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Gender Disparities in the Adoption of Drought Tolerant Legumes a Case of Farmer Research Network Project, Singida District, Tanzania

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Abstract:- Legumes are an important and affordable source of protein for the majority of poor Tanzanians. In addition, intercropping legumes and cereals improves soil fertility and increases farmers' productivity. However, smallholder farmers remain poor, mostly producing at the subsistence level. Therefore, the study aimed at assessing gender disparities in the adoption of legumes (pigeon peas and lablab), using the Singida-RECODA-Farmer Research Network (FRN) project as a case study. Specifically, it determined the project's gender sensitivity, differences in adoption of pigeon peas and lablab and the associated challenges faced by the project beneficiaries. The study adopted a cross-sectional research design, whereby a questionnaire was used to collect primary data from 205 randomly selected respondents; this was complemented by focus group discussions and key informant interviews. In addition, secondary data was obtained from the project's documents. IBM-SPSS and content analysis were used to analyze quantitative and qualitative data respectively. The question to whether the RECODA-FRN Project was gender sensitive was answered through study findings which shows that the RECODA-FRN Project was gender sensitive, and it created an equal opportunity for all gender groups to fully participate, thus, enabling them to adopt the legumes. In addition, the question to how adoption of legumes differ in terms of sex was addressed as findings show a positive and significant ($p \leq 0.05$) association between ones sex and adoption of pigeon peas, unlike lablab. Nonetheless, one's age was not significantly associated with the adoption of either pigeon peas or lablab. Additionally, in identifying challenges faced by the RECODA-FRN project beneficiaries, the study findings show that farmers faced many challenges in cultivation of the legumes these include pests, limited availability of seeds, the legumes not being preferred for household consumption, limited availability of land, and lack of markets. Thus, it is recommended that women's access and control over land needs to be improved to enable them engage better in legumes production for their households improved well-being. In addition, the RECODA-FRN project and Singida district council's agricultural department need to educate the farming community about lablab's potential and how to produce it in such a way that it does not interfere with the growth of other crops. Lastly, the farmers need training on better, environmentally friendly ways of controlling the pests and diseases currently affecting the productivity of pigeon peas and lablab.

Keywords:- *Smallholder farmers, Gender disparities, Adoption, Legumes, pigeon peas, labla, Tanzania*

I. INTRODUCTION

Legumes generally contribute to both the sustainable intensification of production and the livelihoods of smallholder farmers in many parts of the world [1]. In addition, they are used both as food for humans and animal feed and are also essential in the improvement of soil fertility. Therefore, intercropping legumes with cereals increases productivity and ultimately contributing to households' income and food security [30]. In Sub-Saharan Africa (SSA), legumes play a significant role in supplying affordable protein at the household level, enhancing nutrition and health, and enhancing soil fertility through ground cover, weed control, and nitrogen fixation [3];[39];[40];[21]. Moreover, when compared to meat and fish, legumes serve as a good and affordable source of protein [21].

Both government and non-government entities have been at the forefront of transforming smallholder farmers' subsistence agriculture in an attempt to foster community development. In so doing, the diffusion of agricultural technologies is necessary to achieve this; hence, many strategies and projects incorporating farmers have been developed. Such projects foster farmers' adoption of technology, including the application of improved seeds to boost productivity [47]. For example, the Research, Community and Organizational Development Associates (RECODA), is a non-government organization and implemented the Farmer Research Network (FRN) project under the McKnight foundation in Singida district council since (2016), promoting adoption of improved pigeon peas and lablab technologies which are the drought tolerant legumes this study focused on [16]. In addition, the project was in acknowledgement of the inherent opportunity to meet the demand for pigeon peas and lablab in Singida region and worldwide. Furthermore, there was a need for diversification and for coping with climate change through the use of drought-tolerant seeds (pigeon peas and lablab). Hence, the establishment of the RECODA-FRN project, which aimed at promoting intercropping of maize and pigeon peas, or lablab, for increased productivity [16].

In general, farmer adoption of technologies is influenced by many factors, including gender disparities, whereby adoption is frequently not the same for men and women and age groups, and this change over time due to persistent disparities between men and women. The disparities are in terms of levels of participation, access to resources, rights, or remuneration of benefits [4]. Consequentially, men have been reporting higher productivity relative to their female counterparts. In addition, women farmers have been constrained in terms of their access to resources, including time to engage in agricultural activities due to limited finances and access to and control over land [4]. The above limitations constrain women's effective engagement in agriculture, including the adoption of different technologies that lead to their economic dependency on husbands, spouses, or other male relatives. Consequently, the constraints result in a lower diversification of food within households as women are responsible for food selection and preparation, affecting food and nutritional security [4].

Furthermore, globally, there has been a concern to empower women in the agricultural sector for the purpose of bridging the existing gender gap with new knowledge and technologies in the sector [41]. In addition, gender sensitization has proven to be the means towards gender equity, equal opportunity, and women's empowerment in pursuit of sustainable development [53]. The Tanzaniangovernment has made significant efforts to create gender-responsive policies and implementation techniques on the consequences of climate change, which continue to have an impact on rural livelihoods and particularly food security, thus calling for increased gender mainstreaming [5]. The study reveals efforts to be applied by projects fostering adoption of pigeon peas and lablab and including effective gender mainstreaming through the integration of gender into policies, development plans, and implementation strategies that are funded by budgetary allocations in the agricultural sector [5].

Generally, sensitizing gender in agricultural projects has proven to achieve project results, improve performance, and strengthen the impact on reducing poverty [18]. The agricultural sector in sub-Saharan Africa (SSA) remains critical to most of the countries' economies and for women, who are often at the center of households' productivity [54]. Adoption of legumes that are climate resilient has been one of the foremost initiatives taken on by most organizations fighting climate change in Tanzania. The current comparative studies on the adoption of legumes emphasize the overall concept of adoption and its causal relationship to success or failure more than they do on specific socio-demographic characteristics that may be crucial in affecting adoption, such as gender [31]; [29]; [2]. Therefore, the paper examines gender disparities in the adoption of legumes (i.e., pigeon peas and lablab) as promoted by the FRN Project in Singida district by focusing on the project's gender sensitivity, the adoption of both legumes, as well as identifying the challenges faced by the project beneficiaries in the adoption of the legumes by gender.

- **Gender: g**ender can be conceptualized as a social and cultural construct that highlights the contrasts between the traits of men and women, as well as between boys and girls, and, in turn, makes reference to the roles and obligations of men and women [51]. Consequently, gender-based roles and other characteristics evolve over time and depend on various cultural settings. The two basic characteristics of gender in the current study are sex and age, with age being segmented into early maturity, mid-maturity, late maturity, and pre-senile age groups, which range from 25 to 37, 38 to 49, 50 to 61, and 62 and above, respectively [11].

  In project design, it is common to overlook women in leadership, managerial, and beneficial positions; hence, the significance of gender analysis to avoid gender inequalities [18]. Therefore, gender sensitization is crucial in lowering inequalities in projects where there is a disproportion in treatment between men and women, where the latter are less favored [38]. Moreover, where gender inequalities persist, they should be prompted and the differences addressed [52]. Consequently, when gender is related to power, position, class, and responsibility, it not only affects the relationship between men and women in a society but also fosters a project's inefficiency [6].
- **Pigeon peas and lablab legumes**: The FRN Project focused on promoting intercropping of maize and the legumes pigeon peas and/or lablab, which is easily achieved if there is a higher rate of adoption of the legumes by men and women of all age groups. Lablab (Lablab purpureus) and pigeon peas (Cajanus Cajan) are legumes that promote increased income production and dietary diversification based on their economic and nutritional value [36]. And by using seeds that could withstand drought, the FRN project sought to address the requirement for diversification and adaptation to climate change.

  Lablab is a summer-growing and short-lived perennial forage legume with twining or climbing characteristics that can reach lengths of 3–6 meters [14]. Generally, lablab can withstand temperatures as low as 3°C for brief periods and thrive best in climates with daily temperatures between 18 and 35°C and an annual rainfall between 650 mm and 2500–3000 mm [14]. Lablab beans have proven to endure heat and drought, hence, their suitability for climate change [12]. Lablab is a multipurpose legume that can be used as food, fodder, or ethno-veterinary medicine [14].

  On the other hand, pigeon peas are a predominant tropical crop that grows best at temperatures between 26°C and 30°C during the wet seasons and between 17°C and 22°C during the post-rainy season [48]. Pigeon peas are commonly grown in Asian and African countries. Its nutrition value is recognized by it being rich in protein, minerals, fat, and carbohydrates [48].

II. THEORETICAL FRAMEWORK

The study on which the paper is based was guided by two theories. First, there is Rogers' diffusion of innovation theory (DIT), and second, is the Technology Acceptance Model (TAM) due to the adoption process involving an interrelated series of personal, cultural, social, and institutional factors [33]. Rogers' diffusion of innovation covers the cultural, social, and institutional factors, while the technology acceptance model mostly focuses on the personal factors. Together, the two theories provide a better understanding of the FRN project beneficiaries' adoption of pigeon peas and lablab. Generally, Rogers' DIT seeks to explain how, why, and at what rate new ideas, technology, or innovation spread over time among the participants in the social system [37]. And TAM explains that system use can be explained or predicted by user motivation, which can be influenced by perceived ease of use, perceived usefulness, and attitude towards the use of the system [8] [9].

III. METHODOLOGY

A. Description of the stud area

The study was conducted in Singida district, Singida Region due to the implementation of the RECODA-FRN project. The district has a surface area of 3,787 sq. kilometers, with 66% of the land being used for agriculture. The district has one parliamentary constituency, namely North Singida, and it is divided into three divisions, namely Mgori, Ilongero and Mtinko. The three divisions are further subdivided into 21 wards, 84 villages, and 433 hamlets [26]. Specifically, the study was conducted in 5 wards, Ilongero, Merya, Ikhanoda, Mwasenya and Mtinko, a total of 8 villages i.e Sekoture, Mwakiti, Msimihi, Mdilu, Mvae, Mughanga, Minyenye and Mtinko were involved.

B. Research design

The study is mostly descriptive, and it adopted a cross-sectional research design whereby data was collected once [35]. Generally, the design permits the assessment of different groups of people with specific characteristics and allows data collection at a single point in time fairly quickly [49]. Data collected through this design also allows for the determination of a causal-effect (association) relationship among variables [40], [28]. In addition, the study used a mixed-methods approach whereby both quantitative and qualitative primary data were collected using a pre-structured questionnaire, focus group discussions, and semi-structured interviews. Secondary data was obtained from the RECODA-FRN project reports covering different periods; the records were acquired from the project implementers.

C. Sampling and sampling procedures

The study population included all the RECODA-FRN project beneficiaries (male and female) in the above mentioned eight villages mentioned above. The 8 villages had 16 farmer groups with 17 to 39 members, summing to a total of 420 participants: 323 females and 97 males. Simple random sampling was used to acquire the respondents for the survey, thus, every case in the population had an equal probability of inclusion [46]. For the household survey, the Taro Yamane formula was used to determine the study's sample size i.e. $\nu = N/(1+N\varepsilon^2)$ where N was the population size (420) and e the margin of error based on the 95% confidence level 0.05 [55]. The corrected sample size (n) was 205.

In addition to the above, for the three FGDs, purposive sampling was used to get 8, 9, and 10 participants for men's group in Mwakiti village, women's group in Sekoture village, and both men's and women's group in Mtinko respectively. A total of 18 key Informants (KIs) were interviewed; these included the RECODA-FRN Project Officers (2) and Farmer Group Leaders (16) from each group. Generally, key informants are people with relevant information on a particular issue [46].

D. Data collection

A mixed research approach was employed, in which both quantitative and qualitative data were collected. Quantitative data were collected from the 205 respondents using the KoboCollect software. Since data is saved on the smartphone after it is collected, the Kobocollect tool is simple to use and may be utilized in locations without access to the internet. As regards to qualitative data from FGDs guide and KIIs, an FGD guide and KI checklist were used respectively. Three FGDs were conducted. Project reports and project documents acquired from project implementerswere used to determine the project's gender sensitization.

E. Data analysis

Quantitative primary data gathered through the questionnaire was analyzed using IBM-SPSS (version 20). Before the analysis, the data was coded and cleaned. IBM-SPSS was used to determine descriptive statistics (frequencies, ranges, means, and percentages). In addition, Chi-Square tests were performed to compare groups. Furthermore, multiple response analysis was used to disaggregate challenges identified by the RECODA-FRN project beneficiaries in the adoption of pigeon peas and lablab by gender. In analyzing the technology specific challenges, frequency analysis was done to determine the counts and percent for each predetermined challenge, and secondary analysis was done by applying YEH'S Index of Perception (YIP) to rank farmers' responses from the highest to the lowest (Table 1). The formula $YIP = (B–\Omega)/N$ was applied, where B is the number of people who perceived an attribute positively (i.e., good), W is the number of people who perceived an attribute negatively (i.e., bad), and R is the total number of responses. The results have been presented using tables and figures. If the p-value was less than 0.05, differences or associations between variables were deemed statistically significant. Lastly, content analysis was used in the analysis of the qualitative data collected through the FGDs and KIIs, whereby themes were identified based on the study's objectives.

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Yeh's Index of Satisfaction	YIP	Level of satisfaction
Less than 0.20	1	Very Low
0.20 – 0.39	2	Low
0.40 – 0.59	3	Medium
0.60 – 0.79	4	High
0.80 and above	5	Very high

Table 1: Rule of Thumb of Yeh's Index of Satisfaction[56], [57]

IV. FINDINGS AND DISCUSSION

- **Socio-demographic characteristics**

According to the study findings, the majority (95.1%) of respondents had formal education, mostly primary school education and above, whereas 87% of the above adopted pigeon peas and 14% adopted lablab. There are only 3 farmers who attained education beyond secondary school, of which 2 adopted pigeon peas and none adopted lablab. More educated farmers might be more familiar with a technology and its advantage, which they can pass along to other farmers. However, some may be wealthy enough to be less excited about spreading knowledge about fodder legumes, which they perceive as a hassle [45].

The majority (89.3%) of the respondents were married, which is connected to land ownership. And the majority (49.39%) of the respondents indicates use land co-owned by their spouses to produce the adopted legumes. Ref [10] argues that, men are granted the right to choose their own agronomic practices, land ownership and rental arrangements, types of crops to cultivate, and the use of crucial agricultural inputs due to the power relationship and decision-making structure. Based on the results shown in Table 2, 88% of the married respondents adopted pigeon peas and 14% adopted lablab while 89% and 12% are the respondents who co-own land with their spouses had adopted pigeon peas and lablab, respectively.

Respondents living in large sized householdsi.e with more than 9 members accounted for over third (35.69%) of the respondent's population and medium-sized households with 5-8 members accounted for over a half (53.7%) of the respondents. . Household size is important as it influences adoption by being a source of labor [27]. The adoption of new technology is easily facilitated by large family sizes; this is conceivable given that the majority of farm operations require a lot of labour, which justifies the use of family labor [7].To reduce costs in farming activities, the majority of respondents use family labour instead.

Despite all respondents engaging in farming to earn a living, majority (66.8%) of the respondents' main occupation is business. In the FGD, women claimed that most of them engage in traditional brewing and are market vendors. It was also mentioned that women work in stereotypically male occupations such as masonry, bricklaying, and beekeeping. In one of the FGD with women only, it was pointed out that women tend to engage more in income generating activities because they are the real breadwinners, while men take the credit. The quote below emphasizes the above:

"*We have to earn money for the sake of our children. Our husbands are drunkards, and they spend most of their money with their mistresses. Alcoholism can even lead to violence, which makes the children fear their fathers, so children end up asking their mothers for their school needs. As a mother, you must have money that your husband is not aware off*." (FGD participant, Sekoture village, Tunaweza, December 17, 2021).

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Characteristic			Adopters			Non-adopters		
			Male	Female	Total	Male	Female	Total
PIGEON PEAS	Education level	No formal education$_{(n=10)}$	20	80	100	0	0	0
		Primary$_{(n=159)}$	37	50	87	3	10	13
		Secondary$_{(n=33)}$	67	21	88	3	9	12
		Beyond secondary $_{(n=3)}$	67	0	67	33	0	33
	Marital status	Single$_{(n=7)}$	29	57	86	0	14	14
		Married$_{(n=183)}$	45	43	88	3	9	12
		Widowed$_{(n=8)}$	13	88	100	0	0	0
		Separated$_{(n=7)}$	0	71	71	0	29	29
	Household size	1-4$_{(n=22)}$	50	5	55	5	41	45
		5-8$_{(n=110)}$	43	9	52	3	45	48
		> 8$_{(n=73)}$	37	11	48	3	49	52
	Main occupation	Farmer$_{(n=43)}$	42	42	84	2	14	16
		Employee$_{(n=25)}$	72	16	88	8	4	12
		Business$_{(n=137)}$	36	53	89	2	9	11
	Land ownership	Bought$_{(n=26)}$	58	27	85	0	15	15
		Spouse$_{(n=101)}$	61	28	89	6	5	11
		Inherited$_{(n=78)}$	10	77	87	0	13	13
LABLAB	Education level	No formal education$_{(n=10)}$	0	10	10	20	70	90
		Primary$_{(n=159)}$	7	7	14	33	53	86
		Secondary$_{(n=33)}$	12	0	12	58	30	88
		Beyond secondary $_{(n=3)}$	0	0	0	100	0	100
	Marital status	Single$_{(n=7)}$	0	0	0	29	71	100
		Married$_{(n=183)}$	8	5	14	40	46	86
		Widow/Widower$_{(n=8)}$	0	0	0	13	88	100
		Separated$_{(n=7)}$	0	29	29	0	71	71
	Household size	1-4$_{(n=22)}$	14	5	18	41	41	82
		5-8$_{(n=110)}$	7	9	16	38	45	84
		> 8$_{(n=73)}$	5	1	7	34	59	93
	Main occupation	Farmer$_{(n=43)}$	2	5	7	42	51	93
		Employee$_{(n=25)}$	16	0	16	64	20	84
		Business$_{(n=137)}$	7	7	15	31	55	85
	Land ownership	Bought$_{(n=26)}$	15	12	27	42	31	73
		Spouse$_{(n=101)}$	11	1	12	56	32	88
		Inherited$_{(n=78)}$	0	10	10	10	79	90

Table 2: Respondents Socio-demographic characteristics and their adoption of the RECODA-FRN Project Introduced Legumes in percent (n=205)

In the FGD with male participants, it was mentioned that men's main business activities or income-generating activities are trading and fishing. Some men also own small businesses in the markets. The men also pointed out that their wives are cooperative when it comes to supporting their businesses financially in order to earn more income.

V. RECODA-FRN PROJECT'S SENSITIVITY

The study's first specific objective was to determine RECODA-FRN projects' gender sensitivity. Therefore, to achieve the above goals, content analysis was conducted on the project's plans, legislation, tagline, and implementation. The detailed findings and discussion are presented hereunder.

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- ***Project's plans:*** Generally, the content analysis of the project proposal "Engagement of Farmer Research Networks in Assessment of Intercropping Pigeon Peas, Lablab, and Knowledge Sharing for Livelihood Improvement in Singida" shows that one of the objectives was to explore the dynamics that influence information sharing leading to the adoption of the legumes with reference to gender related factors. Therefore, the project implementers were able to realize at the onset that gender-related issues could in one way or another impact the adoption of pigeon peas and lablab in the project area. Therefore, RECODA, as implementers of the FRN project, understood the importance of being gender sensitive in their efforts to spread pigeon peas and lablab technologies in Singida district. Therefore, they ensured there was gender balance so as to facilitate the rapid spread of the above-mentioned legumes and their associated technologies. Recognizing the unique gender demands makes it easier to associate them with investments and actions while addressing the issues that may hinder project or program outcomes [15].

Furthermore, the RECODA-FRN project did seek to address equity in its implementation, notably in terms of access to productive resources for women and youth. Therefore, management of soil health, access to land, and dietary diversity were to be studied in relation to gender. In a nutshell, the project's goal was to better understand how gender affects food and nutritional security and, in so doing, collaborate with the local government authority (Singida District Council) and another local NGO, the Singida Environmental Management Agents (SEMA), in promoting gender equality. Other studies have reported that women play a key role in achieving household food and nutrition security at the farming level [19]. With such understanding, the involvement of government and non-government entities to empower women can be effective in achieving food and nutrition security. Ref [50] argue that addressing gender equity at the project planning level generally allows easy mainstreaming of gender issues throughout the project cycle and therefore increases the likelihood of achieving its goals.

- ***Project principles****:* It is clear from the content analysis of the project's document that it was gender sensitive. Moreover, even the project's principles revolved around its three main elements: farmers, research, and networking. Therefore, under the category of farmers, it was clearly pointed out that efforts will be in place to ensure marginalized groups such as women and the youth are actively engaged in the project and in a meaningful way. As a result, the project was designed and implemented with the goal of promoting gender equality. For example, under the research component, there is a principle that clearly states that "research effectively addresses farmers' problems and opportunities and is continually adapted based on reflection on experiences by FRN members." In addition, the principle points out that there are problems being faced by the beneficiaries, and that based on the principle targeting the marginalized, the project was out to resolve matters raised by representatives from every gender group, including the marginalized. Hence, the concept of gender is implicitly captured. Ref [42] argue that, for a project to successfully address the socio-economic demands of a varied community, gender equality through project principles must be a basic part of the project's design and implementation.

Further to the above, the content analysis also showed the FRN project's guarantee that "Networks support learning and knowledge sharing among all members" clearly stipulates its intention to promote equality among all of its beneficiaries without exclusion. As a result, people of all genders can benefit from the same opportunities for learning and knowledge sharing. Therefore, it is evident that the RECODA-FRN project was gender sensitive right from its planning, initiation, and implementation. Ref [20] points out that, gender equity and inclusivity in learning and knowledge sharing increase the achievements of agricultural projects and programs.

- ***Project's Tagline/Slogan:*** Findings from the study show that the slogan used by the project implementers and the beneficiaries, i.e., "Njaa na umasikini kuwa historia, inawezekana," is literally translated as "It is Possible for Hunger and Poverty to Become History." Therefore, households and the community as a whole could be freed from the bonds of poverty and hunger. Consequently, the marginalized groups, i.e., women and youth, will lead better lives. Furthermore, one of the objectives of the FRN project was to understand the role of gender in enhancing food and nutritional security. And based on the culture in Singida district and as established in Table 3, women make choices in relation to their households' meals, specifically when a household can consume legumes. Therefore, if all women and the youth are on board, the FRN project could lead to an assurance of food and nutritional security at the household and community level. Ref [13] argues that the roles played by women at the household level, in particular meal preparation and what to eat, can significantly influence food and nutritional security.

Decision Maker	Frequency	Percent
Father	6	2.9
Mother	170	82.9
Children	10	4.9
Parents	11	5.4
Other member	8	3.9

Table 3: Households decision making in relation to meals (n = 205)

Generally, nutrition security can best be achieved when individuals have nutrition awareness. Therefore, a good understanding of the nutrition value of specific foods such as legumes can foster their productivity and consumption. Women and mothers, who make the majority of household meal selection decisions (82%), require empowerment when it comes to land access and control (Table 2). Ref [13] contends that women require control over farm land in order to continue playing an important role in food and nutrition security at the household and community levels. Nonetheless, best results can only be achieved through the involvement of all gender groups, i.e., men and women, youth, and the elderly. In addition, smallholder farmers, both as producers and consumers, can see a reduction in poverty and malnutrition due to nutrition-sensitive programs [19].

- ***Project's implementation***: Analysis of the RECODA-FRN project reports (2017–2019) revealed that gender issues needed further exploration through surveys, capacity building, and research. Therefore, through the project's self-interrogation, it was possible to be more gender sensitive as per one of its goals, as shown in Figure 1. Lastly, the project's ability to be gender sensitive was made easier through one of its principles: "Farmers from marginalized groups should have meaningful representation in the network." As shown in Figure 1, leadership positions were equitably shared among male and female beneficiaries, though there were many more male chairpersons (87.5%). Nonetheless, this was counteracted by the fact that female beneficiaries were the majority (93.75%) of group treasurers. Ref [25] argues that, improving women's and youth's representation and engagement in projects is crucial for economic development.

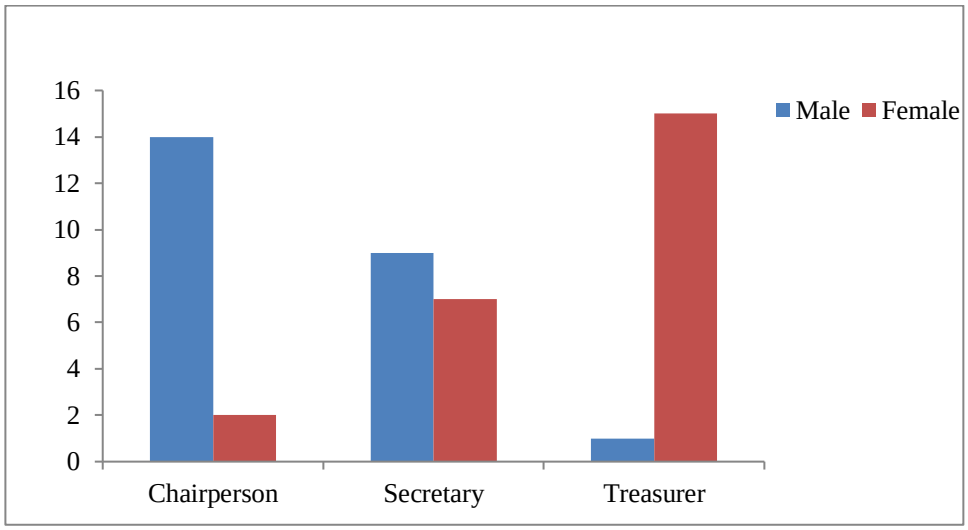

Fig. 1: Leadership of the FRN Project Farmers' Groups by Sex (n = 24)

VI. RECODA-FRN BENEFICIARIES' ADOPTION OF PIGEON PEAS AND LABLAB BY SEX

Generally, study findings (Table 4) show that whereas the majority (87.8%) of project beneficiaries had adopted pigeon peas, only a few (13.2%) had adopted lablab. Most farmers seem to prefer farming pigeon peas to lablab. Most farmers have adopted pigeon peas because they have proven to be very versatile as food, animal feed, a source of firewood, a good source of income, beneficial in improving soil fertility, and nutritionally beneficial (Table 5). It was observed that those who had adopted Lablab could, be referred to as "early adopters," with the majority of them being of a higher social status such as leadership or higher economic status that set them apart from non-adopters [37]. Table 5 also shows that adopters prefer farming lablab for the same reasons raised by pigeon pea adopters as to why they prefer growing the legume, but neither of the stated reasons was mentioned by 50% of lablab adopters.

Sex	Rejected PP		Adopted PP		Rejected LL		Adopted LL	
	n	%	n	%	n	%	n	%
Male	6	24	85	47	76	42.7	15	56
Female	19	64	95	53	102	57.3	12	44
Total	**25**	**100**	**180**	**100**	**178**	**100**	**27**	**100**

Table 4: Distribution of the adoption of pigeon peas (PP) and lablab (LL) by sex (n = 205) in count and percent

Findings in Table 4 show that most pigeon adopters are women, but most lablab adopters are male farmers. Majority (55.6%) of the sample population (55.6%) is female, which explains why most (53%) of the legume (pigeon pea) adopters were women. Early adopters have a peculiarity and are entitled to an advanced social or financial status, of which men have the prerogative [37]. Ref [32] point out that in most societies with any gender gap; men are entitled to higher status and peculiarities.

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Reason for preference	Pigeon peas (n=180)		Lablab (n-27)	
	n	Percent	n	Percent
Good source of food	164	93.3	10	37
Good income source	135	75	13	48.1
Animal feed	114	63.3	11	40
Improves soil fertility	147	81.6	12	44.4
Source of firewood	98	54	3	11.1
Nutritional benefits	134	75	6	22.2

Table 5: Reasons for the RECODA-FRN Legumes Adoption based on preference

VII. COMPARISON OF ADOPTION OF PIGEON PEAS AND LABLAB BY GENDER GROUPS

According to the study findings (Table 6), a farmer's sex was significantly ($P \leq 0.05$) associated with pigeon pea cultivation, with 93% and 83% of males and females cultivating pigeon peas, respectively. Due to that significance, the study rejects the null hypothesis, which states that "adoption of pigeon pea legume does not differ on farmer's sex' and confirms the alternative hypothesis, which is not the case for lablab, where the study fails to reject the null hypothesis, and cannot accept the alternative hypothesis stating 'adoption of lablab legume differs on farmer's sex."

In terms of age, the findings (Table 6) show that there is no significant difference by age group in terms of adoption of both pigeon peas and lablab, whereas in this case, the study cannot accept the alternative hypotheses "adoption of pigeon peas legumes differs on the farmer's age" and "adoption of lablab legumes differs on the farmer's age." The study's finding is in line with studies which reported that the sex of the household head significantly and positively affects adoption, with female-headed households having a higher likelihood of adoption [24]. However, they have less control over resources such as land, labour, financial services, and time. Findings in Table 6 further show that age is not significantly associated with adoption of either pigeon peas or lablab. The finding is in line with a study which report that age is not a significant factor in determining the adoption of agriculture technologies; rather, it is possible that the social structures and systems, simplicity of the particular technology, and acceptance from an individual level are well-established as a way of life and have been incorporated into cultural practices among the beneficiaries, which can then influence the adoption of a technology [22].

The study also found that a farmer's gender and age were not significantly ($P \leq 0.05$) associated with lablab adoption. Lablab as a crop is seen to be rejected by the majority(86.82%) of the respondents due to the challenges that come along with its farming, as illustrated in Table 7. Ref [45] argue that the lack of a significant association between sex and age and the adoption of a technology is typically due to farmers' lack of real interest in the same.

Legume	Sex	Age Group	Rejected	Adopted	Exact Sig. (2 sided)	
					Age group	Sex
Pigeon Peas	Female (n_F=114)	Early maturity	30	70	0.188	0.032
		Mid maturity	17	83		
		Late maturity	10	90		
		Pre-senile age	13	88		
	Male (n_M=91)	Early maturity	5	95	0.766	
		Mid maturity	10	90		
		Late maturity	5	95		
		Pre-senile age	0	100		
Lablab	Female (n_F =114)	Early maturity	87	13	0.868	0.220
		Mid maturity	92.7	7.3		
		Late maturity	88.1	11.9		
		Pre-senile age	87.5	12.5		
	Male (n_M=91)	Early maturity	85.7	14.3	0.506	
		Mid maturity	75.9	24.1		
		Late maturity	86.5	13.5		
		Pre-senile age	100	0		

Table 6: RECODA-FRN Beneficiaries Adoption of pigeon peas (PP) and Lablab (LL) by Sex and Age (n = 205)
NB: n_F = Number of Females and n_M = Number of Males

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VIII. CHALLENGES FACED BY THE RECODA-FRN PROJECT BENEFICIARIES IN ADOPTING PIGEON PEAS AND LABLAB

The RECODA-FRN beneficiaries faced two sets of challenges. The first set includes all the challenges raised by RECODA-FRN beneficiaries, and the second set involves the predetermined challenges for farmers in adoption. Generally, whereas the challenges facing the adoption of pigeon peas and lablab were somehow similar, their ranking differed, as shown in Table 7. As regards pigeon pea adoption, over a third (36.8%) pointed out limited availability of seeds as a major challenge, followed by the legume not being a preferred food in their households (25%), and pest invasion (19.1%). Other difficulties included a scarcity of and limited access to land, particularly for women. The study's finding conforms that pests' invasion and shortage of seeds are major challenges faced by most farmers engaged in pigeon pea farming [17].

Findings in Table 7 also show that the major challenge faced by the RECODA-FRN project beneficiaries in the adoption of lablab farming was pest invasion (21.1%), followed by limited availability of seeds (20%), and legumes not being preferred for household consumption (19.4%). The issue of pests was raised by both men and women. Lablab was generally disliked by households due to its bitter taste. Other difficulties included a lack of available land, a dependable market, and the destruction of other crops because their growth habits interfered with those of the surrounding crops by intertwining (Table 7). Farmers claimed that lablab, when intercropped with other crops like millet, wrapped itself around the other crop, affecting its growth and consequently its yield. As regards Lablab's market, the beneficiaries claimed its market is very poor as most people are unaware of the crop to begin with. The other mentioned challenge was the availability of land, whereas farmers claimed they have no extra land to farm lablab separately, and intercropping leads to the above-mentioned challenge, which was a concern for both men and women. The study's findings are in line with what has been reported in the literature. For example, there are studies which reports that one of the major challenges raised by farmers in farming lablab is seed availability, quality, and pricing, which can be addressed through the engagement of "farmer clusters" in the informal production of seed [23]. In addition, there is a study which shows that farmers cultivating legumes face a number of obstacles that ultimately affect their productivity [43]. The challenges include a lack of markets, a lack of good quality seeds, and limited control over land, pests, and disease attacks.

Challenge		Male	Female	n	%	Ranking
Pigeon Peas (n = 68)	Pest Invasion	1	12	13	19.1	3
	Limited seeds availability	8	17	25	36.8	1
	Not preferred for HH consumption	0	17	17	25.0	2
	Limited land access	0	3	3	4.4	5
	Lack of market	3	7	10	14.7	4
Lablab (n = 205)	Pest Invasion	46	54	100	21.1	1
	Limited seeds availability	34	61	95	20.0	2
	Not preferred for HH consumption	42	50	92	19.4	3
	Limited land access	24	25	49	10.3	6
	Lack of market	20	30	50	10.5	5
	Pest Invasion	35	54	89	18.7	4

Table 7: Challenges Faced by the RECODA-FRN Project Beneficiaries adoption of pigeon peas and Lablab

Further to the above challenges, Table 7 presents the predetermined challenges of adopting pigeon peas and lablab farming. Generally, the predetermined challenges of farming pigeon peas and lablab were analyzed using Yeh's Index of Perception Analysis (YIP), which was created and used by Yeh in 1972 to gauge the extent of people's perceptions. YIP has been used in numerous studies and has been successful in describing satisfaction levels [57]. Yeh's Index of Satisfaction can be obtained by subtracting the number of respondents who are unsatisfied from the number of satisfied ones and then dividing the difference by the total number of responses. As presented earlier in Table 1, Yeh's Index of Perception spans from -1 to +1. (1975). Ref [56], illustrates the general principles of Yeh's Index of Satisfaction. Table 1 lists the values and corresponding levels of satisfaction identified by [56]; [57]. The pre-determined challenges are based on the factors that may influence adoption, as pointed out by [37].These includes relative advantage, complexity, compatibility, observability, and trialability. The challenges were rated on a Likert scale, and YIP analysis was applied to measure the perception and experience of the technology in relation to pigeon peas and lablab farming. The YIP's predetermined challenges for the adoption of pigeon peas and lablab farming are as presented in Table 8. Generally, the level of agreement of the YIP index of satisfaction with the technologies promoted by the RECODA-FRN project is very high for pigeon peas compared to lablab farming, with most in the range of -0.75 to -0.98, 0.98 compared with those of lablab which are in the range of -0.26 to +0.47. Therefore, the results from the YIP analysis seem to suggest the following:

- *Complexity*: This is the degree to which a technology is seen as difficult to comprehend and apply. Most members of a social system can quickly understand some technologies, while others are more complex and will spread more slowly [37]. The high negative YIP values shown for pigeon peas suggest that it is not complicated in its farming process, unlike lablab, which has low positive YIP values, implying it is a complicated crop to farm (Table 8).

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- *Relative advantage*: the degree to which an innovation is thought to be superior to the concept it replaces is known as relative advantage [37]. Whether the technology has a lot of "objective" advantages is less important to an individual, what matters is whether a person sees the innovation as beneficial [37]. Objective advantage in this context refers to the value of the technology being serving its purpose. With pigeon peas, YIP for both males/men (-0.82) and females/women (-0.75) are negative meaning that benefits of farming pigeon peas supersede benefits from farming other legumes hence, it does not stand as a challenge. On the other hand, YIP values for lablab farming are negative for both men (-0.26) and women (-0.18) suggesting the benefits of farming lablab at present are less compared to farming of other legumes, nonetheless, they are minor.
- *Observability:* The extent of an innovation's results or outcomes as they may be seen by other people is referred to as its "observability" [37]. Generally, people are more inclined to adopt innovations if they can easily and quickly see the benefits [37]. When a new idea is visible, it encourages conversation among peers as friends and neighbors of the adopter inquire about the innovation's appraisal. Pigeon peas have a very high negative YIP value, which means that there have been observed benefits among the farmers with regard to farming pigeon peas. However, the observed benefits for farming lablab are not as high as those for pigeon peas (Table 8), which explains why RECODA-FRN beneficiaries are hesitant to adopt it (see sub-section 1.6.2).

Challenge		**Sex**	**Disagree**	**Neutral**	**Agree**	**Total**	**YIP**
Pigeon pea	Farming is complicated	M	82	2	7	91	-0.82
		F	97	5	12	114	-0.75
	Benefits do not supersede other legumes	M	88	2	1	91	-0.96
		F	105	9	0	114	-0.92
	Non-observable benefits	M	89	2	0	91	-0.98
		F	112	0	2	114	-0.96
	Non-participation in trials/demo plots	M	89	2	0	91	-0.98
		F	111	2	1	114	-0.96
	Non-compatibility	M	88	3	0	91	-0.97
		F	111	3	0	114	-0.98
Lablab	Farming is complicated	M	18	17	56	91	0.42
		F	20	20	74	114	0.47
	Benefits do not supersede other legumes	M	35	45	11	91	-0.26
		F	37	61	16	114	-0.18
	Non-observable benefits	M	64	14	13	91	-0.56
		F	91	15	8	114	-0.73
	Non-participation in trials/demo plots	M	67	17	7	91	-0.66
		F	68	38	8	114	-0.53
	Non-compatibility	M	53	34	4	91	-0.54
		F	63	45	6	114	-0.50

Table 8: Explains why RECODA-FRN beneficiaries are hesitant to adopt it

NB; M= Male, F= Female

- *Trialability:* this is the extent to which a new idea can be put to the test. With pigeon peas and lablab, farm demonstration (demo) plots were used for trials, and almost every farmer was predicted to have participated in the trials [37]. With pigeon peas, the YIP values are very high and negative, implying that almost every farmer participated in the trials; hence, it was not a challenge. The YIP values of lablab are also negative but not as high as those for pigeon peas (Table 8). Ref [16] argues that farmers, who engaged in the project trials, ranked the maize-pigeon pea intercrop as the best due to the grain-legume mix and were also able to describe the trial protocols and the data that were gathered and analyzed. Ref [16] continues by saying that engaging farmers in trials may have exposed more farmers to the new technologies than a traditional on-farm trial.
- *Compatibility:* the degree to which an innovation is regarded as compatible with the environment [37]. Pigeon peas have very high negative values of YIP for both men and women, meaning that they are compatible with the environment compared to lablab which has medium negative YIP values. Ref [34] reported that the importance of creating technologies that take into account local realities can be effortlessly recognized, and this is frequently the main goal of many projects. However, it appears there are practical challenges in accomplishing compatibility given that many technologies have not been adopted in smallholder systems [34].

IX. CONCLUSION AND RECOMMENDATIONS

Based on the study's findings, it is generally concluded that the adoption of legumes introduced to farmers in Singida district by the RECODA-FRN project differs between the two legumes, i.e., pigeon peas and lablab, and in the context of gender, only sex has proven to show a significant association when it comes to the adoption of pigeon peas. It is also concluded that household decision-making over the use and control of resources, land tenure; and access to financial resources, all of which are in favor of men, in a way hinder women's adoption of legumes. It is also concluded that pigeon pea adoption differed significantly by gender but not by age group. Thus, there is a need for more efforts to allow both men and women to actively participate in the cultivation of pigeon peas and lablab for increased food and nutritional security. It is further concluded that most farmers adopted pigeon peas but not lablab because the latter is found to be a less preferred food due to its bitterness. In addition, lablab was deemed incompatible when it came to intercropping with other crops, millet in particular.

It is also concluded that the RECODA-FRN was gender sensitive from its conception, inception, and implementation, and that this was based on having clear guiding principles. Lastly, it is concluded that the adoption of pigeon peas and lablab by farmers faced some challenges, the most prominent ones being the unavailability of seeds, pest invasion, households' dislike of the legumes as food, and a lack of readily available markets. Nonetheless, most of the pre-determined challenges in the adoption of the introduced legumes did not seem to bother the farmers but were instead factors that fostered adoption.

Based on the study's findings and conclusions, the following are recommended:

- Legumes may be more widely embraced if women have more control over production resources in a particular land. Women's increased access to and control over land will allow them to properly plan their cultivation of legumes for both household consumption and trade. The RECODA-FRN project and similar projects should initially isolate gender dynamics in the study area rather than linking them to fit the project's goal in order to fully comprehend the dynamism and implement the project without any gender blindness.
- Efforts need to be made by the RECODA-FRN project and Singida district council to enable the project beneficiaries and other farmers' access reliable markets for both pigeon peas and lablab. Doing the above will increase the farmer's income and encourage many others to adopt the introduced legumes.
- The RECODA-FRN project and Singida district council's Agricultural Department need to educate the farming community about lablabs' potential and how to produce it in such a way that it does not interfere with the growth of other crops cultivated by households. Doing so could increase the lablab adoption rate in Singida district, thus enabling households to improve their living standards in terms of food security and income earned.
- The RECODA-FRN project and Singida district council's agricultural department need to train the farmers on better, environmentally friendly ways of controlling the pests and diseases currently affecting the productivity of the introduced pigeon peas and lablab.

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