' adoption and management practices on diversified legumes.

III. Materials and Methods

A. Description of the Study Area

The research was carried out in the Singida Region, situated in the central corridor of Tanzania, specifically in the Mtinko and Ilongero Divisions across nine villages. Singida District Council (SDC) is one of the four councils within Singida Region. Geographically, it is located between latitudes 30º and 70º south of the Equator and longitudes 340º and 350º East of Greenwich. Singida District experiences semi-arid climatic conditions, which are characterized by two distinct seasons: a lengthy dry season from April to November and a rainy season from December to March. The annual rainfall ranges between 600 mm and 700 mm, while the average minimum temperature ranges from 15°C to 30 °C. Singida is considered one of the most impoverished regions in Tanzania [13]. The headquarters of the region are in Singida town and can be reached from Arusha via Babati and Katesh. From Dar es Salaam, it can be via Morogoro and Dodoma, and from Mbeya, it can be reached via Morogoro and Dodoma. Additionally, Singida can be accessed from Shinyanga and Mwanza through Nzega in the Tabora Region. Singida Region is of moderate size, ranking 13th in terms of area and covering approximately 5.6% of Mainland Tanzania's total area of 881,289 km^2. The choice of Singida Region for this research was motivated by the implementation of the FRN project in the region, which aimed to provide legume varieties to smallholder farmers.

B. Data Collection

Using a structured questionnaire with both open-ended and closed-ended questions, primary data were gathered from the respondents. The primary goal of the questions was to gather information on the variables affecting the adoption of the production of diversified legumes. Data from Key Informant Interviews (KIIs) were also gathered. Four KIIs were held, with participants including FRN project leaders and village executive officials. To confirm the data gathered through the questionnaire, extensive qualitative data were obtained using the KIIs checklist.

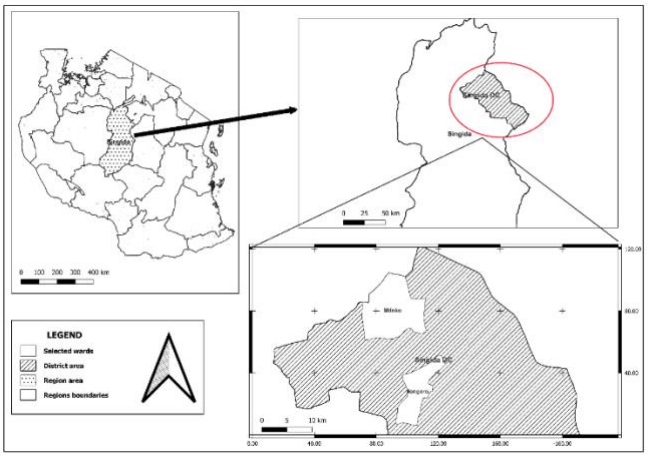

Fig. 2. A study map area.

The data collecting instruments were pre-tested in the study area before real data collection was done to ensure familiarity and clarity, which helped to assure the validity and reliability of the data gathered. The study's final analysis excluded the collected data from pre-testing.

C. Data Analysis

Quantitative data collected through the questionnaire were analysed using the STATA software, whereby both descriptive statistical analyses and inferential statistical analyses were done. Qualitative data were analysed using content analysis.

Smallholder farmers' perception was assessed using a Likert scale with 5 levels, which were categorized as 1= Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly agree. Means for the Likert scale categories were calculated, and they were then grouped into three groups, which are High Awareness, Moderate Awareness, and Low Awareness. Values greater than 3 were considered high awareness, statements with a mean of 3 were considered moderate awareness level, and statement values that had mean values less than 3 were considered low awareness. The analysis was then subjected to principal component analysis for factor analysis. This analysis involved clustering together related attitudinal statements regarding the diversified legumes. The clustered perception statements gave a summary of the individual statements. Using the principal component analysis was due to its ability to yield robust results [14]. Principal component is mathematically represented as follows:

$$PC_n = f\left(a_{ni}x_i \dots\dots\dots\dots\dots a_{1j}x_j\right) \quad (1)$$

where:
PC – Principal component,
N – Number greater than one,
a_{1j} – Regression coefficient for the jth variable and is known as the eigenvector of the covariance matrix between variables,
x_j – is the value of the jth variable.

Explicitly, the equation can be written as:

$$PC_1 = a_{11}x_1 + a_{12}x_2 + \cdots + a_{1j}x_j \quad (2)$$

where PC_1 is the first principal component, X_1 and X_2 are the first and second independent variables of PC_1 in the linear additive model needed to derive the principal component, and

the a_{11} and a_{12} are coefficients (component loadings) associated with the X_1 and X_2 variables.

IV. Results and Discussion

A. Socio-economic Characteristics of Respondents (Farmers)

Different characteristics of the respondents were analysed in this study. The respondents' characteristics included sex, age, marital status, education level, major occupation, land size, access to credit, and income. The findings in Table I show that, among non-adopters of diversified legumes, 57.7% were male, while 42.3% were female. Among adopters, 59.2% were males and 40.8% were females. The results show that more than half of the respondents among both adopters and non-adopters were males. This implies that most of the legume farming activities were mainly done by male farmers in the study area. This was highly influenced by the fact that in most areas, men were the ones responsible for doing most of the economic activities so as to feed their families, while women were more responsible for taking care of children and doing house chores [15].

The results in Table I also show that, among the non-adopters, 59.9% were married, and 48.1% were not married. Also, among the adopters, 38.2% were married, and 61.8% were not married. The influence of marital status on the adoption of diversified legume production can vary widely depending on cultural, social, and economic factors and may not hold true for all farmers in all regions [16]. Marital status can play a role in the adoption of diversified legume production by affecting household decision-making, division of labour, access to resources, and social networks. However, this can vary greatly depending on a variety of cultural, social, and economic factors [17].

Further, the results in Table I show that, among non-adopters, 25.0% had informal education, 59.6% had primary education, and 15.4% had secondary education, while among adopters of improved practices for diversified legume production, 30.3% had informal education; 58.6% had primary education; and 11.6% had secondary education. This shows that more than half of the respondents (59.6% and 58.6%) had primary education. This suggests that higher levels of education can equip farmers with the knowledge, skills, and resources needed to understand the importance of diversified legumes, access to information and resources, and experimenting with new practices that can improve their farming practices. Moreover, the attitude has widely been expressed, with the idea that in farming communities that are literate, the task of convincing or educating them about the adoption of diverse legumes has been greatly simplified [18].

As summarized in Table I, among non-adopters, 25.0% were employed, 61.5% were unemployed, and 13.5% were self-employed. Among adopters, 9.9% were employed; 66.5% were unemployed, and 23.68% were self-employed. More than half of the smallholder farmers who had adopted the diversified legume production were unemployed. This implies that most of the smallholder farmers who had adopted the diversified legume production were able to adopt the diversified legume production since it was the only farming activity that they were doing; so, it was easy for them to attend several training sessions that were conducted by the FRN project.

In Table I, the findings show that, among non-adopters, 67.3% owned land and 32.7% rented land, while among adopters, 64.5% owned land and 35.5% rented land. The results imply that both adopters and non-adopters of diversified legume production owned farms. In the case of access to credit, among non-adopters, 42.3% had access to credit, and 46.2% had no access to credit. Furthermore, among the adopters, 50.7% had access to credit, and 49.3% had no access to credit. The results show that more than half of the respondents who adopted diversified legume farming had access to credit. This implies that access to credit increases the chances of the farmers to adopt diversified legume farming practices. Access to credit can be a key factor in the adoption of diversified legume production by smallholder farmers by providing them with necessary funds, reducing their risks, increasing their bargaining power, and improving their livelihoods [19].

TABLE I: Cross-Tabulation of Demographic Characteristics and Adopters of Diversified Legumes Production (N = 204)

Socio-economic Variables	Not adopted diversified legumes production		Adopted diversified legumes production		Chi-square test (P-value)
	Frequency	%	Frequency	%	
Categorical variables:					
Gender					
Male	30	57.7	90	59.2	0.848
Female	22	42.3	62	40.8	
Marital status					
Married	27	51.9	58	38.2	0.082
Not married	25	48.1	94	61.8	
Educational level					
Informal education	13	25.0	46	30.3	0.626
Primary education	31	59.6	89	58.6	
Secondary education	8	15.4	17	11.2	
Occupation					
Employed	13	25.04	15	9.9	0.014***
Unemployed	32	61.5	101	66.5	
Self employed	7	13.5	36	23.7	
Land ownership					
Own land	35	67.3	98	64.5	0.711
Rent land	17	32.7	54	35.57	
Access to credit					
Yes	28	42.3	77	50.7	0.691
No	24	46.2	75	49.3	
Continuous variables					
Age	35.94	(13.44)	34.46	(12.27)	0.582
Land size	2.49	(1.28)	3.93	(1.64)	0.000***
Income	221,923.08	(90,164.09)	472171.05	(160755.33)	0.000***

*** p<0.001.

The respondents who were adopters and non-adopters had average ages of 35.94 and 34.46 years, respectively. This shows that the majority of legume farmers in the study area were of the productive age range, which is 15 to 64 years. This finding is in line with Lugamara's [20] findings that farmers in their middle years appear to be more productive than those in their early years and those in their later years due to their heavier workloads in the family and community. Taking care of kids and elderly household members, paying for the children's education, covering household health expenses, and contributing to social welfare initiatives in the community are a few examples of chores performed by productive aged people.

As seen in Table I, adopters had an average land size of 3.93 ha, compared to non-adopters, who had an average land size of 2.49 ha. The results demonstrate that adopters owned greater land plots than non-adopters. Large-scale farmers may have more financial resources and economies of scale to devote to varied legume production. Although this can limit their ability to fully profit from diversity, farmers with huge land holdings may also have less time and effort to spend on the care and maintenance of their crops [21].

Lastly, in Table I, the average incomes of the legume farmers among non-adopters and adopters of diversified legume production were TZS 221 923.08 and TZS 472 171.05, respectively. The findings reveal that adopters had more income compared to non-adopters. This shows that the income of a farmer can be a significant factor in the adoption of diversified legume production in Tanzania, as it can provide necessary resources, increase market opportunities, increase access to information and technology, increase risk resilience, and improve livelihoods [22].

B. Smallholder Farmers' Perception and Awareness on Diversified Legumes

The analysis on perceptions was conducted using a 5-point Likert scale. This analysis aimed to group together attitudinal statements related to diversified legumes. According to the results in (Table II) below, the majority (86.8%) of the respondents strongly agreed with the statement "the distribution of seeds was fair", (12.7%) agreed, and (0.5%) strongly disagreed. On the statement "cultivation of legumes is more profitable than other crops", nearly one-third (33.8%) of the respondents strongly agreed, (4.9%) agreed, (2.9%) were neutral, (11.8%) disagreed, and (46.6%) strongly agreed. On the statement "cultivation of legumes is easier than other crops", more than four-fifths (81.4%) of the respondents strongly agreed, (4.9%) agreed, (4.4%) were neutral and (9.3%) disagreed. On the statement "enough information is given before legumes before cultivation", more than seven-eighth (78.9%) of the respondents strongly agreed, (17.2%) agreed, and (3.9%) strongly disagreed.

Statement on "legumes varieties have increased the income level" more than four-fifths (82.4%) of the respondents strongly agreed, (9.8%) agreed, (2.5%) were neutral and (5.4%) strongly disagreed. Statement on "legume varieties have increased food availability to the household" (90%) agreed, (4.9%) agreed, (2.0%) disagreed, and (2.5%) strongly agreed. Statement on "legume harvest is higher than other crops", nearly a quarter (24.5%) strongly agreed, (2%) agreed, (4.9%) were neutral, (14.2%) disagreed, and (54.4%) strongly disagreed.

Moreover (Table III) presents a general overall result on the perception and awareness of diversified legumes, with the grand mean of 4.07 showing there is high awareness.

C. Effects of Awareness of and Attitude towards Diversified Legumes Production on Management Practices of Diversified Legumes Production

Further, analysis on perceptions was conducted using principal component analysis or factor analysis. This analysis aimed to group together attitudinal statements related to diversified legumes.

According to the results in Table IV below, the statement easy to cultivate was statistically significant ($p = 0.000$) in influencing the awareness and perceptions of smallholder farmers in adopting the diversified legume production.

TABLE II: LIKERT SCALE SHOWING PERCEPTION AND AWARENESS ON DIVERSIFIED LEGUMES

	Strongly disagree		Disagree		Neutral		Agree		Strongly agree	
	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %
The distribution of seeds was fair	1	0.5%	0	0.0%	0	0.0%	26	12.7%	177	86.8%
Cultivation of legumes is more profitable than other crops	95	46.6%	24	11.8%	6	2.9%	10	4.9%	69	33.8%
Cultivation of legumes is easier than other crops	0	0.0%	19	9.3%	9	4.4%	10	4.9%	166	81.4%
Enough information is given about legumes before cultivation	8	3.9%	0	0.0%	0	0.0%	35	17.2%	161	78.9%
Legume varieties have increased the income level	11	5.4%	0	0.0%	5	2.5%	20	9.8%	168	82.4%
Legume varieties have increased food availability to the household	5	2.5%	4	2.0%	0	0.0%	10	4.9%	185	90.7%
Legume harvest is higher than other crops	111	54.4%	29	14.2%	10	4.9%	4	2.0%	50	24.5%

TABLE III: OVERALL PERCEPTION AND AWARENESS ON DIVERSIFIED LEGUMES

	N	Mean	Std. Deviation	Remark
The distribution of seeds was fair	204	4.85	0.430	HA
Cultivation of legumes is more profitable than other crops	204	2.68	1.815	LA
Cultivation of legumes is easier than other crops	204	4.58	0.946	HA
Enough information is given about legumes before cultivation	204	4.67	0.833	HA
Legume varieties have increased the income level	204	4.64	0.965	HA
Legume varieties have increased food availability to the household	204	4.79	0.760	HA
Legume harvest is higher than other crops	204	2.28	1.677	LA
Grand Mean		4.07		HA

TABLE IV: FACTOR ANALYSIS

Statements	X	SD	P-Values
Easy to cultivate -> Awareness score	0.230	0.045	0.000
Enough information -> Awareness score	-0.040	0.108	0.923
Fair distribution of Seed -> Awareness score	0.169	0.087	0.031
Food availability -> Awareness score	0.223	0.077	0.001
Increase income level -> Awareness score	0.562	0.127	0.000
Legume harvest is higher -> Awareness score	0.718	0.059	0.000
Legume is more profitable -> Awareness score	0.277	0.046	0.000

Furthermore, easy to cultivate statement was positive influencing with a mean score of 0.230. This implies that the positive influencing mean score of 0.230 suggests that smallholder farmers perceive diversified legume production as relatively easy to cultivate. This indicates that the farmers consider the cultivation of diversified legumes to be a manageable and feasible practice.

These findings suggest that the perception of ease in cultivating diversified legumes plays a significant role in shaping smallholder farmers' awareness and willingness to adopt such agricultural practices. It implies that promoting the notion of easy cultivation techniques and highlighting the benefits of diversified legume production may enhance awareness and encourage more smallholder farmers to engage in this form of farming. The results are in line with the study by Ojiewo *et al.* [23] and Mhango *et al.* [24] who reported that perception of ease in cultivating diversified legumes plays a significant role in shaping smallholder farmers' awareness and willingness to adopt such agricultural practices, so promoting the notion of easy cultivation techniques and highlighting the benefits of diversified legume production may enhance awareness and encourage more smallholder farmers to engage in this form of farming. The results were further mentioned in one of the key informant interviews, who said that:

"At first we needed to promote the notion that diversified legumes are easy to cultivate, since in these areas there's a notion that, cultivating a lot of crops become expensive and results into low yields" (Key Informant RECODA FRN PROJECT, 2022)

Furthermore, enough of information statement was also assessed to see the perception and awareness of the stallholder farmers on diversified legumes. The results in Table 4 show that, enough information is not significantly influencing smallholder farmer's perception and awareness on the diversified legumes ($p>0.05$). It also shows that the negative men score towards awareness of diversified legumes (-0.040). Negative mean score of -0.040 indicates that, on average, smallholder farmers have a slightly negative perception or awareness of diversified legumes in relation to "enough information." This means that, overall, farmers feel that they do not have sufficient information regarding diversified legumes, which may impact their perception and awareness of diversified legumes. Based on these findings, it can be inferred that there may be a lack of information dissemination or communication channels to effectively provide enough information about diversified legumes to smallholder farmers. Similar argument was raised by one of the respondents who has not yet adopted diversified legumes:

"FRN project is somehow seen as a bias project since most of us smallholder farmers do not have access to most of the information about this new technology to us, such as how we can diversify legumes, how to start planting, which legumes are easy to grow together, and many other. I suggest that FRN people should improve their educational trainings so that the education and information on the diversified legumes can be well understood by most of the farmers, thus easy adoption" (A 53YEAR-old man, Mughanga Village).

Results in Table IV further looked on the fair distribution of seed statement. The result show that, fair distribution shows statistical significance towards awareness and perception of diversified legumes among small holder farmers ($p<0.05$), also there was a positive mean score shown by the fair distribution of seed (0.169). The positive mean score of 0.169 indicates that the fair distribution of seeds has a beneficial effect. This suggests that when smallholder farmers receive seeds through a fair distribution system, they have a more positive perception and awareness of diversified legumes compared to other distribution methods. Therefore, smallholder farmers have a more positive perception and awareness of diversified legumes when they receive seeds through a fair distribution system, compared to other distribution methods, as suggested by one study in Malawi [24]. Furthermore, the potential of legume crops to diversify farming systems, increase sustainability, provide multiple benefits, and enhance food security [25]-[27].

On food availability statement, the results in Table IV shows significance influence on the smallholder farmer's perceptions and awareness of diversified legumes ($p<0.05$) and also shows positive mean factor score of 0.223. The positive mean factor scores of 0.223 suggests that the factor food availability have a beneficial effect on the perceptions and awareness of diversified legumes among smallholder farmers. This means that the food availability contributes positively to the smallholder farmers' understanding and awareness of diversified legumes. According to a number of studies, food accessibility helps smallholder farmers learn about and become aware of a variety of legumes. In terms of ensuring food and nutrition security as well as generating money, legumes are crucial in sub-Saharan African smallholder farming systems [28]. Smallholder farmers in Ethiopia are aware of the variety of legume crops that are grown in their local areas; yet, to increase the variety of legumes that individual household's plant, community-level conservation is required [27]-[29]. Another study done in Ghana and Kenya discovered that increasing smallholder farmers' production of grain legumes is a practical way to enhance rural communities' nutrition.

For the case of increase income level, the findings show that increase in income level had statistically significant influence on awareness and perceptions on diversified legumes ($p<0.05$). The factor mean score for the increase income level had a factor mean score of 0.562. The results imply that an increase in income level has a statistically significant influence on the awareness and perceptions of diversified legumes. The very low p-value of less than 0.05 ($p<0.000$) suggests that the relationship between income level and awareness/perceptions is highly unlikely to occur by chance. Furthermore, the high factor mean score of 0.562 indicates that an increase in income level has a substantial positive impact on the awareness and perceptions of diversified legumes. This suggests that as the income level of smallholder farmers increases, their understanding and perception of diversified legumes also

improve significantly. According to Mhango *et al.* [24] income level of smallholder farmers is positively related to their understanding and perception of diversified legumes. Moreover, a study by found that farmers who participated in multiple output markets, including legume markets, reported higher income and better food security than non-participants. Furthermore, a study by Vanlauwe *et al.* [28] concluded that farmers put more value on short-term benefits of legumes, including food and income, than long-term benefits such as natural resource management. This finding indicates that smallholder farmers who have high incomes are more likely to diversify than the ones with low incomes.

The findings in Table IV also show that the statement; legume harvest is high has a significant influence on smallholder farmer's awareness and perception of diversified legumes ($p<0.05$). Furthermore, the statement had a factor mean score of 0.718 in explaining the smallholder farmer's perception and awareness on diversified legumes. These results imply that the statement "legume harvest is high" has a statistically significant influence on the awareness and perception of diversified legumes among smallholder farmers. The p-value of less than 0.05 suggests that the relationship between the statement and the awareness/perception of diversified legumes is unlikely to occur by chance. Additionally, the high factor mean score of 0.718 indicates that the statement "legume harvest is high" is strongly associated with and explains a significant portion of the smallholder farmers' perception and awareness of diversified legumes. This suggests that when smallholder farmers perceive that their legume harvest is high, it positively affects their understanding and perception of diversified legumes. The results are in line with other studies that suggested that smallholder farmers' understanding, and perception of diversified legumes are positively affected by high legume harvests [4].

Lastly, the statement legume is more profitable was also used to assess its influence on smallholder farmers' perceptions and awareness of diversified legumes. The results show that the statement had a significant influence on the awareness/perception of smallholder farmers ($p<0.05$). Moreover, the result shows a factor mean score of 0.277. The findings suggest that the claim that "legume is more profitable" has a statistically significant impact on smallholder farmers' awareness and perception of diverse legumes.

Additionally, the statement "legume is more profitable" appears to positively influence smallholder farmers' perceptions of and familiarity with a variety of legumes, according to the factor mean score of 0.277. This shows that farmers' comprehension and perception of varied legumes are positively impacted when they believe legumes to be more profitable. According to Muoni *et al.* [4], farmers put more value on the short-term benefits of legumes, including food and income, than on long-term benefits, such as natural resource management. Another study by Ferreira *et al.* [30] found that legumes' low profitability for farmers may be attributed to a lack of public and private investments in breeding programs and legume-adapted technology for planting, managing, harvesting, processing, and storing when compared to cereals. Therefore, farmers' understanding, and perception of diversified legumes are influenced by economic factors such as profitability.

V. Conclusions and Recommendations

Findings of this study based on the analysis indicate that several factors have proven the statements; "easy to cultivate", fair distribution of seed, food availability, increased income level, and legume harvest high had a significant influence on the awareness and perception of diversified legumes among smallholder farmers. However, the factor of "enough information" was not significant but had a positive influence on farmers' awareness and perceptions of diversified legumes. Therefore, efforts should be made to enhance information dissemination, including the use of various platforms such as farmer field days, community workshops, radio programs, and mobile technology. Addressing this issue by improving access to information and increasing awareness campaigns could be beneficial in promoting the adoption and positive perception of diversified legume production among smallholder farmers. Also, the significant influence of fair distribution of seed on farmers' awareness and perception of diversified legumes suggests the importance of ensuring equitable access to quality seeds. Stakeholders, including government agencies, NGOs (FRN project), and seed companies, should collaborate to develop and implement fair distribution systems that prioritize smallholder farmers. This can involve establishing seed banks, promoting community-based seed production, and providing transparent and inclusive mechanisms for seed access and distribution.

Acknowledgement

I would like to express my heartfelt gratitude to Almighty God for giving me the strength to overcome the challenges and complete my dissertation. I am truly grateful for the unwavering support and encouragement of my family, both financially and emotionally, throughout this journey. My sincere thanks go to my supervisors, Prof. Kim Abel Kayunze and Dr. Micheal Kadigi, for their invaluable guidance and instruction in the successful completion of my research. Their kindness, patience, and constant advice have been instrumental in my academic achievement.

Funding

I am thankful for the support provided during data collection by RECODA (Farmers Research Network Project).

Conflict of Interest

The authors declare that they do not have any conflict of interest.

References

[1] WFP. *WFP in Africa: 2013 Facts, Figures and Partners* [Internet] 2013; Available from: athttps://documents.wfp.org/stellent/groups/public/documents/communications/wfp282142.pdf

[2] Awiti H, Gido E, Obare G. Smallholder farmers climate smart crop diversification cost structure: Empirical evidence from Western Kenya. *Journal of Frontier in Sustainable Food Systems.* 2022; 6(20):842987.

[3] Hassen A, Shigeta M, Hussien J. Assessing smallholder farmers' knowledge and perceptions on diversified legume production systems in Ethiopia. *Sustainability*. 2020; 12(4):1529.
[4] Muoni T, Barnes A, Öborn I, Watson C, Bergkvist G, Shiluli M, *et al*. Farmer perceptions of legumes and their functions in smallholder farming systems in east Africa. *International Journal of Agricultural Sustainability*. 2019; 17:3:205-218.
[5] Katungi E, Farrow A, Chianu J, Sperling L, Beebe S. Common bean in Eastern and Southern Africa: a situation and outlook analysis. *International Centre for Tropical Agriculture*. 2009; 61:56.
[6] Mremi J, Jeckonial J and Nyamhanga P. Gender Dynamics, Dietary Diversity among Small Scale Legume Farmers in Singida District, Tanzania. *AJASS*. 2023; 6(1):307-321. Available at http://repository.tia.ac.tz/handle/123456789/150
[7] Haug R. Farmers' knowledge and perceptions of grain legume cultivation and its potential benefits in Tanzania. *Experimental Agriculture*. 2018; 54(4):606-622.
[8] FAO. *Pulse crops for sustainable farms in sub-Saharan Africa*. Rome, Italy. 2018; Retrieved from https://www.fao.org/3/I8300EN/i8300en.pdf
[9] Udoh S, Nwosu I. Enhancing Farmers' Knowledge and Adoption of Diversified Legumes in Nigeria: An Application of Social Marketing Strategies. *Sustainability*. 2020; 12(8):3281.
[10] Lave J, Wenger E. *Situated Learning: Legitimate Peripheral Participation*. Cambridge, UK: Cambridge University Press; 1991.
[11] Bandura A. *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall; 1986.
[12] Mwinzi JM. Theoretical Frameworks and Indigenous Knowledge Systems. *International Journal of Education and Research*. 2015; 13(2): 677-684
[13] Lekule C. Investigating school experiences of vulnerable children in Singida, Tanzania: Challenges, strategies, and possible interventions. *Electronic Theses and Dissertations.* 2014; *5079.* https://scholar.uwindsor.ca/etd/5079
[14] Jolliffe I, and Cadima J. Principal Component Analysis. A review and recent developments. *Phil. Trans. R. Soc.* 2016; *A*.374201502022015020 2http://doi.org/10.1098/rsta.2015.0202
[15] Mdoe N, Macha J. Gender and Rural Poverty in Tanzania: Case of Selected Villages in Morogoro Rural and Kilosa Districts. *LADDER working paper*; 2002.
[16] William A, Donkoh S, George N. Adoption of Bambara groundnut production and its effects on farmers' welfare in Northern Ghana. *African Journal of Agricultural Research*. 2016; *11*(7):583-594.
[17] Okello GO. Gender relations in beans crop production and marketing among smallholder farmers in homebay county [Masters thesis]. Nairobi, Kenya: University of Nairobi; 2018.
[18] Tegegne Y. Factors affecting adoption of legume technologies and its impact on income of farmers: The case of Sinana and Ginir Woredas of Bale Zone. MSc thesis in Agricultural Economics. Haramaya, Ethiopia: Haramaya University; 2017.
[19] Nyasimi M, Kimeli P, Sayula G, Radeny M, Kinyangi J, Mungai C. Adoption and dissemination pathways for climate-smart agriculture technologies and practices for climate-resilient livelihoods in Lushoto, Northeast Tanzania. *Climate*. 2017; 5(3):63.
[20] Lugamara CB. Determinants of Smallholder Farmers' Adoption and Willingness to Pay for Improved Legume Technologies in Tanzania. *Tanzania Journal of Agricultural Sciences*. 2021; 20 (2):245-260.
[21] Anang B, Bäckman S, Rezitis A. Does farm size matter? Investigating scale efficiency of peasant rice farmers in northern Ghana. *Economics Bulletin*. 2016;36(4):2275-2290.
[22] Makate C, Makate M, Mango N, Siziba S. Increasing resilience of smallholder farmers to climate change through multiple adoption of proven climate-smart agriculture innovations. Lessons from Southern Africa. *Journal of Environmental Management*. 2019; 231:858-868.
[23] Ojiewo C, Omoigui L, Pasupuleti J, Lenné J. Grain legume seed systems for smallholder farmers: Perspectives on successful innovations. *Outlook on Agriculture*. 2020;49(4):286-292.
[24] Mhango W, Snapp S and Phiri G. Opportunities and constraints to legume diversification for sustainable maize production on smallholder farms in Malawi. *Renewable Agriculture and Food Systems*. 2013; *28*(3):234-244.
[25] Snapp S, Cox C, Peter B. Multipurpose legumes for smallholders in sub-Saharan Africa: Identification of promising 'scale out'options. *Global Food Security*. 2019;23:22-32.
[26] Ditzler L, van Apeldoorn D, Pellegrini F, Antichi D, Bàrberi P, Rossing W. Current research on the ecosystem service potential of legume inclusive cropping systems in Europe. A review. *Agronomy for Sustainable Development*. 2021; 41:1-13.
[27] Ruelle M, Asfaw Z, Dejen A, Tewolde-Berhan S, Nebiyu A, Tana T *et al*. Inter-and intraspecific diversity of food legumes among households and communities in Ethiopia. *PloS One*. 2019;14(12):e0227074.
[28] Vanlauwe B, Hungria M, Kanampiu F, Giller K. The role of legumes in the sustainable intensification of African smallholder agriculture: Lessons learnt and challenges for the future. *Agriculture, ecosystems & environment*. 2019;284:106583.
[29] DeJager I., Abizari A, Douma J, Giller K, Brouwer D. Grain legume cultivation and children's dietary diversity in smallholder farming households in rural Ghana and Kenya. *Food* Security. 2017; 9:1053-1071.
[30] Ferreira H, Pinto E, Vasconcelos M. Legumes as a cornerstone of the transition toward more sustainable agri-food systems and diets in Europe. *Frontiers in Sustainable Food Systems*. 2021; 5:694121.