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DETERMINANTS OF DEMAND AND SUPPLY OF MICROCREDIT AMONG FISH FARMERS IN OSUN STATE

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Abstract. With the help of microcredit, a farmer's way of life could be transformed from one of utter destitution to one of greater dignity. For the poor and disadvantaged, especially rural farmers, it unlocks potential and increases productivity and well-being. This study investigated the determinants of demand and supply of microcredit among fish farmers in Osun State. A multi-stage sampling procedure was used to select 150 fish farmers and 50 microcredit providers for the study. Data were analyzed using descriptive statistics and a simultaneous equation model. The result revealed that many fish farmers are males (86.5%), married (77%), and educated (95%). Simultaneous equation estimates revealed that farmers' income, age, interest rate, and educational level determine microcredit demand among fish farmers whereas liquidity, experience in lending, and interest rate determine the microcredit supply in the study area. The findings of the study revealed that microcredit suppliers consider several factors before supplying credit to fish farmers.

Keywords: economic principles, loan, Nigeria, pisciculture, simultaneous equation

INTRODUCTION

Millions of people worldwide rely on the fishing sector for their means of subsistence. Nigerians' well-being is also significantly impacted by fish farming. When compared to other sources like beef, mutton, and chicken in Nigeria, fish is a less expensive form of animal protein (Omowa, 2016; Sogbesan and Kwaji, 2018; Olaleye et al., 2019). It is a significant food source that is priceless for the protein it offers and the industrial items it generates. As a component of the global diet that contributes to sustained food security, fish has economic, social, and cultural significance.

Compared to beef, chicken, mutton, and turkey, it is generally less expensive (Omoare et al., 2013; Kehinde, 2022). Fish is the cheapest source of animal protein, making up around 40% of a typical Nigerian's daily intake (FDF, 2007; 2010). According to studies, consuming fish can help prevent the spread of malnutrition-related illnesses like anemia and kwashiorkor as well as other illnesses (Olagunju et al., 2007; Oke and Kehinde, 2019). It is impossible to overstate Nigeria's economic dependence on fish farming. About one-third of Nigeria's GDP comes from the fish farming industry (Olaoye et al., 2013; Baruwa and Omodara, 2019). The industry makes up around 373 billion naira of Nigeria's GDP (CBN, 2012; Omodara et al., 2021). Fish farming provides job and wealth-creation chances to many people who make their livings from fisheries-related activities, helping to improve the socioeconomic standing of the populace (Olagunju et al., 2007; Kehinde, 2022). Given the widespread adoption of fish farming in Osun State, there is potential for job development, youth empowerment, and poverty alleviation in the Nigerian fish farming

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industry (Oyedele and Akinola, 2012). Fish could provide raw materials for the agro-industry, particularly feed mills (Esu et al., 2009; Oke and Kehinde, 2019).

Despite the fact that fish has health, economic, and consumer benefits, there is a significant supply and demand imbalance (Baruwa and Omodara, 2019; Omodara et al., 2021). Nigeria's ever-increasing demand for fish, which is now satisfied by importation, calls for a supply of 2.04 million metric tons (Kudi et al., 2008; Fisheries in Nigeria, 2013; Omowa, 2016; Baruwa and Omodara, 2019). To make up the difference, Nigeria imports fish worth $500 million annually, or around 0.7 million metric tonnes (Baruwa and Omodara, 2019). Nigeria imports fish on a yearly basis for a cost of over 288 billion naira (CBN, 2017; Omodara et al., 2022). The enormous disparity between Nigeria's demand and supply for fish is caused by a number of factors. These problems, among others, include the difficulty in obtaining financing and the absence of credit availability for fish farmers. Due to a variety of constraints, many fish farmers do not have sufficient access to official sources of funding (Oke and Kehinde, 2019; Kehinde, 2022). These restrictions include high-interest rates, bureaucratic roadblocks, delayed approval, collateral requirements, guarantors, lack of nearby banks, payment defaults, lack of information, attitudes, and insufficient credit (Nwaru et al., 2011; Oke et al., 2019; Omodara et al., 2021). According to Olasunkanmi (2012) and Kehinde and Ogundeji (2022), an insignificant number of farmers had access to bank loans. Alternatively, attention has shifted to microcredit (Kolapo et al., 2021). According to Frank et al. (2013), microcredit is a small loan given to smallholders, particularly those in the agriculture sector. The loans are often unsecured and awarded based on the applicant's moral character and the business's cash flow (CBN, 2012). The basis for the demand for credit in Nigerian agriculture is the reality that agricultural investment expenditures exceed anticipated returns (Kehinde, 2020).

Microcredit is the provision of extremely tiny loans that are not bankable to unemployed people, underprivileged business owners, and other people in poverty (Orimogunje et al., 2020; Kolapo et al., 2021). These people do not meet even the minimal requirements for formal credit since they lack collateral, stable employment, and verifiable credit histories (Tata and Prasad, 2005).

Microcredit services have historically been offered in Nigeria, mostly to low-income rural and urban people. Low-wage workers organize themselves into self-help clubs, where members trade funds and credit cards. Other unofficial sources of microfinance include cooperative societies and money collectors known as "Baba Alajo" (Kolapo et al., 2022). The goal of microcredit institutions is to aid those who are unable to obtain credit in overcoming poverty and funding self-employment activities. It is underlined that offering microcredit to small and medium-sized businesses has been a key tool in promoting the growth of industrialization, enhancing the effectiveness of the business, and increasing their production. For a business to expand, microcredit is necessary. Investment and the increase of merchants' revenue are hampered by loan availability. Because of the perceived risky nature of small firms and the lack of government guarantee programs to cover the loan, commercial banks are hesitant to provide loans to the private sector, especially SMEs. One cannot overstate how crucial microcredit is to fish farmers, especially those who are less privileged (Nosiru, 2010; Oke and Kehinde, 2019). Microcredit enables fish farmers to buy the inputs required for production and increases the value of fish (Nosiru, 2010). As a result, successive Nigerian governments have introduced a variety of microcredit sources, including the Bank of Agriculture (BOA), Bank of Industry (BOI), commercial banks, microfinance or community banks, and cooperative organizations in an effort to spread the use of microfinance in Nigeria (Kolapo et al., 2022). The new policies also promote borrowing from family, friends, and private lenders. Any of these local providers of microcredit could offer loans to fish producers. The mechanism used by the majority of microfinance institutions to distribute credit to farmers is a group approach (Kehinde et al., 2021). This is explained by the fact that they give loans to farmers using social collateral instead of conventional, physical, or financial collateral, i.e., the borrowers' reputation (Kehinde et al., 2021). Following this, BOA and/or BOI urge fish producers to form fish cooperatives so they can apply for microcredit.

Although microcredit is of great importance to the sustenance of fish farming, many fish farmers find it extremely difficult to access the credit (Oladele, 2006; Omodara et al., 2021). This implies the existence of a gap between the demand and supply of microcredit among fish farmers (Adebayo and Adeola, 2008; Olasunkanmi, 2012). This was often ascribed to the fact that only crop producers were able to secure loans from the microcredit scheme among other reasons (Olaoye et al.,

2011; Olasunkanmi, 2012). Furthermore, the demand and supply of microcredit are influenced by several factors such as personal attributes of the individual, area-specific attributes, and credit source attributes (Udoh, 2005; Olasunkanmi, 2012; Sarma and Borbora, 2015; Samphantharak and Townsend, 2018; Aligbe et al., 2018). These attributes influence individuals differently irrespective of their gender such that what might determine the demand for credit by a particular female farmer might be different from what determines credit demand by another farmer. For instance, Aligbe et al. (2018) indicated that age, educational level, household size, annual income, farming experience, and farm size are determinants of demand for credit while the household size of farmers, annual income of farmers, gender, and farm size have a significant influence on credit supplied to the farmers. In line with this, Nwaru et al. (2011) revealed that farm income, profit, education, and interest amount determined demand whereas liquidity, experience in lending, and interest amount determined the supply of microcredit. Several other studies also show contradictory results with either negative, insignificant, or positive effects of the determinants. The literature on the determinants of credit demand and constraints is varied. Some studies focus on the demand for credit generally among households, irrespective of the purpose of the credit (Akpandjar et al., 2013). Other studies focus on the determinants of demand for credit among smallholder farmers in rural areas (Ssonko and Nakayaga, 2014; Tura et al., 2016; Umanath et al., 2018). Some studies focus solely on the determinants of credit constraints (Ali et al., 2014; Chandio and Jiang, 2018).

However, accessing microcredit is pertinent to transforming the well-being of fish farmers (Norton et al., 2010; Tijani, 2011). But the amount accessed for fish production is one of the major factors critical to lifting small-scale farmers above the subsistence level and enabling cushioning of the fish business against risks (Weber and Musshoff, 2012). Despite this, studies (Tijani, 2011; Nwaru et al., 2011; Oyedele and Akintola, 2012; Frank et al., 2013) have concentrated on the determinants of credit demand and supply among crop farmers. Not many studies have been carried out regard to fish farmers (Olaoye et al., 2017). To the best of our knowledge, no research has been carried out to investigate determinants of credit demand and supply among fish farmers, especially in the southwestern region of Nigeria. In addition, the few available studies on microcredit (Ajani and Tijani, 2009; Balogun and Yusuf, 2011; Olaoye et al., 2017) focused on the demand side of microcredit, neglecting the supply side. Other studies such as Mohamed (2003), Guiso et al. (2004), Okurut (2006), and Mpuga (2008) addressed the issue of access to micro-credit without referring to effective size. Whereas access to microcredit and the amount accessed is more of a supply-side issue related to the potential lender's choice of the maximum credit limit (Nwaru et al., 2008; Aligbe et al., 2018). Therefore, the need for urgent attention to reviving fish enterprises necessitates researching the supply of credit among fish farmers. This fact initiated the need for this research. This paper focuses on the factors affecting the demand and supply of microcredit among fish farmers in Osun State. Specifically, it describes the socio-economic characteristics of fish farmers; it analyses factors affecting microcredit supply and demand among fish farmers. Analyzing the factors influencing the demand and supply of credit would have significant policy implications which would be helpful in redressing the relative decline from low patronage of credit facilities. The paper is structured as follows: section two contains the literature review, and section three introduces the empirical models and provides a brief description of our estimation procedure of the simultaneous equation model. Section four presents the results and discussion. The conclusion and policy implication of the study is provided in section five.

LITERATURE REVIEW

Nigeria has inland water surface areas of about 14 million hectares, of which 1.75 million are available and suitable for aquaculture (Olaoye et al., 2013). Aquaculture is primarily a vast land-based industry in Nigeria, where it is carried out in freshwater at subsistence levels (Olaoye et al., 2013). Commercial farming is still not very common (Fagbenro, 2005). Currently, the majority of fish farmers run small-scale operations with ponds that range from 25 to 40 meters in length to small clay ponds (0.02–0.2 hectares). More than 85,000 tons of fish were produced by the sector (FDF, 2008; Olaoye et al., 2013). Despite Nigeria's rich fishery resources and relatively high fish consumption (FDF, 2005; 2008), the country's 0.62 million metric tons of fish supply is insufficient to meet the 2.66 million metric tons of demand (FDF, 2008). To increase the amount of fish farming production now being done in Nigeria, new fish farms

must be built. Despite the interest that the government and the commercial sector have so far shown in fish production in general, fish farming currently has a relatively low growth rate. This may be caused by a lack of access to microcredit among other things. For fish firms to become more commercialized and intensive, credit is a crucial tool. However, the expansion of fish farms has been hampered by insufficient financing access. Both Hanson and Menezes (1971) and Orimogunje et al. (2020) pointed out that people only borrow money because it offers them control over products and services rather than because they want it for their own sake. As a result, smallholders' access to loans could boost family income and assist the impoverished in building up their savings to engage in job-generating ventures (Germidis et al., 1991; Oke et al., 2019).

Rural farmers in Nigeria can obtain finance from formal and informal sources, respectively (Badiru, 2010). Commercial banks like the Nigerian Agricultural Bank (NAB) and Micro Finance Institutions are two formal credit providers. NGOs, cooperative societies, support groups, farmers' associations, rotating savings and credit associations (ROSCAs), businesses, traders, loan sharks, rural shopkeepers, clubs, and saving societies like "Esusu" and "Ajo", as well as friends, family, and spouses are among the informal sources of credit (Badiru, 2010; Okojie et al., 2010). The informal credit sources provide loans to farmers in exchange for agricultural produce, generally in exchange for repayment in cash or kind. Most of the time, these sources don't demand a deposit relationship and there's no need for collateral (Badiru, 2010). Due to this, informal sector financing continues to be Nigeria's principal source of credit for the rural economy, making credit facilities more accessible to small rural holders. Both the supply and demand of credit are greatly influenced by numerous factors. Individual characteristics of the person, regional characteristics, and credit source characteristics could be split into variables (Udoh, 2005). These characteristics have distinct effects on people regardless of their gender, therefore what influences one farmer's demand for credit may not necessarily influence another farmer's demand for credit.

Several scholars have made an effort to explain the variables influencing farmers' access to finance (Izekor and Alufohai, 2010; Alufohai, 2006; Alufohai and Ahmadu, 2005). According to Asekome and Ogbechie (2011), financing is difficult to obtain and, when it is obtained, moneylenders charge rates that are too high for micro-enterprises to afford. The high rates increase the cost of capital and have a detrimental influence on the farm enterprise's yearly turnover. According to Asekome and Ogbechie (2011), farmers purchase inputs at inflated prices since they are unable to do so in wholesale marketplaces, which lowers their profit margins. The aforementioned highlights the necessity of making sufficient loanable funds accessible to farmers on time, at low-interest rates, and to the amount necessary to make returns on investment more alluring, according to Ikhelowa (2011). However, it's unclear how much financing farmers actually received in comparison to how much they requested. In addition to the borrower's age, farm size, educational background, distance to technical services (in kilometers), household size, socioeconomic associations like age grade, co-operative societies, farmer and women's associations, the total amount of money a borrower would have requested will also depend on favorable borrowing and investment conditions (Ewuola and Williams, 1995). Considering the rate of interest and profitability as one of the borrowing and investment conditions, a farmer would borrow funds when the expected rate of return from the project is greater than the cost of the borrowed funds.

Government regulatory controls, interest rate ceilings, loan limitations, collateral requirements, expensive administrative and procedural costs, and subsidized discounts further hinder the ability of formal credit institutions to perform their duties (Srinivas, 1993). Due to this reduction in market share, there is a big imbalance between the supply and demand of credit (Hoff and Stiglitz, 1998). The advantages of the unregulated money supply, quick accessibility, cheap liquidity, minimal administrative and procedural expenses, little to no collateral, flexibility in interest rates, and payback schedules are where the unregulated credit markets enter the picture (Srinivas, 1993). Fouillet and Augsburg (2007) looked into the program's many regional reaches and have suggested solutions to India's supply and demand imbalance. They have discovered that one of the key elements influencing the availability of microcredit is the cost of credit. By charging borrowers high-interest rates, Swain (2002) has discovered that the credit markets are characterized by high borrowing costs and high demand for credit. Allathia (2008) asserts that transaction costs, such as those associated with information, supervision, monitoring, and hazards, have an impact on the availability of MFIs. These cost elements cannot simply be

separated, since they are sequential, overlap, and connect to one another. The gap between demand and supply for microcredit, according to Massar et al. (2002), is not due to a lack of funding but rather to the prudential policies, high penetration rates, subpar performance, political climate, and security issues of MFIs. Additionally, according to Zeller (1994), informal lenders and group members learn about the wealth, debt, and income possibilities of loan applicants. As a result, ration loans require a thorough assessment of the whole household's wealth and leverage. Accordingly, Nwaru (2004) found that while the gross income of the lender, the total cost of lending, the source of the loan, the worth of the loan application, and previous loan repayment significantly influenced credit supply, credit demand was significantly influenced by interest rate, the educational level of the farmer, the amount borrowed previously, the size of the farm, and gross savings.

MATERIAL AND METHODS

Studied area

This study was carried out in Osun State, Southwestern Nigeria. Osun State lies within latitudes 6º and 9º N of the equator and approximately between longitudes 2º and 7º E of the Greenwich meridian (Anamayi et al., 2010). It is one of the land-locked states of the Federal Republic of Nigeria. It covers an estimated area of 8,062 square kilometers (Olasunkanmi et al., 2012). The state runs an agrarian economy with the vast majority of the populace taking to farming. The state is a typical rainforest with mean annual rainfall varying between 880mm and 2600mm and is characterized by forest vegetation. Ọsun State is an inland state. It is bounded in the north by Kwara State, in the east partly by Ekiti State and partly by Ondo State, in the south by Ogun State, and in the west by Oyo State. Osun State is divided into three federal senatorial districts, each of which is composed of two administrative zones. Osun consists of thirty Local Government Areas, the primary (third tier) unit of government in Nigeria. Osun state is divided into three (3) senatorial districts, namely: Osun east, Osun west, and Osun central. Each senatorial district is made up of 10 local government areas (LGA). Osogbo is both the commercial center and the capital of Osun state. The majority of the residents of Osun State engage in fish farming.

Sampling technique and sample size

The two-stage sampling procedure was used to obtain data for the study. The first stage involved a simple random selection of 5 local government areas (LGAs) from each senatorial district. The second stage involved the

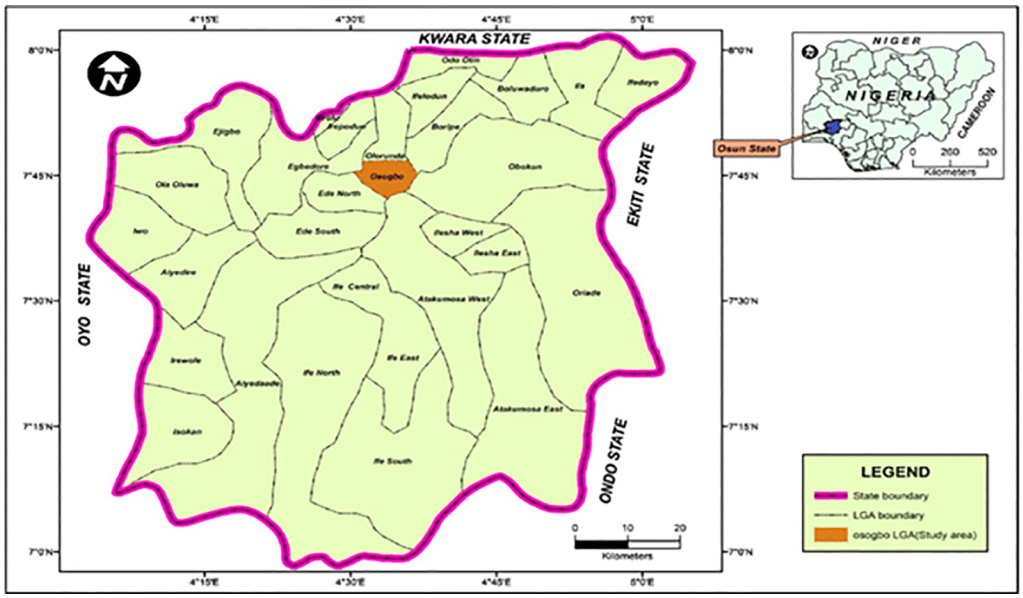

Fig. 1. Map of Osun State

selection of 50 micro-credit agencies from the LGAs using a snowballing technique. Also, in the second stage, 30 fish farmers were randomly selected from LGAs. A total number of 150 fish farmers and 50 microfinance agencies were selected for the study.

Analytical technique and model

Descriptive statistics and a simultaneous equation model were used to analyze the data collected.

Simultaneous equation model

Following Nwaru et al. (2011), the study employed two equations in a schematic fashion of simultaneous modeling to determine factors affecting the demand and supply of microcredit. The model contains two equations explaining the variables with interrelationships. The model assumes that demand and supply of credit inter-dependently determine the viability of the fish enterprise and consequently, the welfare of fish farmers. Therefore, the models contain the demand for microcredit equation and the supply of microcredit equation. The model contains 2 equations in 2 endogenous variables that influence each other. The model adopts a two-stage estimation procedure to reduce the incidence of multicollinearity and eliminate the effect of simultaneous equation bias through the reduced form equations.

Employing 2SLS estimation techniques, the equations of the model are therefore specified as follows:

Demand function:

$$Y_1 = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + a_7X_7 + \mu_1 \ldots \quad (1)$$

Supply function:

$$Y_2 = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + \mu_2 \ldots . \quad (2)$$

In the demand equation:

Y_1 – amount of microcredit demanded (₦)

The explanatory variables are: X_1 – years of education (years); X_2 – pond size (square meters); X_3 – gender (1 = male; 0 = female); X_4 – farmer's income (₦); X_5 – interest rate (%); X_6 – household size (number); X_7 – age of farmers (years) and μ_1 – error terms.

The inclusion of these independent variables in the model was based on a previous expectation of the variable used and a review of the literature. These independent variables are expected to influence the amount of microcredit demanded (Table 1). The farmer requested the whole amount of microcredit, regardless of whether it was granted. The farmer's total number of years spent in formal education is referred to as years of education. The income that farmers received from farming the prior year is known as farm income. The number of individuals that share the farmer's home and are subject to his care is referred to as the household size. The entire sum that the farmer paid in interest charges on borrowed funds is known as the interest rate. For male farmers, the gender was specified as one, while for female farmers, it was zero. The total pond area that is being used is the pond size. Age refers to how long the fish farmer has been alive.

In the supply equation:

Y_2 – amount of microcredit supplied (₦)

Table 1. Description of variables

Variables	Unit	Expected sign	Description
Age	Year	±	Measured in years
Gender	Dummy	±	1 = male, 0 = female
Income	Naira	+	Measured in Naira
Household size	Number of persons	±	Measured in the number of household members
Pond size	Square meter	±	Measured in square meters
Education	Years spent in school	±	Measured in years spent in school
Interest rate	The percentage charged on credit	–	Measured in percentage charged on credit

Source: own elaboration.

Table 2. Description of variables

Variables	Unit	Expected sign	Description
Liquidity of the lender	₦	±	Measured in Naira
Business leverage of credit institution	₦	±	Measured in Naira
Experience in leading	Years	±	Measured in years
Interest rate	The percentage charged on credit	±	Measured in percentage charged on credit

Source: own elaboration.

The explanatory variables are: X_1 – liquidity of the lender (₦), X_2 – business leverage of the credit institution (₦), X_3 – experience in lending (years), X_4 – interest rate (%), X_5 – type of credit (0 = credit with no collateral; 1 = credit with minimum savings), μ_2 – error terms.

The inclusion of these independent variables in the model was based on a previous expectation of the variable used and a review of the literature. These independent variables are expected to influence the amount of microcredit supplied (Table 2). The total amount of money the lender was willing to make available for borrowing is used to calculate credit supply, and the lender's liquidity is represented by the current asset/current liabilities ratio of his farm business. Current debt and owner equity make up the lender's business leverage. The length of time a lender has been in the lending business is considered their lending experience. The entire sum that the lender got as interest fees on money lent is the interest rate. The microcredit typology is the kind of credit. U_i is the error term that is thought to satisfy every requirement of the traditional linear regression model.

RESULTS AND DISCUSSION

Socioeconomic characteristics of fish farmers

The socioeconomic characteristics of fish farmers are presented in Table 3. The average age of fish farmers is approximately 42 years. This shows that fish farmers are young and more energetic to carry out rigorous activities involved in fish farming. This is a prolific age range. Additionally, this result shows that very many young individuals work in fish farming, which bodes well for the future of fish production (Olowosegun et al., 2004). This is due to the fact that fish farming demands a lot of responsibility and proper attention. About 86.5% of fish farmers are male. This indicates that fish farming is dominated by male farmers. The claim made by Brummett et al. (2010) that men predominately participate in fishery activities can be used to support this outcome. Ekong (2003) agreed that marriage is highly regarded in our society. The reports of Fakoya (2000) and Oladoja et al. (2008), which argue that marriage puts some level of responsibility and commitment on those who are married, further supported this conclusion. The majority (77%) of the farmers are married. This shows that the farmers will be committed to the business because of the responsibility of the family. In Nigeria, marriage is sacred and confers some levels of responsibility on the individuals involved (Fakoya, 2000; Ekong, 2003). This finding indicated that responsibility/commitment which is in line with Adeoye et al. (2012) who reported 93.7% of the fish farmers in Ogun State are married. The average household size is 5 persons. This implies that the farmers have family labour that can assist with farming activities. This further implied a moderate household. There is the likelihood that the size of the household may influence the number of hired laborers, thereby

Table 3. Socioeconomic characteristics of fish farmers

Variable	Fish farmers
Age (yrs)	41.64 (12.12)
Male (%)	86.5
Married (%)	77
Household size (#)	4.55 (2.23)
Formal education (%)	95.8
Years of farming experience	7.44 (5.14)

Figures in parentheses are standard deviations.
Source: own calculation.

reducing cost (William et al., 2012; Amachree et al., 2019). The majority (95.8%) of fish farmers have formal education. This shows that literate farmers dominate fish farming in Osun State. This indicates that the educated class, particularly those with a high level of education, dominate fish farming. This is true because fish farming requires extensive technological and scientific expertise to be carried out successfully. The average number of years of farming experience is 7. This suggests that the fish farmers have a substantial amount of experience. The conclusion implies that respondents are not new to the industry and may have acquired abilities to mitigate risk. Experience improves efficiency because, as is often said, "experience is a good teacher". Respondents with experience greater than 5 years in the fish farming industry will have better skills and business strategies and be better able to predict market conditions that will allow them to sell their products for higher prices (Olaoye et al., 2013). The idea is also in line with the Schumpeterian theory of economic development, which suggested that technical efficiency was influenced by technical knowledge and understanding in addition to other socio-economic environments with which the farmers must take decisions (Amachree et al., 2019).

Determinants of microcredit supply among fish farmers

The F-value was significant (P = 0.000), suggesting strong explanatory power. This shows that the entire model is of best fit and significant at 1 percent. The determinants of microcredit supply among fish farmers are presented in Table 4. The coefficient of liquidity was positive and significant. This implies that an additional unit increase in the liquidity of the lender increases the supply of credit by ₦0.084. The relationship between the liquidity ratio and money supply is positive, indicating that the liquidity ratio is moving in the same direction as the money supply and higher levels of liquidity ratio are associated with higher levels of the money supply. According to Nwaru et al. (2011), who found that microcredit lenders readily release credit to potential borrowers based on the level of liquidity, this conclusion is consistent with their findings. The liquidity ratio is the percentage of total deposits that must be retained in designated liquid assets in order for the financial institution to be able to service depositors' cash withdrawal requests and maintain system credibility (Olweny and Chiluwe, 2012). Although it is widely acknowledged that the liquidity ratio is used to increase or decrease cash availability, researchers have argued that the primary purpose of the statutory reserve ratio is to allow for the floating of government securities (Otalu, 2014). In other words, informal lenders will adjust their credit supply upward in response to a higher level of liquidity. This result is in line with Tra and Lensink (2004) and Essien (2009) who indicated that informal lenders readily disburse credit to prospective borrowers based on the level of their liquidity. The coefficient of years of experience in lending was positive and significant. This suggests that an additional unit increase in years of experience in lending increases the supply of credit by ₦2.243. This implies that years of experience in lending have a direct relationship with credit supply. This is in line with studies from Essien (2009) and Nwaru et al. (2011), who found that the length of time a lender has been active in lending may help the lender avoid or minimize problems that arise from lending. The length of time a lender has been actively involved in lending may be a sign of the practical experience he has amassed on how to efficiently resolve lending-related issues. Such hands-on experience would enable him to handle loan applicants more effectively, carefully evaluating them for sincerity and sincerity. According to Nwaru et al. (2004; 2011), this would lower the risk associated with his loan portfolio and enhance the amount of credit available. The coefficient of interest rate was positive and significant. This is in line with the *a priori* expectations of the study. This suggests that

Table 4. Determinants of microcredit supply among fish farmers

Variable	Coefficient	Z-value	P-value
Constant	–1.635**	–2.26	0.026
Liquidity	0.084**	2.39	0.016
Experience in lending	2.243**	2.19	0.023
Interest rate	1.924**	2.48	0.013
Type of credit	2.983	1.56	0.210
Business leverage	–0.224	–1.10	0.270
R^2	0.65		
Adjusted R^2	0.52		
F value	24.98***		

Significance level: *10%, **5%, ***1%.
Source: own calculation.

an additional unit increase in interest rate increases the supply of credit by ₦1.924. This is consistent with Ugbomeh et al. (2008)'s report that the amount of credit offered rises with the rate of interest, which is the cost of money given. This conclusion supports the discovery by Nwaru et al. (2011) that the interest rate significantly influences the amount of credit extended.

The determinants of microcredit demand among fish farmers

The F-value was significant (P = 0.000), suggesting strong explanatory power. This shows that the entire model is the best fit and is significant at 1 percent. The determinants of microcredit demand among fish farmers are presented in Table 5. The coefficient of farmers' income is positive and statistically significant. This is in conformity with the findings of Cheng (2010) and Nwaru et al. (2011) who reported a positive and significant relationship between credit demand and farm income. This implies that a unit increase in farmer's income will increase credit demand by ₦2.972. This may be explained by the possibility of reinvesting farm profits in commercial ventures, which raises credit demand. Farmers with high incomes are also more likely to receive credit facilities from lenders since they have a better likelihood of repaying the loan. This result is in agreement with Nto (2006), Nwaru et al. (2008), and Essien (2009) who reported a positive and significant relationship between credit demand and farm income. The coefficient of the age of farmers was positive and statistically significant. This indicates that a unit increase in the age of the farmer increases credit demand by ₦3.336 (Ajagbe, 2012b). This suggests that as the respondents' ages increase, smallholder farmers are more likely to request agricultural credit, suggesting that older farmers are presumed to have amassed knowledge, experience, and a thorough understanding of lending institutions. As a result, the demand for agricultural credit will rise (Mignouna et al., 2011; Kariyasa and Dewi, 2013). This result is consistent with studies that have looked at similar topics, including Crook (2001), Diagne and Zeller (2001), Akram et al. (2008), Chen and Chivaku (2008), Akudugu et al. (2009), Akudugu (2012), Akpan et al. (2013), Mohammed et al. (2013), Hananu et al. (2015), and Mwonge and Naho (2022), which found that age is a significant factor in determining smallholder farmers' demand for credit. Therefore, the study concludes that age plays a pivotal role in influencing smallholder farmers' decisions for microcredit. The pond size was positive and statistically significant. This could indicate that a unit increase in pond sizes increases demand for credit by ₦6.240. This finding is consistent with the findings of various related studies (Uaiene et al., 2009; Simtowe et al., 2009; Oboh and Ekpebu, 2011; Mignouna et al., 2011; Akudugu, 2012; Abraham, 2014; Hananu et al., 2015; Mwonge and Naho, 2022). This implies that pond size plays a vital role as collateral security for granting credit. It also gives the farmers freedom to consider risk options in adopting new agricultural technologies which demand additional capital which might be obtained through credit. The coefficient of interest rate was negative and significant. This shows that a unit increase in the interest rate reduces credit demand by ₦2.886. The negative effect of interest rate indicates that a credit scheme with a higher interest rate lowers the probability of farmers' demand for microcredit and vice versa. This is in agreement with the finding of Nwaru (2004), Essien (2009) and Nwaru et al. (2011), Ibrahim and Aliero (2012), Ololade and Olagunju (2013), Assogba et al. (2017), and Mwonge and Naho (2022). Also, from the law of demand, the higher the price of a loan charged (that is, high-interest rate), the lower the credit demand. Therefore, the study concludes that farmers who perceived the interest rate charged by MFIs to be high are

Table 5. The determinants of microcredit demand among fish farmers

Variable	Coefficient	Z-value	P-value
Constant	–4.851**	–2.36	0.017
Farmers income	2.972*	1.88	0.059
Age of farmers	0.336**	2.19	0.028
Pond size	6.240***	3.95	0.000
Gender	–4.262	–0.85	0.394
Interest rate	–2.886***	–3.41	0.000
Family size	–1.257	–1.50	0.133
Education	3.002*	1.67	0.094
R^2	0.61		
Adjusted R^2	0.43		
F value	15.24***		

Significance level: *10%, **5%, ***1%.
Source: own calculation.

less likely to demand agricultural credit from them. The coefficient of years of education was positive and statistically significant. This shows that a unit increase in years of education increases credit demand by ₦3.002. This is consistent with the findings of Oladeebo and Oladeebo (2008) that highly educated household heads are more likely to have stable incomes and are better able to obtain finance from both formal and informal institutions, making them more prone to take risks than less educated farmers. Additionally, they are more likely to develop relationships with affluent people in their social networks who can provide unsecured loans. This is explained by the fact that people with literacy are able to read and submit better bank applications than people without literacy. In this sense, people with higher levels of education are more receptive to novel ideas and enhanced management techniques. These results are consistent with the findings of Barslund and Tarp (2008), Chen and Chivaku (2008), Ibrahim and Aliero (2012), Akpandjar et al. (2013), Ali et al. (2014), Duniya and Adinah (2015), Tang and Guo (2017), and Chandio et al. (2020). Their studies concluded that the formal schooling years of farmers enable them to cope with the procedure to gain formal credit.

CONCLUSION AND POLICY IMPLICATIONS

This study investigated the determinants of demand and supply of microcredit among fish farmers in Osun State. Data were analyzed using descriptive statistics and a simultaneous equation model. This study concluded that fish farmers were male, experienced, educated, and at an economically active age. Liquidity, experience in lending, and interest rate are determinants of microcredit supply among fish farmers while determinants of microcredit demand among fish farmers are farm income, age of farmers, pond size, and years of education. In implementing microcredit policy interventions for fish farmers, these significant variables should be taken into consideration. It could be concluded from this study that informal credit suppliers consider several factors before supplying credit to rural farmers. In accordance with the findings of the study, it is advised that measures be developed by the government and other organizations to help farmers overcome their financial hardships in order to lessen the negative effects of high-interest rates on demand for microcredit.

Action should be taken to lower the excessive interest rates that microcredit providers charge.

The financial policy should encourage financial institutions to create solutions that meet the needs of low-income farmers while still being profitable and incorporating low-interest rates into their portfolios. Additionally, suitable educational programs should be developed for fish farmers to improve their capacity to decide on the sum required to carry out a specific project with knowledge. It would be beneficial to create relevant educational programs for farmers, both formally and informally, such as evening classes and adult education initiatives. Finally, it should be highlighted that simply providing credit is insufficient to eradicate poverty and boost income and productivity.

In order to complement microfinance, another intervention needs to be put into place. Therefore, the operators of rural credit markets require suitable educational services, training, and skill development in order to manage productive and efficient businesses, as well as to secure an appropriate operational environment for informal credit operators and marketplaces for their products. The Central Bank of Nigeria (CBN) should provide an appropriate solution to deal with the issue of the inadequate capital base of informal micro-credit institutions.

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UTILIZATION OF SOIL FERTILITY MANAGEMENT PRACTICES AMONG ARABLE CROP FARMERS IN OSUN STATE, NIGERIA

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Abstract. This study examined the utilization of soil fertility management practices (SFMPs) among arable crop farmers in Osun state, Nigeria. Multistage sampling was used to select 160 arable crop farmers. Data were collected using a well-structured interview schedule and analyzed using descriptive statistics and Person Product Moment Correlation (PPMC). The results revealed that the majority of the farmers are married males, mostly aged 51 years old, with an average farm size of 2.6ha, and mainly growing maize (96.9%), cassava (91.9%) and yam (68.1%). The respondents use cultural methods, synthetic fertilizers and organic manure in that order as SFMPs. SFMPs are used at the following levels: cultural methods: ridging across the slope with a weighted mean score (WMS) of 2.81, rotational cropping (WMS = 2.66) and mulching (WMS = 2.47); synthetic fertilizers: NPK (WMS = 1.75) and urea (WMS = 1.27); organic manure: poultry manure (WMS = 0.77) and animal dung (WMS = 0.76). The major source of information for SFMPs was radio (95.6%). PPMC analysis showed that age ($r = 0.20$*; $p = 0.01$) and farm size ($r = 0.16$*; $p = 0.04$) are significantly related to the utilisation of SFMPs. In conclusion, the respondents were small scale farmers who mostly utilize cultural methods of SFMPs and are mainly influenced by crop type as a function of age and farm size.

Keywords: arable crop farmers, soil fertility management, socio-economic, information

INTRODUCTION

Arable crop production has remained a major component of all crop production activities in the agricultural subsector. Kindly delete 'including a large array of arable crops' These crops can be classified as cereals, legumes, roots and tubers, as well as horticultural crops. These crops are major sources of staple foods for people across the globe. A reduction in arable production will lead to a hike in the prices of available products and subsequently hunger and malnutrition. These crops differ in their soil and nutrient requirements (Adewumi et al., 2019).

Soil fertility is managed to conserve agricultural land and food security. Sustaining soil fertility and food security cannot be separated. The decrease in soil fertility is furthermore aggravated by continuous cropping, which results in nutrient depletion in the soil. As the human population increases, the indigenous farming system, such as shifting and fallowing, that used to be practiced by farmers to ensure soil fertility is being discontinued to continuously feed a large number of people (FAO, 2013).

Farmers use different methods to evaluate and identify their soils as fertile or infertile using soil colour, soil texture, depth, drainage and topography (Gebeyaw, 2015). The indigenous knowledge commonly used by farmers involves leaving of crop residues on the field.

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This is an organic matter management system. Some farmers apply animal waste or manure to their fields. Nutrient management is a vital factor for achieving the expected yield in arable crop production through the use of fertilizers, which is the major contributor to increasing productivity (Khoshgoftarmanesh and Eshghizadeh, 2011).

Xiaoying and Shubo (2015) reported that there is a transition in fertilizer application behaviour such that farmers now apply more fertilizers because of soil fertility decline and the desire to increase crop yield and density with the general use of chemical fertilizers instead of organic ones like animal manure and plant materials. However, this may not be true for different locations, thus the need to research the utilisation of SFMPs in Osun state.

Achieving the objective of this study combined the following tasks:

i. examination of the socio-economic characteristics of the respondents;
ii. identification of the arable crops cultivated by the respondents;
iii. identification of the various types of SFMPs used by the respondents as soil improvement strategies;
iv. identification of the level of utilization of SFMPs;
v. identification of the various sources of agricultural information on SFMPs.

Hypothesis of the study

The hypothesis was stated in a null form:

Ho_1: There is no significant relationship between the selected socio-economic characteristics of the respondents and the level of utilization of SFMPs.

MATERIALS AND METHODS

Procedure and sample size

The population of this study included all arable crop farmers in Osun state in the southwest of Nigeria. However, a multistage sampling technique was used to select the arable crop farmers across the state. The Osun State Agricultural Development Programme (OSADEP) has three agricultural zones (Ife/Ijesa, Iwo and Osogbo) with varying numbers of extension blocks. A random selection of two (2) extension blocks was made from each selected agricultural zone. Oriade, Obokun and Irewole were selected from Ife/Ijesa, while Iwo and Ola-Oluwa were selected from the Iwo Agricultural Zone. The next stage involved another random selection: three (3) extension cells from each selected extension block. The extension cells were selected based on the arable crop farmer's dominance and their involvement in arable crop farming. Furthermore, 30% of the farmers were randomly selected in each of the extension cells across the selected extension blocks that were used for this research work. The total number of respondents selected in Osun state was one hundred and sixty. Questionnaires and scheduled interviews were used to get information from the farmers.

Method of data analysis

The data for this study were analyzed by using descriptive and inferential statistics. The descriptive statistics included frequency count, percentages, mean, standard and weighted mean score, while the inferential statistics employed Pearson Product Moment Correlation (PPMC) to test the hypotheses.

RESULTS AND DISCUSSION

Respondents' socio-economic characteristics

Figure 1 shows the respondents' socio-economic characteristics.

Age of the respondents: About 33.5% of the farmers are aged between 41–50, 33.8% are between 51 and 60, 18.4% are above 60, 7.6% are between 31 and 40, 7.0% are between 21 and 30, while 0.6% are 20 or less. The farmers' mean age is 51.2. This reveals that most of the respondents are aged between 41–60. Igbalajobi et al. (2013) noted that Nigerian arable crop farmers are ageing. This is similar to the report of Adeola et al. (2014), who found that the average age of the farmers in southwestern Nigeria was 49.3%. This conforms with the report of John (2012) and Mahapatra (2019) that the average age of an Indian farmer is 50.1, while that of a US farmer is 58 (Zuluf, 2020), that of a Japanese farmer is 67, and that of a European farmer is more than 65. Ng'ombe et al. (2014) argued that age significantly influences perception and farmers' knowledge.

Sex of the respondents: Figure 1 shows the distribution of the respondents' sex. 72.2% of the respondents were male, and 28.7% were female. This study reveals that there is a dominance of male farmers in arable crop farming in the selected states, which could be attributed to the energy-demanding activities involved. Amanze et al. (2012) found that men participate more actively

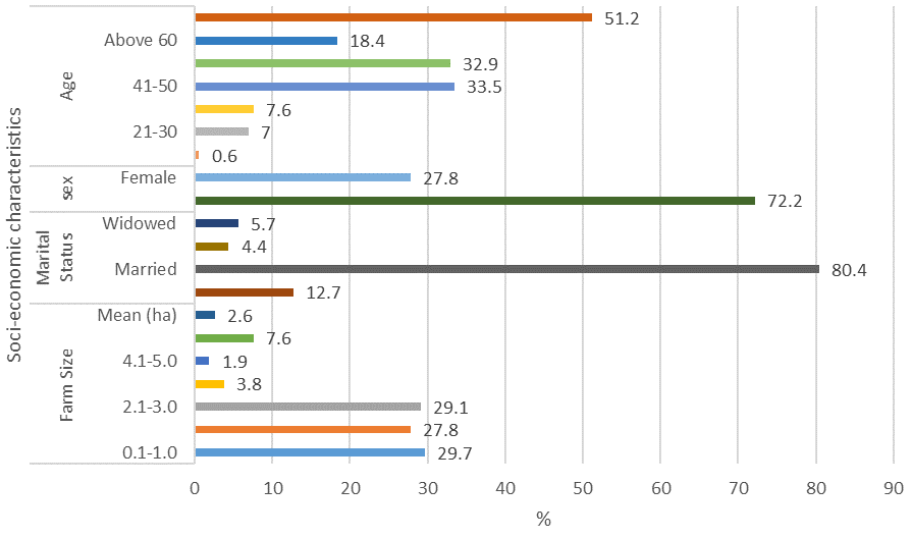

Fig. 1. Socio-economic characteristics of arable crop farmers
Source: field survey, 2021.

in arable crop farming than women, and Orifah et al. (2018) also observed that the dominance of males in farming could be a reflection of traditional restrictions placed on women which limit their right to own land and input resources in the study areas.

Marital status of the respondents: The respondents' marital status revealed that 12.7% are single, 80.4% are married, 4.4% are divorced, and 5.7% are widowed. This result shows that more than 80% are married. Ojediran et al. (2020b) suggested that marriage encourages people to explicitly focus on high-yielding activities such as farming to produce enough crops for domestic consumption and sales to satisfy other cash needs. The views of married people are respected within the rural communities (Ogunsumi, 2010; Adeola et al., 2017).

Distribution of the respondents by farm size: The distribution shows that about 29.7% have a farm size between 0.1–1 ha, about 27.8% have between 1.1–2.0 ha, 29.1% have between 2.1–3.0 ha, 3.8% have 3.1–4.0 ha, 1.9% have 4.1–5.0 ha, 7.6% have more than 5 ha, and the average farm size cultivated by the respondents is 2.6 ha. Adeola et al. (2017) also established that the average farm size used for cassava cultivation in Oyo State was 2 hectares. This result shows that arable farmers in southwestern Nigeria are small scale farmers and this could lead to more intensive and efficient use of land resources. Kassie et al. (2015) revealed that small landowner farmers in rural Tanzania were more liable to adopt intercropping, chemical fertilizers and conservation tillage as their integrated soil fertility management practices.

Arable crops cultivated by the respondents

The distribution of arable crops cultivated by the respondents is shown in Fig. 2. The respondents planted maize (96.6%), cassava (91.9%), yam (68.1%), cowpea (33.1%), okro (25.6%), cocoyam (25.6%), Pigeon pea (2.5%), pepper (20.0%), melon (18.1%), potatoes (12.5%), tomatoes (8.9%) and soybean (6.3%). This shows that most of the farmers cultivate cassava, maize and yam. This is in line with the work of Adeola and Adetumbi (2015), who found that most of the farmers in southwestern Nigeria plant maize and cassava.

Types of SFMPs employed by the farmers

Figure 3 shows the types of SFMPs employed by the farmers. In Osun, 30.0% used animal dung, poultry manure was used by 48.7%, 2.5% of the respondents reported the use of compost, and green manure was used by 33.1%. This reveals that the organic manure used most by the respondents is poultry manure, followed by green manure and animal dung. This is comparable to an investigation by Adeniran et al. (2017), who reported that poultry manure and cattle dung are the most common organic manures used among maize farmers in Ido, Oyo State.

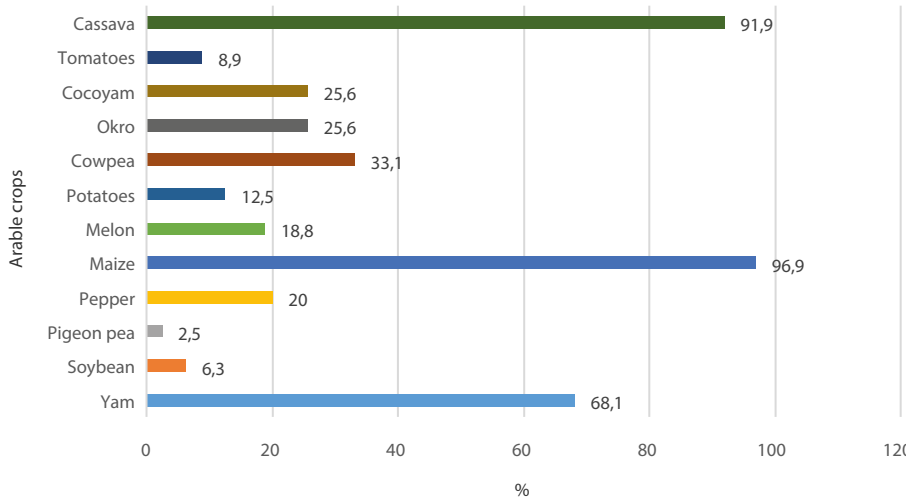

Fig. 2. Arable crops cultivated by the respondents
*Multiple responses recorded.
Source: field survey, 2021.

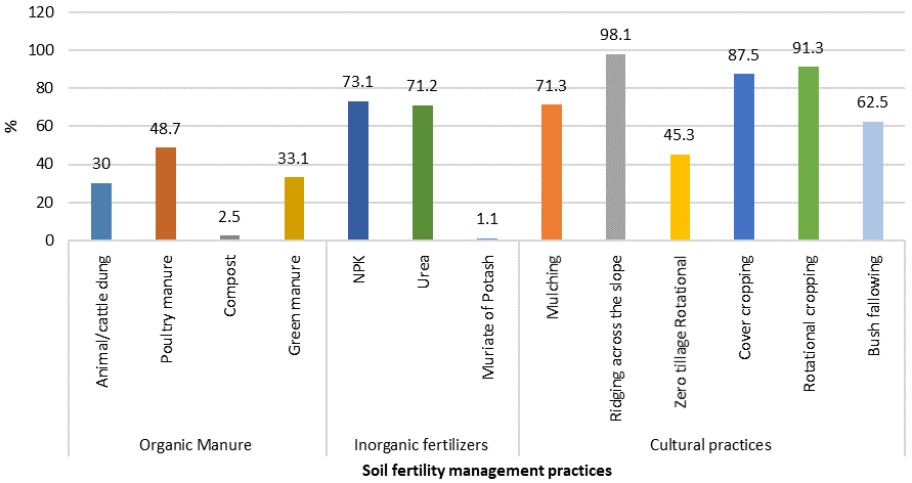

Fig. 3. Types of SFMPs employed
*Multiple responses recorded. Percentages are in parentheses.
Source: field survey, 2021.

The results showed that the synthetic fertilizers used by the respondents were NPK (73.1%), urea (71.2%) and muriate of potash (1.1%). This shows that NPK and urea are the major synthetic fertilizers used by arable farmers. This is comparable to the work of Bwambale (2015) on synthetic fertilizers. Orifah et al. (2018) revealed that farmers in Jigawa were favourably disposed to synthetic fertilizer, the traditional practice of conventional tillage and organic farmyard manure. Bwambale (2015) reported that farmers in Uganda commonly use traditional practices, organic manure, foliar fertilizers and synthetic fertilizers as soil fertility management practices. This shows that location can affect the trend of the prevalent SFMPs used.

Level of utilization of SFMPs employed

Table 1 shows the level of utilization of the SFMPs employed by the respondents. The results have been ranked in chronological order, with ridging across the slope coming in first (WMS = 2.81), rotational cropping second (WMS = 2.66), mulching third (WMS = 2.47), cover cropping fourth (WMS = 2.08), use of NPK fifth (WMS = 1.75), urea sixth (WMS = 1.27), the use of bush fallowing seventh (WMS = 0.98), green manure eighth (WMS = 0.88), poultry manure ninth (WMS = 0.77), animal dung tenth (WMS = 0.76), zero tillage rotational eleventh (WMS = 0.44), compost twelfth (WMS = 0.02) and muriate of potash thirteenth.

These results show that the farmers utilize ridging across the slope, rotational cropping, mulching, and cover cropping the most. It can be deduced that indigenous or traditional knowledge is more widely used in Osun state. This is followed by the usage of NPK and urea (synthetic fertilizer), then organic manure (green manure, poultry manure and animal dung). This shows that the farmers perceive soil fertility as a problem (Mugwe et al., 2009). This may be the reason for the use of various integrated practices (Bwambale, 2015). However, the major type planted by the respondents may also have played a role. Olaitan and Omomia (2006) and Orifah et al. (2018) observed that cultural management practices like crop rotation, planting of cover crops, mulching and ridging across the slope help in water conservation, controlling erosion and the improvement of soil organic matter through decomposed leaves and crop residues. The low use of organic manure may be connected with bulkiness, quantity needed, smell and drudgery (Edeoghon et al., 2008).

Sources of agricultural information

Table 2 shows the sources of agricultural information used by the farmers. The farmers had various sources, ranging from radio (95.6%), friends/neighbours/fellow farmers (92.5%), the marketplace (80.1%), farmers

Table 1. Level of utilization of SFMPs employed

Management practices	Always	Occasionally	Rarely	Never	WMS	Rank
Organic manure						
Animal/cattle dung	32 (20.3)	8 (5.1)	8 (5.1)	110 (69.6)	0.76	10th
Poultry manure	36 (22.8)	23 (14.6)	18(11.4)	81 (51.3)	0.77	9th
Compost	–	–	–	155 (98.1)	0.02	12th
Green manure	42 (26.6)	2 (1.3)	9 (5.7)	1.5 (66.5)	0.88	8th
Synthetic fertilizers						
NPK	72 (42.6)	30 (19.0)	15 (9.5)	41 (25.9)	1.75	5th
Urea	42 (26.6)	59 (37.3)	14 (8.9)	43 (27.2)	1.27	6th
Muriate of Potash	0 (0.0)	1 (0.6)	0 (0.0)	157 (99.4)	0.01	13th
Cultural practices						
Mulching	102 (64.6)	41 (25.9)	2 (1.3)	13 (8.2)	2.47	3rd
Ridging across the slope	134 (84.8)	20 (12.7)	2 (1.3)	2 (1.3)	2.81	1st
Zero tillage rotational	1 (0.6)	23 (14.6)	20 (12.7)	114 (72.3)	0.44	11th
Cover cropping	75 (47.5)	39 (24.7)	26 (16.5)	18 (11.4)	2.08	4th
Rotational cropping	87 (55.1)	41 (25.9)	17 (19.0)	13 (8.2)	2.66	2nd
Bush fallowing	13 (8.2)	32 (20.3)	52 (32.9)	61 (38.6)	0.98	7th

WMS – weighted mean score. Percentages are in parentheses.
*Multiple responses recorded.
Source: field survey, 2021.

Table 2. Sources of agricultural information of the respondents

Sources of agricultural information	Frequency	Percentage
Radio	153	95.6
Internet/social media group	31	19.4
Phone messages	18	11.3
Friends/neighbours/fellow farmers	148	92.5
Agro/fertilizer dealers	80	50.0
Extension agents	101	63.1
Newspapers/magazines	23	14.4
Television	64	40.5
Traditional ruler	40	25.0
Market place	129	80.1
Cooperative socjety	119	74.4
Farmers' meeting	121	75.6

WMS – weighted mean score. Percentages are in parentheses.
*Multiple responses recorded.
Source: field survey, 2021.

meetings (75.6%) and co-operative society (74.4%) as the main sources of information. Others include extension agents (63.1%), agro-fertilizer dealers (50.0%), television (40.5%), traditional rulers (25.0%), internet or social media groups (19.4%), newspapers or magazines (14.4) and phone messages (11.3%). Major sources of information were 2-way and regular sources of interaction. Nowadays, radio has call in options, and because of the coverage, somebody's question may have provided answers for others (Mittal and Tripathi, 2009). The observed results are unlike those found by Adeola and Adetumbi (2015), who reported extension agents as prominent sources of information for farmers.

Correlation between socio-economic characteristics and level of utilisation of SFMPs

The results of the Pearson's product-moment correlation (PPMC) analysis show that a significant relationship exists between age (r = 0.20*; p = 0.01), farm size (r = 0.16*; p = 0.04), and the level of utilisation of SFMPs. This shows that the level of SFMPs used by the farmers was a function of their age and farm size. The alternative hypothesis was accepted. This is similar to a report by Ojediran et al. (2020a).

Table 3. Correlation between socio-economic characteristics and level of utilisation of SFMPs

Variable	r-value	p-value	remarks
Age	0.20*	0.01	S
Marital status	0.67	0.39	NS
Farm size	0.16*	0.04	S

NS – not significant, S – significant.
*Significant at 5% level.
Source: field survey, 2021.

CONCLUSION AND RECOMMENDATION

This study reveals that arable crop farmers are mostly married males, aged 51 years, using an average of 2.6ha farm size and cropping mainly maize, cassava, and yam. The respondents use cultural methods, synthetic fertilizers, and organic manures in that order as SFMPs. The level of utilisation of SFMPs is predominantly cultural methods of ridging across the slope and rotational cropping and mulching; synthetic fertilizers: NPK and urea; and organic manure: poultry manure and animal dung. The major sources of information regarding SFMPs were radio, fellow farmers and the marketplace. PPMC analysis showed that age and farm size are significantly related to the level of SFMPs. This shows that the level of SFMPs used by the farmers is a function of their age and farm size. In conclusion, the respondents were small scale farmers who mainly utilize cultural methods of SFMPs and are mainly influenced by crop type as a function of age and farm size. Therefore, farmers need to be educated in the utilization of relevant SFMP techniques or those combinations of them that conserve soil fertility sustainably.

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SHAPING INTENTION TO PAY ATTENTION TO HEALTH CLAIMS

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Abstract. Health claims increase consumer awareness, knowledge, and health consciousness. However, front and back labels, which are widely used for marketing purposes, raise doubts about consumer tendencies towards paying attention to health claims and reasons for their placement. Therefore, the aim of this article is to investigate, using the Theory of Planned Behaviour, the extent to which intention to pay attention to health claims is determined by its predictors. An extended model based on the theory was used to identify factors that shape attitudes towards health claims and the intention to pay attention to them. In order to achieve this, we conducted a study on 552 people, and the data allowed us to verify the statistically proposed theoretical model. The study revealed that while trust is the main factor determining attitude towards health claims, the impact of subjective knowledge is negative. Research is important from the perspective of the theoretical understanding of consumer attitudes but can also be practically used to properly influence consumers in terms of consumption of healthy products.

Keywords: food claims, health consciousness, consumer intentions, health education, theory of planned behaviour

INTRODUCTION

Consumption of unhealthy food is one of the major risk factors for developing non-communicable diseases (DeMagistris, 2020). These diseases are specifically caused by a diet rich in high-energy food, fat, sugar and salt, and low in fruit, vegetables and dietary fibres (Montagnese et al., 2019). The awareness of these facts among consumers is constantly increasing, which is reflected in the growing interest in consumption of products with higher nutrient compositions (Bloomberg, 2019). One of the key mechanisms proposed to encourage the implementation of a healthier diet is the provision of information on food packaging (Jo and Lusk, 2018), such as health claims.

Health claims are non-obligatory texts on food labels. They describe the relationship between a food substance (food, food component or dietary supplement ingredient) and the reduced risk of disease or health-related conditions (USFDA, 2021). Their function is only informative, but their form is very precisely described by lawmakers. Since their introduction, consumer interest in claims has been steadily growing (Tugault-Lafleur and Black, 2019). According to Ballco and Gracia (2020), consumers would use them more often if they were more available. The use of health claims has already increased significantly, especially in EU countries (Pravst et al., 2018). Nowadays, their implementation is a common practice (Hieke et al., 2016). However, there is no conclusive information as to whether claims are really effective (Talati et al., 2018).

Setiawati et al. (2018), in their research on healthy eating based on the Theory of Planned Behaviour (TPB), have shown that there is a positive relationship between health awareness (consciousness) and attitudes towards

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certain foods. As indicated above, education and trust may also influence attitudes. Moreover, HCs may create more favourable attitudes towards products (Kozup et al., 2003). These observations are in accordance with the Theory of Planned Behaviour (Ajzen, 1991), which is a popular socio-psychological model used for understanding and predicting intentions and behaviour (2015). In addition, Ajzen has suggested that attitudes are usually a good predictor of intentions when their intensity is high (Ajzen, 1991). We modified this variable and used attitude towards paying attention (APA) to health claims, as specified in our survey. Therefore, with a positive and strong attitude towards paying attention to health claims, the intention to pay attention to health claims should be stronger. Moreover, it has been shown that attitudes have strong correlations with behavioural intentions (Shaw and Shiu, 2002). Subjective norm (SN) is another important factor influencing intentions. It may be defined as social pressure or influence that enables people to perform a certain behaviour (Sreen et al., 2018). According to Ajzen (1991), "the global measure of SNs is the extent to which important others would approve or disapprove of an individual's behaviour". In the majority of studies on the topic, it has been demonstrated that SNs play a significant role in determining intentions (Bhutto et al., 2019; Sultan et al., 2020), but some authors claim they are an irrelevant predictor (Paul et al., 2016). Finally, perceived behavioural control (PBC) is the third factor that influences Intentions. This is the perceived ease or difficulty in carrying out a particular behaviour and, therefore, it reflects past experiences and anticipated obstacles (Paul et al., 2016).

Although TBP is a popular social-psychological model based on attitudes, subjective norms and perceived behavioural control (Ajzen, 1991), to the best of our knowledge, there are no articles describing health claims tested under TPB that emphasize variables such as attitude towards paying attention (APA) to health claims or intention to pay attention (IPA) to health claims.

Overall, there is no consensus regarding the impact of health claims on intentions and consequently on behaviour (Steinhauser and Hamm, 2018). There are also discrepancies in the reported effects of various claims (Hieke et al., 2015; Kaur et al., 2017). Therefore, the aim of this article is to investigate, using the Theory of Planned Behaviour, the extent to which intention to pay attention to health claims is determined by its predictors: attitude towards paying attention to health claims, subjective norm and perceived behavioural control. Moreover, the secondary aim is to discover to what extent attitudes are influenced by health consciousness, trust and knowledge, which for the purposes of this study will be presented as subjective knowledge about the impact of what is eaten on health. This led to the following hypothesis: health consciousness (H1), subjective knowledge (H2) and trust (H1) are positively related to attitude towards paying attention to health claims; attitude towards paying attention to health claims (H4), subjective norm (H5), perceived behavioural control (H6) are positively related to intention to pay attention to health claims. The empirical model is presented in Figure 1.

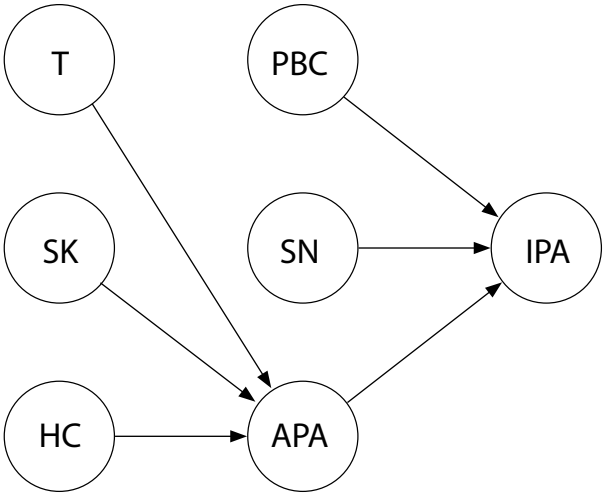

Fig. 1. SEM model
IPA – intention to pay attention to health claims, PBC – perceived behavioural control, SN – subjective norm, APA – attitude towards paying attention to health claims, T – trust, SK – subjective knowledge, HC – health consciousness.
Source: own elaboration based on Ajzen, 1991.

MATERIALS AND METHODS

The research was based on Ajzen's Theory of Planned Behaviour (Ajzen, 1991). The model used in this paper consists of several variables, which include items verified by other authors, used in other studies and presented in previously published articles. The variables used are attitude towards paying attention (APA) to HCs – including 5 items e.g., bad (1) – good (7) (Han et al., 2019), perceived behavioural control (PBC) – including 3 items

e.g., "Whether or not I pay attention to health claims is completely up to me" (Contini et al., 2020; Kim and Hwang, 2020; Yadav and Pathak, 2016) and subjective norm (SN) – including 3 items e.g., "Most people who are important to me pay attention to health claims" (Aitken et al., 2020; Contini et al., 2020). All of them were used as predictors of intention to pay attention (IPA) to health claims (HCs) – including 3 items e.g., "I intend to pay attention to health claims while shopping" (Tudoran et al., 2009). In addition, since consumers with a particular concern for health and a healthy diet are more interested in health-related information (Hoppert et al., 2014), but also based on the research by Carrillo et al. (2014) and Lähteenmäki (2013) who claim that knowledge of claims influences food choices, and based on the research by Klopčič et al. (2020) showing the role of trust, the authors have decided to add 3 variables to the analysed model. The following 3 predictors of attitudes were used – subjective knowledge about the impact of what is eaten on health (SK) – including 3 items e.g., "I know about food substances and their relation to health" (Piha et al., 2018), trust (T) – including 3 items e.g., "I trust health claims" (Konuk, 2019), and health consciousness (HC) – including 4 items e.g., "I reflect about my health a lot" (Hansen et al., 2018; Michaelidou and Hassan, 2008; Talwar et al., 2021). Items in all questions were rated on a 7-point Likert scale.

The main survey was conducted online among a sample of 649 USA residents and based on the Amazon Mechanical Turk (MTurk) platform. The participants were informed about the volatility of the study, the possibility of its termination at any time and the purposefulness of the study and the use of the collected data. They were also compensated for completing the survey. After rejecting surveys that did not pass the verification with regard to attention checking questions, a sample of 552 respondents was selected for the final analyses. Since our research focused on health issues and food purchases, the sample size obtained produced very reliable and credible results. The mean age of the respondents was 39.54 years (SD = 12.33, Min = 18, Max = 75). The group of respondents was evenly divided according to social and economic demographics (Table 1).

In order to verify the obtained data, the research tool was first assessed before the structural research model was created. In addition, bootstrapping was performed on 5,000 re-samples. At the beginning of the analysis, the convergent and discriminant validity of the given

Table 1. Description of the study group

Variable	Option	Frequency	Percent
Gender	Female	285	51.6
	Male	262	47.5
	Prefer not to say	5	0.9
Education	Lower than high school	1	0.2
	High school or equivalent	123	22.3
	Bachelor's degree	301	54.5
	Master's degree	106	19.2
	Doctorate	11	2.0
	Other	10	1.8
Household size	1	58	10.5
	2	124	22.5
	3	151	27.4
	4	160	29.0
	5	40	7.2
	more than 5	19	3.4
Employment	Full-time	335	60.7
	Part-time	74	13.4
	Retired	29	5.3
	Self-employed	50	9.1
	Student	11	2.0
	Unable to work	7	1.3
	Unemployed	46	8.3
Income	≤ $19.999	35	6.3
	$20.000–$29.999	48	8.7
	$30.000–$39.999	60	10.9
	$40.000–$49.999	72	13.0
	$50.000–$59.999	77	13.9
	$60.000–$69.999	86	15.6
	$80.000–$89.999	53	9.6
	$90.000 ≥	121	21.9
Buying food	More than 4 times a week	16	2.9
	3–4 times a week	75	13.6
	Twice a week	210	38.0
	Once a week	218	39.5
	Less than once a week	33	6.0

N = 552.
Source: own survey.

items and the composite reliability of variables (Hill and Hughes, 2007) were checked. Convergent validity tests whether constructs that are expected to be related are, in fact, related. Discriminant validity tests whether constructs that should have no relationship do not really have it. Finally, composite reliability measures internal consistency within scale items. The heterotrait-monotrait ratio of correlations (HTMT), which is a measure of similarity between latent variables, was also used to assess discriminant validity. Finally, structural equation modelling (SEM), also known as path analysis, was conducted. SEM includes models that explain relationships between measured (observable/manifest) and latent (non-observable) variables. It is used to analyse structural relationships and allows cause-and-effect relationships to be identified, considering different dependencies at the same time. All analyses were conducted using RStudio, R Compiler (Revelle, 2013), Lavaan and SemTool packages (Rosseel, 2012).

RESULTS

Assessment of the research tool

Confirmatory factor analysis showed that all factor loadings exceeded the min of 0.6 (Chin, 1998). Cronbach's α coefficients ranged from 0.75 to 0.95. Additionally, the composite reliability (CR) parameter ranged between 0.75–0.95, which is above the cut-off value (Hair et al., 2011). Finally, in all cases, the average variance extracted (AVE) was higher than the approved minimum of 0.5 (Hair et al., 2011) and ranged from 0.51 to 0.87. Thus, it can be concluded that the results show internal consistency of multiple indicators (Bagozzi and Yi, 2012). All the results are presented in Table 2.

Table 2. Confirmatory factor analysis

Construct	Item	Loading	p value	Cronbach's α	CR	AVE
1	2	3	4	5	6	7
Health consciousness (HC)	HC1	0.73	***	0.83	0.75	0.51
	HC2	0.74	***			
	HC3	0.72	***			
	HC4	0.65	***			
Subjective knowledge (SK)	SK1	0.85	***	0.9	0.85	0.72
	SK2	0.82	***			
	SK3	0.86	***			
Trust (T)	T1	0.76	***	0.91	0.75	0.64
	T2	0.84	***			
	T3	0.78	***			
Attitude towards paying attention (APA) to health claims	APA1	0.86	***	0.94	0.93	0.76
	APA2	0.9	***			
	APA3	0.84	***			
	APA4	0.93	***			
	APA5	0.84	***			
Subjective norm (SN)	SN1	0.79	***	0.9	0.82	0.67
	SN2	0.83	***			
	SN3	0.84	***			

Table 2 – cont.

1	2	3	4	5	6	7
Perceived behavioural control (PBC)	PBC1	0.63	***	0.74	0.76	0.53
	PBC2	0.94	***			
	PBC3	0.6	***			
Intention to pay attention (IPA) to health claims	IPA1	0.95	***	0.95	0.95	0.87
	IPA2	0.94	***			
	IPA3	0.91	***			

*** $p < 0.001$.
Source: own survey.

Table 3. Discriminant validity

Construct	HC	SK	T	APA	SN	PBC	IPA
Health consciousness (HC)	1.00						
Subjective knowledge (SK)	0.71	1.00					
Trust (T)	0.39	0.47	1.00				
Attitude towards paying attention (APA) to health claims	0.33	0.27	0.56	1.00			
Subjective norm (SN)	0.52	0.48	0.66	0.49	1.00		
Perceived behavioural control (PBC)	0.35	0.25	0.13	0.20	0.29	1.00	
Intention to pay attention (IPA) to health claims	0.56	0.53	0.67	0.54	0.72	0.30	1.00

Source: own survey.

The heterotrait-monotrait ratio of correlations (Table 3) showed results below the suggested 0.9 (Henseler et al., 2015), which indicates that all parameters were independent. This also indicates that discriminant validity was established (Henseler et al., 2015). As suggested by Schumacker and Lomax (2017), various measures were used to evaluate the model and all met the suggested ranges: RMSEA = 0.060, GFI = 0.907, AGFI = 0.876, CFI = 0.959, NFI = 0.933, chi^2 = 673.4 and df = 225 (Hair et al., 2017; Marsh and Hocevar, 1985). As the validity of the proposed model was confirmed by the above results, further analyses of individual relationships were performed.

Path analysis

The final part of the study was a path analysis (Table 4), which can also be described as a causal modelling approach to exploring the correlations within a defined network. The applied model explained the high level of variability of intention to pay attention (IPA) to health claims (R2 = 0.66). The impact of trust (T) on attitude towards paying attention (APA) to HCs (H3) was 0.61 ($p < 0.01$), and in the case of health consciousness (HC) (H1), it totalled 0.34 ($p < 0.01$). The impact of subjective knowledge (SK) (H2) on APA was statistically significant, but its direction was different than assumed ($\beta = -0.36$, $p < 0.01$). Among the 3 variables affecting intentions, 2 out of the 3 hypotheses were confirmed. Thus, β for the effect of attitude towards paying attention (APA) on intention to pay attention to HCs (IPA) (H4) was 0.17 ($p < 0.01$), while in the case of subjective norm (SN) (H5), it equalled 0.61 ($p < 0.01$). The hypothesis regarding the impact of perceived behavioural control (PBC) on IPA (H6) was not confirmed ($\beta = 0.03$, *ns*).

Table 4. SEM results

Endogenous Variable	Exogenous Variable	Beta	B	SE	p-value	CI lower	CI upper
IPA	APA	0.17	0.24	0.09	**	0.04	0.39
	SN	0.71	1.22	0.23	***	0.88	1.80
	PBC	0.03	0.06	0.09	*ns*	–0.13	0.23
APA	HC	0.34	0.43	0.16	**	0.17	0.79
	T	0.61	0.78	0.12	***	0.56	1.06
	SK	–0.36	–0.46	0.15	**	–0.81	–0.22

*** $p < 0.001$, ** $p < 0.01$, *ns* – not significant.
Source: own survey.

DISCUSSION

The aim of this article is to investigate, using the Theory of Planned Behaviour, the extent to which intention to pay attention to health claims is determined by its predictors. For this purpose, the influence of perceived behavioural control (PBC), subjective norm (SN) and attitude towards paying attention (APA) to health claims on the above-mentioned intention has been analysed. In addition, the role of trust (T), subjective knowledge (SK) and health consciousness (HC), as well as its impact on attitudes, have been verified. Our research is not representative, however, the size of the sample and its sociodemographic structure allow us to conclude that the results of our research are highly reliable.

The first finding resulting from this study concerns trust. This factor affects attitude towards paying attention to health claims the most (Table 4). This means that the more consumers trust health claims, the more they may prefer products associated with them. This can be a significant clue for food producers when it comes to using claims that consumers already trust. The results of this study are somewhat similar to those obtained by Benson et al. (2019) who showed that consumers trust claims. Other research showed that confidence in claims is one of the main determinants of consumer food product selection (Annunziata et al., 2016). Additionally, trust may appear to be a powerful tool for customers to make food choices, which is in line with our results showing that trust is the most significant factor influencing APA. However, the subject of trust seems to require further investigation.

We have assumed that, like trust, subjective knowledge about health claims would also be an important factor influencing attitudes (Table 4). However, the results showed that SK had the opposite effect on attitudes. Thus, the higher its level, the more negative the attitude towards health claims. Therefore, it might be the case that for some customers, health claims constitute nothing special. Moreover, it may seem to them that claims are only another marketing tool (Pereira et al., 2019), only raising the price of the product and, as such, the product may seem unnecessarily expensive. Research on the role of knowledge regarding food and health claims is not homogeneous. Hung and Verbeke (2019) claimed that there was a positive association between understandability and reliance on health claims. However, there is also research that found the opposite results, more in line with those achieved in this study. According to Cavaliere et al. (2016), consumers with low nutritional knowledge have a greater interest in nutritional claims. It seems that the role of knowledge is definitely worth further analysis.

In the presented study, we have shown that health consciousness has a significant impact on attitudes (Table 4). Its importance has been confirmed by various trials in which it has been indicated that health consciousness acts as a motive for particular food purchasing and consumption (Hansen et al., 2018) or buying intentions (Shin and Mattila, 2019). The results from this study are in opposition to articles demonstrating that health consciousness may not affect intentions (Pino et al., 2012). Nonetheless, as indicated in the given study, claims build a certain amount of health consciousness in societies in which the introduction of claims has been underpinned.

In addition, health consciousness itself is also important for people to pay attention to claims.

In this study, we have further shown that just as the influence of certain predictors on attitudes is diverse, so is it the case for intention predictors – attitude, subjective norm and perceived behavioural control. Within the context of the first two variables, we have proven that intentions are more influenced by subjective norm than APA. However, the influence of APA is still significant (Table 4). The results of our research are also consistent with the results obtained by various authors who refer to subjective norm and claim that it plays a significant role in determining intentions (Bhutto et al., 2019; Sultan et al., 2020). However, the present results are inconsistent with those of some researchers who have emphasized that the relationship between attitudes and intentions is very high (Al-Swidi et al., 2014), or that attitudes are the primary factor influencing intentions (Spence et al., 2018). We have assessed subjective norms and noted that they have a great influence on intentions, further indicating that paying attention to health claims is still more conditioned by external (social) factors than internal ones, which also means that consumers are more driven by the belief that they should eat more healthily than they should or would like to. Thus, the influence of health claims on intentions is not simple. Nevertheless, it is associated with some intellectual effort and the occurrence of subjective norms related to relying on it.

In this study, like was done in the one by Yazdanpanah and Forouzani (2015), we have shown that perceived behavioural control does not significantly influence intentions (IPA), which stands in contrast to the results obtained by Carfora et al. (2021), who indicated that perceived behavioural control may be the most important predictor of intentions. We have estimated that the problem regarding the lack of perceived behavioural control influence may be related to whether, according to consumers, behavioural control relates to physical access to the product containing claims, or perhaps to the fact of seeing and understanding the claims.

An important scientific implication of our research is the confirmation of the impact of subjective knowledge, health awareness and trust on attitude towards paying attention to health claims, and at the same time showing that the level of knowledge can have a negative impact on attitudes. This stands in opposition to the assumptions underlying the introduction of claims into the legislature of many countries. It was assumed that a high level of knowledge about claims would mean a stronger reliance on them. It turns out that this does not have to be true. In addition, as the level of trust of individual consumers varies, despite having a strong overall impact on attitudes, the practitioners might consider increasing the importance of claims even more by, for example, focusing on their occurrence on the packaging in accordance with the guidelines of the relevant organizations (FDA, EFSA), while emphasizing the authority of those organizations. They might also consider further distinguishing claims from other texts, including marketing claims. In addition, both individual governments and food producers should be more focused on creating information or marketing campaigns emphasizing the role of claims, especially in the context of trust. In the case of the inverse impact of the level of knowledge on consumer attitudes, producers of food for special purposes, the consumers of which may be people with a high level of nutritional knowledge, might consider the appropriateness of health claims for these products on their packaging.

The performed study has some limitations that should be considered. The first one refers to the use of the subjective knowledge parameter instead of trying to verify the actual level of respondents' knowledge. In addition, the research was not based on actual products available on the market. Moreover, not all of the health issues have been investigated in depth, i.e., with regard to the possible effects of body mass index on health consciousness. In addition, no specific health claims have been analysed. Furthermore, we did not conduct the analysis related to different sociodemographic profiles or ethnic factors. Ultimately, the research was conducted on an individualistic society (USA), and furthermore, the data were not compared to other societies – especially collective ones. We believe that the above limitations may constitute scope for future analyses.

CONCLUSIONS

In our article, we have managed to characterize the factors influencing APA and have proved their influence on this variable. Moreover, we have determined 66.6% of the variance of the model. The main implications of the study refer to the fact that subjective norm appeared to be the most important determinant of intentions, where perceived behavioural control seemed to be insignificant. The results of the impact of this variable was the

opposite in some studies (Carfora et al., 2021). Therefore, we consider our research to have added value and to be a possible target for future, more detailed studies. In addition, attitude towards paying attention to health claims is highly impacted by trust and inversely influenced by subjective knowledge, which confirms the high importance of trustworthy messages contained in claims. Consequently, the message is put forward that claims may be incomprehensible to consumers. Additionally, the potential role of simplified claims or other methods that might replace health claims should be considered. One example of a simplified system is the nutriscore system, which has already been launched in the European Union.

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THE EFFECT OF SELECTED MACROECONOMIC POLICIES ON CITRUS PRICE VOLATILITY IN SOUTH AFRICA: A REFLECTION ON EXPERIENCES OF FARMER SUPPORT

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Abstract. The macroeconomic policies enacted by the South African government after democracy and their effects on the welfare of resource-poor farmers remains a subject of scholarly interest. It is not known if farmers are cushioned against exogenous macroeconomic shocks. The aim of this study was to analyse citrus price volatility in National Fresh Produce Markets and to study the effects of macroeconomic policy shocks. Secondary data for prices was sourced from the Johannesburg National Market. GARCH was employed as an empirical model to estimate price volatility. According to the results, price volatility for lemon and soft citrus is statistically insignificant. Price volatility for oranges was statistically significant at a 99% persistence level ($\alpha = 0.39$, $p = 0.0030$) and ($\beta = 060$, $p = 0.0000$). The exchange rate ($\alpha = 0.05$, $p = 0.0000$), CPI ($\alpha = –0.26$, $p = 0.0035$) and prime lending rates ($\alpha = 0.12$, $p = 0.0026$) were significant in explaining price volatility in oranges. Added values of the coefficient of α and β for Grapefruit amounted to 1.1, which means the price volatility was explosive. High levels of price volatility mean farmers are faced with the difficulty of projecting expected levels for farm income and profitability. The results provide insights into farm planning and decision making. It is recommended that the government provide farmers with resources that can cushion against price instability and enable them to access export markets.

Keywords: resource-poor, farmers, price, volatility, macroeconomic policies

INTRODUCTION

As a result of democratic dispensation, which culminated in the lifting of trade sanctions and the pursuit of the reintegration of the economy into global markets, the South African government introduced sweeping policy reforms. For the purposes of this study, important policies that were introduced include the Land Restitution and Redistribution Act, deregulation of agricultural markets, trade liberalization and inflation targeting. To address the socioeconomic challenges faced by resource-poor farmers that benefited from the Land Reform programme, such as lack of skills and poor access to resources (i.e., markets, farm inputs, technology, farm credit and information), between 2004 and 2009, the South African government introduced a number of farm support programmes. These included the Comprehensive Agricultural Support Programme (CASP), Ilima-Letsema (meaning cooperatives in English), the Micro Agricultural Financial Institution of South Africa (MAFISA), Fetsa Tlala Integrated Food Production initiative, Land Care programme and Recapitalization and Development Programme (RADP). While these different programmes had different delivery mandates, the overriding goal was to enhance successful implementation of the Land Reform programme through realisation of optimal farm-level productivity and commercialization of agricultural outputs (Cousins, 2016). Historically, the

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prevalent feature for most of these farmer support programmes is the provision of fertilizer, seeds, infrastructure equipment and other planting material.

With regard to marketing, the deregulation of agricultural markets, which culminated in the abolishment of agricultural subsidies and marketing boards, was reported as per the literature (Bernstein, 2013. It was noted that market liberalization harmonised trade tariffs, thereby making it easy for other countries to export their agricultural products into South Africa (Erten et al., 2019). In 2000, to bring about price and currency stability, the South African Reserve Bank promulgated a new macro-economic policy dubbed inflation targeting (SARB, 2011). Under the inflation targeting regime, the repo rate, which is the interest rate with which the SARB borrows money from commercial banks, became an instrument for stabilising inflation and the value of the exchange rate. By adopting a free-floating exchange rate, the value of the Rand would be determined by the forces of demand and supply (Miyajima, 2020). This development ushered in a new era for the independence of the SARB, where henceforth it could separate its functions from those of politicians (e.g., job creation) and focus mainly on the maintenance of price stability. Kydland and Prescott (1997) and Barro and Gordon (1983) believed that the independence of Central Banks would result in lower inflation and good prospects for economic growth (Aguir, 2017).

These policy reforms delivered a mix of results. According to Sihlobo and Qobo (2021), deregulation of agricultural markets and trade liberalization worked in favour of the established commercial agricultural sector. The commercial sector achieved growth in productivity and increased export competitiveness, but these results were not achieved among resource-poor farmers. As of 2017, 80% of the total value of agricultural output was produced by just a few commercial farmers (i.e., 40122 individuals), and less than 20% was produced by 2 million smallholder farmers (StatsSA, 2020). On the question of whether the farmer support programmes are effective, recent studies by several researchers, namely Maka and Aliber (2019) and Rusenga (2020), Mncina and Agholor (2021) and Zantsi et al. (2021), have painted a bleak picture. They posit that these programmes to a large extent are poorly designed and not fit for purpose as they do not address the needs of resource-poor farmers. Most of the farmer support programmes are poorly coordinated and there is late delivery for some of the services (Mncina and Agholor, 2021), whereas a high number of farmers struggle to access markets, especially export markets (Rusenga, 2020). Specifically for citrus, Bitzer and Buman (2014) posit that the support programmes designed for resource-poor citrus producers were not efficient to enable them to meet the stringent quality requirements of export markets. The researchers further caution that the existing strategic partnership models (this being a sub programme under RADP), where white commercial farmers assist black farmers to access export markets, are not sustainable as they create a dependency syndrome (Bitzer and Buman, 2014). Genis (2018), in the study where he looked into the transferred land reform projects in South Africa, reported that resource-poor citrus farmers struggle to access export markets and that they rely on local markets. A recent study involving field research conducted between September 2020 and May 2021 in four provinces, namely Gauteng, Limpopo, Mpumalanga and KwaZulu-Natal, among 40 vegetable producers operating small-scale (0.25ha to 5ha) and medium scale (5ha to 50ha) operations had discovered that these farmers did not have access to export markets (Wegerif, 2022). The important market facilities for these farmers included municipal fresh produce markets used by more than 50% of interviewed farmers, informal bakkie traders (12%) and retail supermarkets (30%) (Wegerif, 2022). Farmers far away from Gauteng province, by almost 496 kilometres (such as those of Vhembe district in Limpopo), among others, supplied their produce to the Joburg market (Wegerif, 2022).

The situation is different to other countries in sub-Saharan Africa, where small-scale farming (from as small as 0.25ha in extent) remains the lifeblood of the economy (FAO, 2015). A number of innovative strategies, such as contract-grower schemes and public-private partnerships (e.g., in Mozambique) (Mangeni, 2019), cooperative schemes (e.g., in Kenya) (FAO, 2015) and advanced telecommunications technologies (e.g., in Ghana) (Wyche and Steinfield, 2016), are effective for accessing export markets.

With regard to the inflation-targeting policy framework, among others, the important channels through which this policy manifests itself in the economy include movements in exchange rates, interest rates and consumer price inflation (Oladipo, 2017). In a study by Aye and Odhiambo (2021) based on 39 developing countries that adopted inflation targeting, it is said that

when inflation in these countries exceeded the threshold of 5.9%, growth in the agricultural sector declined, and there was an acceleration of inflation in these countries. These macroeconomic factors can serve as exogenous factors that can give rise to price instability in local markets. The implications are that, while resource-poor farmers are already struggling because of poor farmer support programmes, they are also facing the risk of price uncertainty in local markets. In this study, we analyse citrus price volatility as citrus is of strategic significance to the economy. During the 2017/18 season, the citrus industry was responsible for R19 billion, South African currency, that was contributed to the total gross value of agricultural production in South Africa (NAMC, 2020). Citrus commodities in South Africa are some of the few export-orientated commodities that can be grown in almost all of the provinces (eight out of nine) (CGA, 2022) and carries high potential for development. In the world at large, price volatility in the agricultural sector remains an area of interest as it affects long-term planning (FAO, 2011).

LITERATURE REVIEW

The global food crises of 2007–2008 brought the issue of food price volatility into policy discourse (Lang, 2010). This food crisis resulted in social unrest across the world, and this has since triggered renewed interest in research into the area of food price volatility (Tadesse et al., 2016). A study that looked into the price volatility of selected grain crops in Germany discovered that, among other factors, macroeconomic factors such as petrol price volatility and exchange rate were important (Ott, 2014). In Africa, food price volatility is said to be the major cause of household food insecurity, and it has the potential to incite political instability and attacks on civilians by insurgent groups (Rezaeedaryakenari et al., 2020). Tadesse et al. (2016) have since formulated three major categories for the causes of food price volatility. These include root causes (e.g., weather and macroeconomic shocks), conditional causes (e.g., high market concentration) and internal drivers (e.g., market speculation and trade bans) (Tadesse et al., 2016). Perhaps the category for root causes, of which one of the examples is macroeconomic factors, requires more attention because if not addressed, its effects can be systematic and end up creating a vicious cycle.

Figure 1 shows that key macroeconomic indicators, e.g., CPI, interest rate and exchange rate, for the period of 2010 to 2022 have been unstable (see Fig. 1). It can be seen that in January 2010, May 2014, February 2016 and January 2017, the CPI exceeded the SARB's target band of 3 to 6% (see Fig. 1). Since 2014, both the Rand and the prime lending rate have exhibited an upward trajectory, with the Rand losing value against the dollar for most of that time. For almost a decade, i.e., December 2012 to January 2020, the prime lending rate followed in the same direction as the movement of the Rand, and this is because it is used as an instrument to limit the supply of money into the economy. The spikes that are

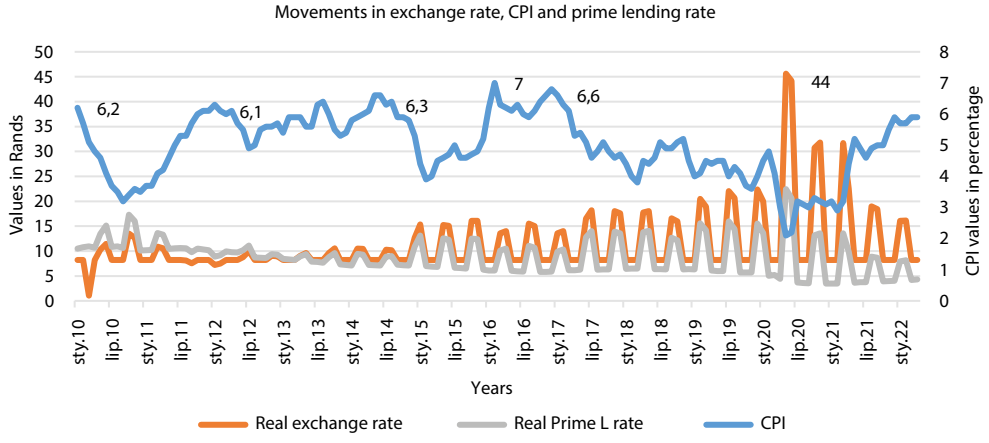

Fig. 1. Trends in the movements of exchange rate, CPI and prime lending rates (2010 to 2022)
Source: data sourced from StatsSA (www.statssa.gov.za) and SARB (www.resbank.co.za)

showing in May 2020 are because of the covid-19 pandemic. These factors can have adverse effects on the prices of agricultural produce. In a study that covered the period 1984 to 2014, Mazorodze and Tewari (2018) posited that, during this period, the undervalued Rand boosted growth in agricultural exports.

As the Rand weakens, locally produced goods and services become cheaper to international buyers (Mazorodze and Tewari, 2018). Aye and Odhiambo (2021) posit that there is a need to balance currency undervaluation and control of inflation. In an environment where key farm inputs (e.g., fuel and machinery) are imported from abroad, which is the case in South Africa, a weaker rand means that these items are more expensive, and this can lead to high inflation. The effects of interest rates on resource-poor farmers have been studied already. In the work of Chisasa and Makina (2012), it is said that in South Africa, due to upward movements of interest rates, the ratio of credit for small-scale farmers to total private sector credit declined from 18% in 1986 to 1% in 2009.

Based on the available literature, a number of studies in South Africa that looked into price volatility paid more attention to grain crops. Sayed and Auret (2020) recently looked at the volatility transmission of white maize from other countries to South Africa. In South Africa, there has never been a study looking into price volatility for citrus, and this constitutes a knowledge gap. Based on the above discussion, this study attempts to study citrus price volatility in the South African National Fresh Produce Markets, this being the single most important marketing facility for resource-poor farmers, and also to reflect on how macroeconomic factors, namely interest rates, exchange rates and inflation, affect citrus price volatility. GARCH is employed as an empirical model to study citrus price volatility. Akaike Info Criterion was used to select the best GARCH type model, and the Wald test was used for validating causality. To deliver on this, the remainder of the study comprises sections dealing with study methods, empirical results, discussion and conclusion and recommendations.

STUDY METHODS

Study area

Figure 2 shows the regions in South Africa where citrus is produced. According to CGA (2022), citrus is produced in eight out of nine provinces, with Limpopo province constituting the biggest area (40 383ha) cultivated at 40%, followed by Eastern Cape (25%), Western Cape (19%), and Mpumalanga (8%). Orange Free State and North West provinces have the lowest number of hectares cultivated. Ironically, while Gauteng province does not have a high share of agricultural production, the biggest local fresh produce market is situated in this province. The Joburg market remains the biggest fresh produce market in South Africa, with approximately 42% of the market share amongst fresh produce markets, valued at around R20 billion. Given its dominance in terms of share of the fresh produce market industry, the Joburg Market serves as a barometer for fresh produce prices (Joburg Market, 2021).

Fig. 2. Growing areas of citrus in South Africa
Source: CGA, 2020.

Sampling technique

Based on the availability of data, secondary monthly data from January 2010 to April 2022 spanning a period of 12 years and constituting 147 observations was sourced from the Johannesburg Fresh Produce Market, which is owned by the South African government. Data on Consumer Price Index and exchange rates were sourced from StatsSA and the South African Reserve Bank respectively. By comparison, a study by Tirno et al. (2021) employed GARCH on a monthly series constituting a sample of 132 observations to study price volatility, and thus this gives confidence for our own sample size.

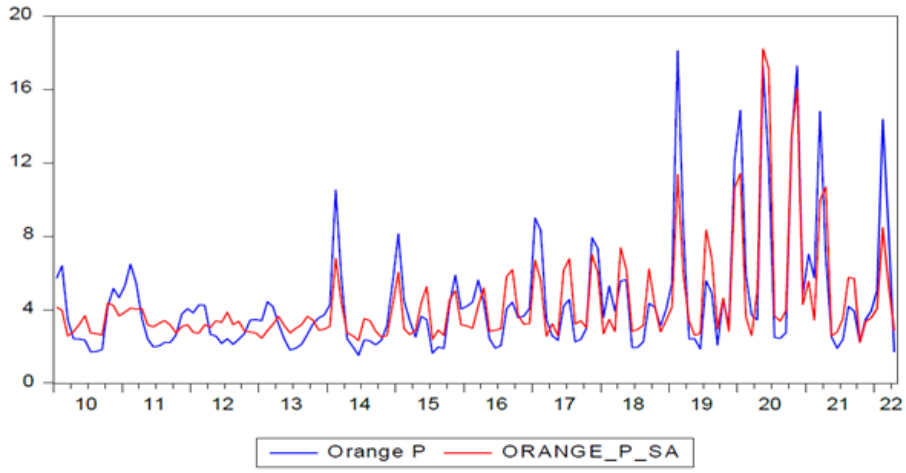

Fig. 3. Eviews seasonally adjusted orange price series
Source: Eviews output with data from Joburg market.

Data Handling and Management

Eviews was employed to generate a new series (denoted Orange_P_SA) that is seasonally adjusted, and in figure 3, the new series is presented together with the initial raw data series.

One of the important steps before testing for stationarity using the unit root test is to address the influence of the predictable components of price movements, such as the effects of seasonality, inflation and trends, as they should not be considered part of price volatility. Seasonality should be removed, leaving only the unpredictable or stochastic component for further analysis (Shi et al., 2014).

Using descriptive analysis, the seasonality of orange prices was analysed. With 2010 set as a base year, the effect of inflation was removed by deflating the nominal prices with the CPI.

Basic Procedures for building GARCH model

The approach for studying price volatility can be complex as a number of invisible market factors overshadow the movements of real prices. These include the stochastic nature of prices, the influence of the lag period on movements of prices and the influence of externalities such as policies, weather etc. The conditional variance is not constant over time. In the conditional variance, the underlying stochastic process is conditionally heteroscedastic. In the face of many competing econometric models, such as the ARIMA, Error Correction Model (VCM) traditionally used for modelling time series relationships and for forecasting, the GARCH model is found to be suitable for analysing price volatility. This is because, unlike these other models, GARCH has the capacity to address heteroscedasticity (Hsu Ku et al., 2007).

The Eviews software package 2009 was employed to run the analysis. Before a GARCH model is built, a number of steps must be followed. This includes the need to establish clustering volatility and to test for unit root test and ARCH effects. To test for stationarity, a Dickey Fuller Test was employed, and the series was found to be non-stationary at its own level. Only when differenced at first order did it become stationary. To test for ARCH effects, using Eviews software, a residual diagnostic test was employed, followed by a heteroscedasticity test.

MODEL SPECIFICATION

Conditional Mean Models

Some models are not capable of considering the lag effects of past relationships in a series. The Box-Jenkins approach considers past relationships and the effects on a time series and considers the autoregressive nature of a time series (Box-Jenkins, 1970). An Autoregressive (AR) Model is one in which we use the statistical properties of the past behaviour of variable to predict its future behaviour. An autoregressive model with p lags, is given by

$$Y_t = \mu + \varnothing_1 Y_{t-1} + \varnothing_2 Y_{t-2} + \ldots + \varnothing_p Y_{t-p} + \varepsilon_t = \mu + \sum_{i=1}^{p} \varnothing_1 Y_{t-1} + \varepsilon_t \quad (1)$$

Where ε_t = the white noise error, μ is the mean, $\varnothing$ is the weight and Y_{t-1} is the value y at t-1 periods ago. Moving Average (MA) Models: a time series is said to be in a moving average (MA) process if the current time series is a linear combination of current and finite number of previous shocks. The j^{th} order MA process can be expressed as

$$Y_t = \mu + \varepsilon_t + \varnothing_2 \varepsilon_{t-1} + \varnothing_2 \varepsilon_{t-2} + \ldots + \varnothing_2 \varepsilon_{t-q} = \mu + \sum_{i=1}^{p} \varnothing_j \varepsilon_{t-j} + \varepsilon_t \quad (2)$$

Where ε_t and ε_{t-1} are the previous white noise disturbance term and the current disturbance terms respectively t, σ is the MA parameters which describes the effect of the past error on Y_t.

Autoregressive Integrated Moving Average (ARIMA) models are the most general class of models for forecasting a time series, which can be stationary by transformations such as differencing and lagging. Mathematically, it can be expressed as:

$$Y_t = \mu + \sum_{i=1}^{p} \varnothing_1 Y_{t-1} + \sum_{i=1}^{p} \varnothing_{j1} \varepsilon_{t-j} + \varepsilon_t \quad (3)$$

Conditional Variance Model

ARCH Models were introduced by Engle (1982). The ARCH (q) regression model can be expressed as U^2_t in terms of past values of U^2_t.

That is,

$$U^2_t = \mathrm{W} + \sum_{i=1}^{q} \sigma_i U^2_{t-1} \quad (4)$$

GARCH Models are those that are mainly used to model volatility. GARCH models generalize the ARCH model in the same sort of way that an ARMA model generalizes an MA model. The GARCH (p,q) model can be expressed as:

$$h_t = \mathrm{W} + \sum_{i=1}^{q} \alpha_i \mu^2_{t-1} + \sum_{j=1}^{p} B_j h_{t-j} \quad (5)$$

With the constraints w > 0, $\alpha > 0$, i = 1,., q and $B_j > 0$, J = 1, … p. For instance, GARCH (1,1), GARCH (1,2), GARCH (1,3) and GARCH (2,1) models are displayed as follows:

$r_t = \mu + \mu_t$, $\mu_t \sim \mathrm{N}(\mathrm{O}, \sigma^2)$

GARCH (1,1) : $h_t = \mathrm{w} + \alpha_1 U^2_{t-1} + B_1 h_{t-1}$

GARCH (1,2) : $h_t = \mathrm{w} + \alpha_1 U^2_{t-1} + \alpha_2 U^2_{t-2} + B_1 h_{t-1}$ (6)

GARCH (1,3) : $h_t = \mathrm{w} + \alpha_1 U^2_{t-1} + \alpha_2 U^2_{t-2} + \alpha_2 U^2_{t-3}\, B_1 h_{t-1}$

GARCH (2,1) : $h_t = \mathrm{w} + \alpha_1 U^2_{t-1} + + B_1 h_{t-1} + B_2 h_{t-2}$,

Selection of explanatory variables

Data from StatsSA (2010 to early 2022) shows that transport, food inflation and electricity were important contributors to headline inflation. Learning from the work of Akram (2009) and Duverall et al. (2013), three macroeconomic variables, namely exchange rate, interest rate and inflation are considered to be explanatory variables. There are other macroeconomic variables, such as tariffs, income tax policies and so forth, but in order to focus, the three important ones mentioned are considered. MoroŞan and ZubaŞ (2015) caution that these variables may be correlated. This means if considered into a model, they may lead to a multi-collinearity problem, and the results may be spurious. To address this problem, using E views software, a standard correlation model was run. The results of this correlation point to prime lending rate being correlated with exchange rate at a coefficient of 0.70, whereas other variables, e.g., CPI and exchange rate, are negatively correlated with a low coefficient value of -0.38. CPI is also negatively correlated with prime lending rate, with a coefficient of -0.25. Because of these results, in specifying the GARCH model, the prime lending rate was paired with CPI, and CPI was paired with exchange rate.

Combined mean and variance model

In Eviews, GARCH was estimated by setting the equation for the mean and variance jointly.

The equations for the four dependent (Y) variables under consideration, i.e., the prices of the four species, were set separately, exploring different GARCH formations and types (i.e., GARCH (1,1), (1,2), (1,3) and (2,1)). Based on the results of the correlation, two exogenous variables, namely exchange rate and CPI, were held as explanatory variables in the first approach, and in the second approach, it was CPI and prime lending rate. Five different error distribution criteria were set. These included the normal (Gaussian) distribution, Student's t, Generalised Error (GED), Student's t with fixed df and GED with fixed parameter. After modelling the mean and variance equations, a model significance test using the Wald Statistics test was applied, followed by serial correlation test (i.e., ARCH LM test and Correlogram). The lowest value of the Akaike Info Criterion was used to determine the best type model for GARCH.

The following hypotheses were set

H_0: The four citrus species under study do not have persistent price volatility.

H_a: The four species under consideration have persistent price volatility.

A representative equation for each of the species can be represented as follows:

$$\text{GARCH} = C(4) + C(5)*\text{Resid}(-1)^{\wedge 2} + C(6)*\text{GARCH}(-1) + C(7)*D(\text{CPI}) + C(8)*D(\text{Exh\_Rate}) + C(9)*D(\text{prime lending rate}) + \varepsilon_t \quad (7)$$

Where the independent variable, GARCH, represents the price volatility, and in the case of orange, is expressed as D(Orange_P_SA), which is the seasonally adjusted price in its first difference form. C(4), is the constant and C(5)*Resid represents the ARCH effects in the lagged form, whereas C(6)*GARCH (–1) is the previous month's price volatility. In the results, Resid will be denoted as Alpha (α), whereas GARCH will be denoted as Beta (β).

RESULTS AND DISCUSSION

Stationary in time series, Dickey Fuller Test results

Table 1 provides a summary of the results. At their own level, the variables were found not to be stationary. As can be seen in the table, all variables have a P value of less than 5%, and thus the hypothesis is rejected, meaning the variables are now stationary at the first difference. Furthermore, for all the six variables, the t statistics are more than the critical value. These results provided the basis for modelling both the ARCH and GARCH equations.

Table 1. Dickey Fuller Test results, at the first difference

	Test Equation	ADF test statistics	P value
Orange Price	With intercept	–7.31	0.0000
	With intercept and trend	–7.28	0.0000
	None	–7.3	0.0000
Soft citrus price	With intercept	–7.32	0.0000
	With intercept and trend	–7.29	0.0000
	None	–7.31	0.0000
Grapefruit price	With intercept	–18.6	0.0000
	With intercept and trend	–18.6	0.0000
	None	–18.6	0.0000
Lemon Price	With intercept	–7.3	0.0000
	With intercept and trend	–7.4	0.0000
	None	–7.4	0.0000
Exchange rate	With intercept	–7.4	0.0000
	With intercept and trend	–7.4	0.0000
	None	–7.4	0.0000
CPI	With intercept	–9.0	0.0000
	With intercept and trend	–10	0.0000
	None	–10	0.0000
Prime Lending rate	With intercept	–7.88	0.0000
	With intercept and trend	–7.85	0.00000
	None	–7.78	0.0000

Source: data used sourced from Joburg Market (2010–2022).

To establish if there is clustering volatility, the mean equation for each of the four citrus prices in their difference forms were computed in Eviews, after which a residual was plotted. Figure 4 presents the clustering volatilities.

By establishing the existence of clustering volatility and the ARCH effects, a condition for running the GARCH was fully met. For each of the prices of the four species, an episode of low volatility is often followed by an episode of high volatility. The different spikes in the graph, shows different socio-economic shocks. The period constituting the last part of 2018 up to end of 2021, shows similarities among the clustering volatilities of the four species, and this is probably due to the effect of Covid 19. To test for the ARCH effects, using E views software residual diagnostic test was employed, followed by heteroscedasticity test. The results for testing the ARCH effects shows that both the P value for the F-statistics and for the Observed R square, are less than 5 percent and therefore the null hypothesis is rejected, meaning that there exists ARCH effects.

Price volatility (variance) estimation results

Table 2 presents the results for the variance model based on the lowest Akaike Info criterion established across

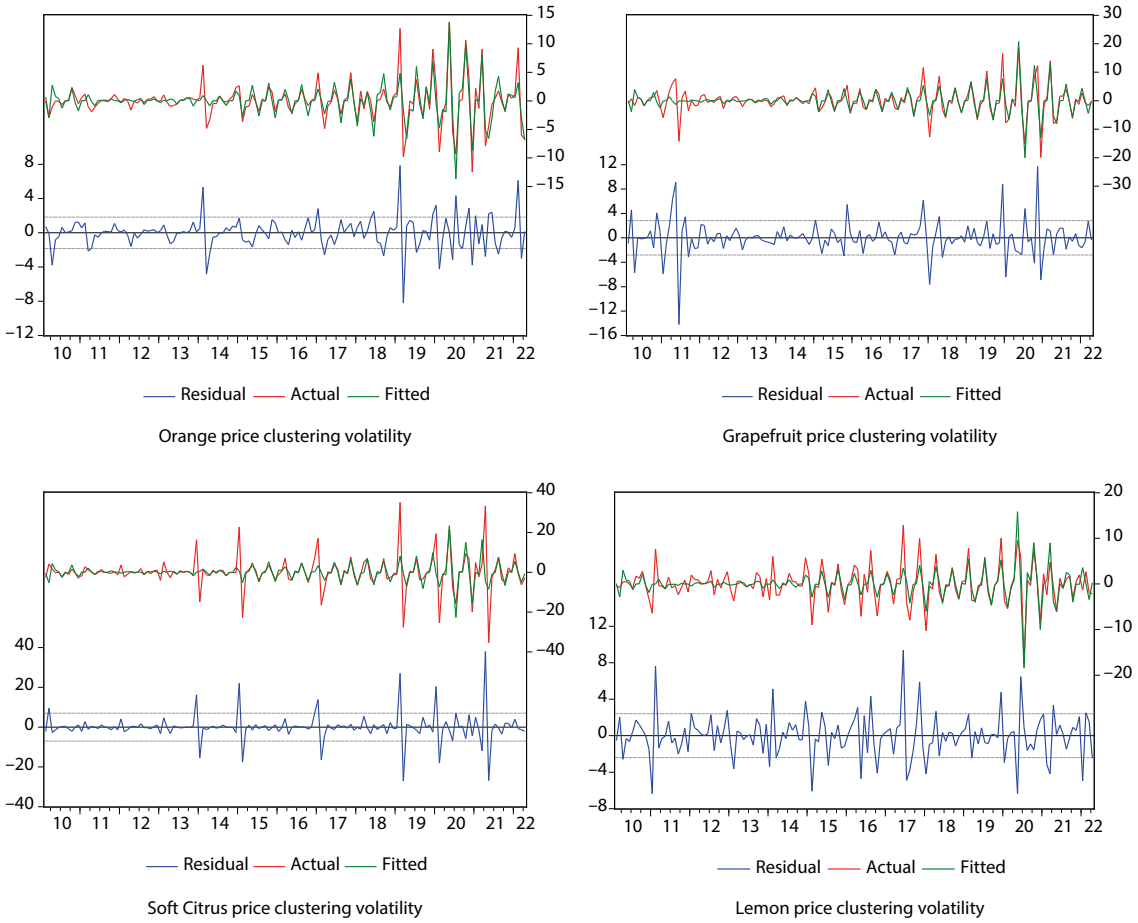

Fig. 4. Clustering volatilities for the four citrus species in South Africa
Source: data used sourced from Joburg Market (2010–2022).

the five error distribution methods. For Lemon, the lowest value for Akaike Info Criterion is 4.47 under GED and GARCH (1,1), yet the P value for Resid (-1) is more than 5%, and in terms of the Correlogram and ARCH LM test, the model does have ARCH effects and serial correlation, and the model is not accepted. Price volatility for Lemon is statistically insignificant. Soft citrus had the lowest Akaike Info value of 5.05 under student t. Both the residual and GARCH in their lagged form had a p value of more than 5%, and therefore are not statistically significant to explain price volatility for soft citrus. The Wald test results also show that the explanatory value, i.e., exchange rate, CPI and prime lending rate, with a p value of more than 5% are statistically insignificant to explain price volatility for soft citrus.

The implications are that everything remaining constant, farmers who are risk averse are likely to include soft citrus and lemon in their crop mix.

Regarding price volatility for oranges, the results with the lowest value for Akaike Info Criterion of 2.52 are found in GARCH (1,1) under GED, where the added values of coefficients yields a figure of 0.99, which indicates that price volatility for oranges is persistent. The *p* values are less than 5%, suggesting that the previous month's residual and the previous month's GARCH are statistically significant in explaining next month's orange price volatility. These explanatory variables serve as internal shocks.

The diagnostic testing results (Correlogram and ARCH LM test) are statistically significant, showing

Table 2. Summary of price volatility among the four species

Variance output		Lemon	Soft citrus	Orange	Grapefruit
GARCH Type		GARCH (1,1)	GARCH (1,1)	GARCH (1,1)	GARCH (1,3)
Error Distribution Method		GED	Student t	GED	GED
Lowest Akaike Info		4.47	5.05	2.52	4.21
Resid^2 (–1) or *Alpha*		–0.005 (0.9652)	358.3 (0.9951)	0.39 (0.0030)	0.26 (0.0197)
GARCH (–1) or *Beta*		0.58 (0.2170)	0.002 (0.7850)	0.60 (0.0000)	0.84 (0.0000)
Alpha + *Beta*		0.58	358.3	0.99	1.1
CPI		–7.59 (0.1443)	684.5 (0.9951)	–0.26 (0.0035)	–1.18 (0.1097)
Exchange rate		0.02 (0.9585)	76.8 (0.9951)	0.05 (0.0000)	0.40 (0.0159)
R squared		0.62	0.29	0.84	0.66
Correlogram Squared (p value)		Less than 5%	More than 5%	More than 5%	More than 5%
ARCH LM Test	Prob. F(1,44)	0.0000	0.7035	0.75	0.25
	Prob. Chi-square	0.0000	0.7012	0.75	0.24
Histogram	Jarque-Bera Stat	27.5	1905	102.4	31.6
	Histogram P value	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Wald test (p values)					
		Lemon	Soft citrus	Orange	Grapefruit
Ho: C(5) = 0	t statistic	(0.3986)	(0.9951)	(0.0036)	0.4832
	f statistic	(0.3986)	(0.9951)	(0.0036)	0.4832
	Chi square	(0.3971)	(0.9951)	(0.0030)	0.4820
Explanatory variables (p values)					
		Lemon	Soft citrus	Orange	Grapefruit
C(6) = C(7) = C(8) = C(9) = 0	t statistic	n/a	n/a	n/a	n/a
	F statistic	(0.0000)	(0.9993)	(0.0000)	(0.0000)
	Chi square	(0.0000)	(0.9993)	(0.0000)	(0.0000)

Source: data used sourced from Joburg Market (2010–2022).

that there are no ARCH effects, and there is no serial correlation. The Wald test results are also statistically significant at less than 5%. The exogenous factors, exchange rate and CPI with coefficient values of 0.005 and -0.26 respectively and *p* values of less than 5% are significant in explaining orange price volatility. For the CPI, the negative sign suggests that a unit increase in inflation will decrease orange price volatility at a factor of 0.26%. With regard to prime lending rate, the only instance in which it is statistically significant in explaining price volatility for one of the species (which is orange) is in GARCH (1,1) under GED, with the lowest value of Akaike Info Criterion of 2.53. It carries a coefficient of 0.12 and a *p* value of less than 5% (See Annexure A).

The theoretical explanation for the effects of exchange rate and CPI on orange price volatility can be found in the work of Aye and Odhiambo (2021), where it is purported that a weaker exchange rate can make imported agricultural inputs more expensive and stimulate high inflation. According to CGA (2020), as of 2019,

oranges accounted for the largest area cultivated with citrus at 48%, followed by soft citrus at 25%, lemon at 19% and grapefruit at 9%, and by virtue of volume, is the biggest species to be exported. Incidentally, whenever the currency is weak, farmers will supply oranges to export markets, and this will affect local prices. Madito and Odhiambo (2018), Ngarava (2021) and Habanabakize and Dickason-Koekemoer (2021) have highlighted that inflation in South Africa is constituted by the following parameters: transport, electricity, fuel and labour. Thus, inflation is one of the channels that may hamper resource-poor farmers from supplying citrus products to local markets. The channel for the movement of exchange rate and interest rates can be linked to the mandate of SARB. To demonstrate this, normally, when the Rand depreciates, the SARB acts by increasing the repo rate. An increase in repo rate normally leads to an increase in the prime lending rates; a situation that results in farmers not being able to qualify for loans and credit.

Lack of access to credit normally leads to low volumes of citrus supplied to the market ceteris paribus. This must be read against the backdrop of a poor farmer support policy framework in South Africa. To improve on the policy framework, regarding farmer support programmes, South Africa can exploit policy provisions of the World Trade Organization, which are prescribed in the Green Box policy framework. The Green Box provides a broader framework outside restrictions for subsidies and tariffs on how the government can manoeuvre to make resource-poor farmers competitive and able to access export markets (IMF et al., 2022).

Some of the inflation contributing resources, such as the cost of diesel and electricity, can be included as part of the support structures for the farmers. Mpandeli and Maponya (2014) believe the South African government can include transport and accessibility to markets as other important farmer support services for resource-poor farmers.

Coming to the price volatility of grapefruit, in table 2, where the lowest Akaike Info value was established in GARCH (1,3) under GED, with added values for the residual and for the GARCH, yielding a figure of 1.1, it can be seen that its price volatility is not just persistent, but explosive. However, the Wald test results show that in terms of the t statistics, F statistics and the Chi square, the residual is not statistically significant in explaining grapefruit price volatility. The exogenous factors, CPI and exchange rate are statistically significant. The other results for the other different error distribution methods are presented in Annexure A to Annexure D. The previously mentioned annexures also contain the results of other exogenous variables, namely for prime lending rate paired with CPI.

CONCLUSION AND RECOMMENDATIONS

Using data derived from the Johannesburg Fresh Produce Market spanning a period of 12 years, GARCH was employed as an empirical model to study citrus price volatility. This is the first study of its kind in South Africa. The results show that price volatility is persistent for oranges at a 99% level and persistent for grapefruit at a 110% level. Due to the high levels of volatility, making projections for expected farm income and profitability may remain a difficult task for resource-poor farmers, and thus make it difficult to plan business expansion. The effects on selected macroeconomic variables were studied. The results show that interest rate, inflation and exchange rate were significant in explaining orange price volatility, whereas for grapefruit, it was only exchange rate and inflation. Since in South Africa, inflation targeting is the main economic policy framework for stabilising prices, and given the independent mandate of the SARB, the studied macroeconomic parameters may move in any direction at any point in time. Just as what happened during the crisis period of Covid-19, where the SARB increased the repo rate on more than 5 different occasions, it is clear that the government has no control over these parameters. As a recommendation, there is scope for the government to exploit the provisions of the Green Box programme of the WTO by providing farmers with resources that are susceptible to movements in exchange rate, interest rate and inflation. As examples, such resources could be diesel and transport. Assisting farmers to diversify their market accessibility with exports being a priority could be another key strategy for dealing with the effects of high price volatility in local markets.

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STRUCTURE, CONDUCT, AND PERFORMANCE OF BEANS MARKETING IN MALAWI: A CASE STUDY OF LILONGWE DISTRICT

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Abstract. Poorly performing markets are one of the major limitations to achieving high farm income and ultimately poverty reduction in sub-Saharan Africa. Using the structure, conduct, and performance approach applied to bean markets in Malawi, we bring to light the status and performance of the smallholder marketing system. Multiple methods were employed in this study: the Herfindahl-Hirschman Index to evaluate the market structure; adopted pricing strategies and affiliation with large companies or associations to assess conduct; and marketing margins to measure market performance. Our results show that 39 percent of markets are imperfectly competitive. Also, the lack of reliable markets, purchase prices, access to credit, operating capital, and transaction costs were major factors that undermined the potential for bean traders to operate at a higher scale. The commonly adopted pricing mechanisms include cost-plus pricing, dynamic pricing, and quality-dependent pricing. Very few bean traders (7%) are affiliated with large trading companies and associations. Seven bean marketing channels were observed. We recommend that policies favoring improvements in rural road networks and market infrastructure should be encouraged to reduce transaction costs. In order to eliminate barriers to increasing quantities of beans handled by traders, the government should provide soft loans with low interest rates to traders. Deliberate actions to promote the affiliation of small traders with larger companies and associations involved in bean trading should be promoted.

Keywords: structure, bean market system, bean traders, Lorenz curves, Herfindahl-Hirschman Index (HHI)

INTRODUCTION

Over the past decades, sub-Saharan African bean market access has experienced tremendous growth. For example, between 2019 and 2020, approximately 6.8 and 9.3 million people in Uganda, Burundi, Zimbabwe, and Malawi gained access to and consumed high-iron-rich beans, respectively. This is amidst an environment where demand for plant proteins from a well-structured and performing market is yet unmet (Ahmed et al., 2021; Aschemann-Witzel et al., 2021). Despite improved bean access and consumption, which can now meet not only overall demand but also the population's nutritional needs, it is well known that there has been insufficient research on the structure, conduct, and performance of the bean market and its determinants. It is scientifically proven that extensive management farming practices, principally for profit, correlate to not only increased productivity and better specialization but also result in higher income (Olwande et al., 2015; Bernard and Spielman, 2009). In spite of such development, the majority of smallholder farming households, especially in developing countries like Malawi, are unable to benefit from the comparative advantage of realizing a lot from their agricultural husbandry, partly due to low productivity and low marketing intelligence (Reddy, 2010;

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Sjauw-Koen-Fa, 2016). This is due to the low level of commercialization and the failure to see agriculture as a viable enterprise with reliable market interfaces (Brixiová et al., 2015; Atiase et al., 2018; Bernard and Spielman, 2009). It has been argued that access to viable markets provides an impetus for smallholder farmers to increase agricultural productivity and product diversification (Ge et al., 2020). This is because markets not only serve as selling points for produce, but also as training grounds, which in turn improves their subsequent productivity appetite (Dixon et al., 2001). Such development has the advantage of making farmers increase their produce base and facilitate an extensive value network for their produce to reach areas of high demand.

In order to improve farming enterprises, the Malawian government has implemented policies aimed at improving market reforms through the National Export Policy in general (Government of Malawi, 2016). Despite this, little has been discussed on market structure, conduct, and performance aimed at harnessing smallscale farmers in the country. This is despite the fact that the country, over the past years, has been implementing numerous policies geared at improving agricultural marketing and extension services to enhance the welfare of farming households (Ragasa, 2022; Matita et al., 2022; Lunduka et al., 2013; Government of Malawi, 2016). Among the policies are agricultural market liberalization, market infrastructure development, the development of information systems, and agricultural commodity exchange (World Bank, 2020). It is worth noting that prior to market liberalization, Malawi had one marketing board, namely, the Agricultural Development and Marketing Corporation (ADMARC) (Malawi Government, 2016). The board was instituted to have dominant responsibility for marketing agricultural products. The mandate of the ADMARC centers on buying and selling agricultural products and dictating prices. Mechanisms for agricultural production and regularizing agricultural marketing structure and performance. Therefore, the underperformance of such a state-owned enterprise resulted in the proliferation of other stakeholders that affected the structure, prospective stability, and performance of the agricultural markets in the country (Baulch et al., 2018; Ochieng et al., 2019), thereby informing the quest for further research with beans as a key crop.

Therefore, in light of these reforms that were geared at improving the performance of agricultural markets, especially in crops such as beans, the agricultural legume market system in Malawi still remains in an evolutionary state (Government of Malawi, 2016). Nevertheless, in some countries of sub-Saharan Africa, agrarian legume economies are among the emerging contributors to the household wealth basket and are fundamental for sustainable food security (Vanlauwe, 2019). It is worth noting that dry bean demand has reportedly been on the increase despite low production levels (World Bank, 2020). A study by IFPRI (2011) attributed these low bean yield levels to an inadequate agricultural and bean market system that is failing to appropriately incentivize smallholder farmers to understand the structure, practices, and performance of the market. As a result, beans continue to be an inexpensive and affordable source of proteins and vital micronutrients such as zinc, iron, calcium, and vitamin B, they reduce the risks of getting cancer and cardiovascular diseases over time, and the crop has been scientifically proven not only to boost the human immune system but also to reduce the risk of getting diabetes (Singh and Singh 1992; Heller, 2011; Garden-Robinson, 2013; Larochelle et al., 2016). Nonetheless, it has been noted that Malawi's bean value chain lacks a well-functioning, structured, and coordinated market (USAID, 2011). Poor road networks, restricted credit availability to key stakeholders, high transaction costs, and unstable market structures all provide obstacles to key stakeholders in the value chain being able to reach markets (Munthali, 2013).

Common beans are produced in Malawi at elevations between 1000 and 1700 meters, and the crop needs an average annual rainfall of between 800 and 1500 millimeters. The crop is typically farmed by smallholder farmers, particularly women. Many different farming strategies are used to grow the crop, including pure crop, mixed crop, relay cropping after maize, „dimba" gardens to take advantage of lingering moisture, irrigation (often after a rice crop), and tree crop alleyways (Chirwa et al., 2007).

Common beans are grown in a variety of places in Malawi. However, the primary bean-producing region is in central Malawi mostly because of the availability of land, rich soils, favorable rainfall patterns, and proximity to important bean markets (Birachi, 2012). Major bean-growing regions in the country include Dedza, Thyolo, Mulanje, Ntchisi, Chitipa, Dowa, Mzimba, Mangochi, Ntcheu, and Phalombe (Magreta and Jambo, 2012). A wide range of bean research projects have

been carried out in Malawi with the assistance of the government (National Agricultural Research Services) and non-governmental organizations (NGOs), such as the International Centre for Tropical Agriculture (CIAT) (Tumeo et al., 2017). Kholepethe, Kabalabala, Napilira, Phalombe, Sugar 131, CAL 143, Napilira, Kabalabala, NUA59, NUA45, VTT294/4-4, Nagaga, Nkhalira, Kambidzi, Sapatsika, and Maluwa are just a few of the improved bean varieties that have been released as a consequence of the research on beans (Birachi, 2012).

About 60% of the bean crop in Malawi is sold (Birachi, 2012). Although Malawi trades more than 80% of its beans as dried grain, the product is also sold as fresh pods. The majority of beans sold in local markets are intended for consumption, although big „demanders" of beans include institutions like hospitals, prisons, and schools. The amount of bean grading and sorting before marketing is small due to the absence of produce standards. Beans of diverse varieties, hues, and sizes are easily sold on the market. When beans are graded, which happens infrequently, they are mostly divided into their separate categories, independent of size.

Only approximately 20% of farmers cultivate some surplus common beans for sale; the majority plant them for domestic consumption (Birachi, 2012). Nevertheless, there are only a tiny number of medium- to large-scale farmers who grow beans for profit (Birachi, 2012). Although common beans are mostly grown for domestic consumption, there is potential for the crop to be commercialized given the continual rise in both domestic and foreign demand (Magreta and Jambo, 2012; Nkhata et al., 2021).

It is noteworthy that the nation's bean market sector is still in its infancy despite the availability of various bean varieties, the majority of which are renowned for their marketability. Another point to consider is that only 10–20% of Malawi's land is planted with improved bean types (Birachi, 2012). The lack of affordable access to better seed is the largest obstacle to the use of improved cultivars. Many smallholder farmers turn to recycling because they cannot purchase better seed (Birachi, 2012). Although the bean market sector is still rudimentary, the demand for beans, both domestically and internationally, does not match the existing levels of output (Mtumbuka et al., 2014; Katungi et al., 2009; USAID, 2009). In addition to being consumed at home, a sizable quantity of beans is also in great demand in places like schools, hospitals, and prisons (Mtumbuka et al., 2014). It is evident from the fact that current bean production is insufficient to meet demand that the bean marketing system has been ineffective in encouraging adequate bean production. In addition, rising costs for animal products and poor household incomes in rural areas have also contributed to the rise in demand for beans (Mtumbuka et al., 2014).

Given the status of agricultural markets and the importance of beans to human nutrition, the available studies on bean marketing in Malawi focused their research on addressing the performance aspect of bean markets (Nyondo et al., 2013; Mtumbuka et al., 2014, and Kasonga, 2018). Despite this, an important aspect of the bean that is imperative to market systems has been sparsely researched and has left a research gap that requires an extensive review in order to find a solution that will redirect bean marketing and functioning in Malawi. On the same note, much as scholars assert that the structure, conduct, and performance approaches of most crops are holistic in determining the markets of the product (Williams et al., 2006), the need for a fresh review of the subject focusing on the bean market system cannot be overstated if the country is to have effective pathways and gains in such a high-demand legume.

As a result of the aforementioned arguments, the current study contributes to the literature in three ways. Firstly, the study contributes to the growing academic and professional discourse on the bean market system and associated value chain through systematically evaluating the performance of the bean market system in Malawi. Secondly, it provides relevant information on the subject matter to understand effective bean marketing performance for an efficient bean market system. Thirdly, the study analyses market structure, conduct, and performance by using robust analytical methods to provide solutions to to make the bean market system more effective. Therefore, the need for a study to examine the structure, conduct, and performance of the bean market system in the country cannot be overemphasized.

MATERIALS AND METHODS

Data sources

The study was conducted in 18 markets in Lilongwe district. These markets included Mitundu Kamphata Nanjili Nathenje and Malingunde in rural areas, and Nsungwi, Area 18, Mgona, Wakawaka, Chinsapo, Area 23, Lizulu, Area 25, Area 24, Area 36, Chigwirizano, Kaphiri, and Mchesi. The study used primary data,

which were collected from a sample of 314 bean traders. Purposive sampling technique was used to select bean markets in Lilongwe district. In each market, a census method was employed to select traders for interview. Focus Group Discussion interviews with farmers were also conducted to provide insights on the quantitative data collected from traders. Focus Group Discussions aided the formulation of marketing channels where farmers could easily point out the different off-takers of their commodities. Key informant interviews with larger traders and associations were conducted to help explain results from quantitative data and create some marketing channels used in this paper.

Evaluating market structure

Market structure is defined as a set of characteristics that are responsible for determining the economic environment of firms. These characteristics include the number of sellers and their respective market shares, buyers, sellers, and potential barriers to entry; the degree of product differentiation; and the conditions of entry and exit (Bain, 1968). Market structure is measured by determining the level of market concentration. Market concentration is an important proxy for measuring the competition among firms in the industry. It gives an insight into how competitive the markets are, given the prevailing market environment. There are a number of methods for measuring concentration ratios. Some of these methods include the nth-firm Concentration Ratio (CR_n), the Herfindahl-Hirschman Index (HHI), the Lorenz curves, and Gini coefficients. The nth-firm Concentration Ratio (CR_n) is used when describing the market share of the few biggest firms in the market. It determines the level of competition (normally expressed as percentages) amongst the selected large firms in the industry. The major drawback of this approach is that it lacks proper justification for the choice of four top industries. The choice of four top industries is to some extent arbitrary (Pulaj and Kume, 2013). Lorenz's curve is mostly used to measure income inequality, while Gini coefficients deal with inequality of income distribution (Pulaj and Kume, 2013). The HHI was postulated and applied in the field of industrial economics by Herfindahl (1950), and Hirschman (1964). The method is the most widely applied measure of concentration, and it acts as the benchmark to evaluate other methods for measuring concentration. Unlike other measures like CR_n, which considers only the largest firms, HHI is calculated by summing up all squared market shares of firms in the market (Pulaj and Kume, 2013). The literature suggests that HHI is a good measure of competition intensity because it is more complete and elaborate than other methods such as CR4 and the Gin coefficient (Pulaj and Kume, 2013; Anbarci and Katzman, 2005). This is because it uses a weighted average of the market shares of all firms and traders. Therefore, it is with this understanding that this study employs HHI as a measure of market concentration. According to Shapiro (2010), HHI is categorized as follows: unconcentrated if the value of HHI is less than 1500; moderately concentrated if the value of HHI is in the range of 1500–2500; highly concentrated if the value of HHI is greater than 2500.

Herfindahl-Hirschman Index (HHI)

In order to determine the market concentration in the bean market, the Herfindahl-Hirschman Index (HHI) was used. The index further stipulates the competitiveness of the market (Pulaj and Kume, 2013). The HHI can be presented as follows:

$$HHI = \Sigma^{n}_{i=1} MS^2 \tag{1}$$

In this case, MS_i is the market share of the seller (i), whereas n is the number of sellers in the market. Market shares are calculated in terms of the quantities of beans handled by each seller in the market. Market share in this case is given by the following formula:

$$MS_i = \frac{V}{\Sigma^{n}_{i=1} V_i} \tag{2}$$

represents the quantities of dry beans handled by seller i in Kg and $\Sigma^{n}_{i=1} V_i$ represents total quantity of beans in the market. Structured questionnaires were administered to traders to capture characteristics that affect market structure. Furthermore, focused group discussion was also conducted among bean producers to ascertain the structure of beans markets.

Furthermore, the Lorenz curves have been constructed to show the degree of inequalities on sales among traders. The Lorenz curve shows how revenue is distributed within in a certain market. It was designed in 1905 to represent the distribution of wealth by Max O. Lorenz. The total percentage of income earned by various demographic groups is shown on the Lorenz curve (Delbosc and Currie, 2011).

Evaluating Bean Market Conduct

Market conduct describes the behavioral patterns that market participants use to adapt to shifts in the external environment brought on by market structure. It involves techniques used to determine prices and outputs, initiatives to promote sales, and the presence or absence of intentional measures to block new entrants (Bain, 1968). Conditions that were thought to represent exploitative, predatory, or tactful relationships involving wholesalers and retailers were examined in order to analyze the behavior of bean markets. The study examined variables including membership in professional associations or larger dealers. Moreover, market behavior was assessed by looking at the methods used by bean merchants to set prices.

Evaluating Bean Market Performance

Market performance is an economic result of changes in the market environment and the patterns of behavior that marketing agents follow in pursuit of an economic goal (Bain, 1968). Since "market performance" is a multidimensional term, it can be measured in a number of ways depending on the economic result that one is interested in measuring. In this study, marketing margin is used as an indicator to measure market performance. According to Olukosi and Erhabor (1988), marketing margin is one of the major measures of market performance. It is along this line that total gross marketing margin (TGMM) was used to evaluate the performance of bean marketing. Marketing margins were calculated at each bean marketing channel. Total gross marketing margins (TGMM) are expressed as follows:

$$TGMM = \frac{P_s - P_b}{P_s} \times 100 \qquad (3)$$

where P_s is selling price, P_b is buying price, and TGMM is total gross marketing margin. Producer's share was also used to determine performance of bean marketing channels. It was calculated by subtracting the percentage TGMM from 100.

KEY FINDINGS

Evaluation of market share

To illustrate the degree of disparities in the cumulative market shares of bean dealers, the Lorenz curve was created. The distribution of bean traders' cumulative share of sales is shown in Figure 1. The magnitude of the deviation from a diagonal line reveals the degree of disparity in the total amount of sales revenues. There is a significant disparity in the shares of bean traders, as depicted in Figure 1. With a rise in the share of cumulative sales, the degree of inequality gets worse. Figure 1 shows that the lowest 20% of traders account for about 5% of the market's total sales. Furthermore, the top 20% of dealers account for close to 70% of sales income. The results indicate that the largest share of sales revenue is controlled by the top 20% of traders.

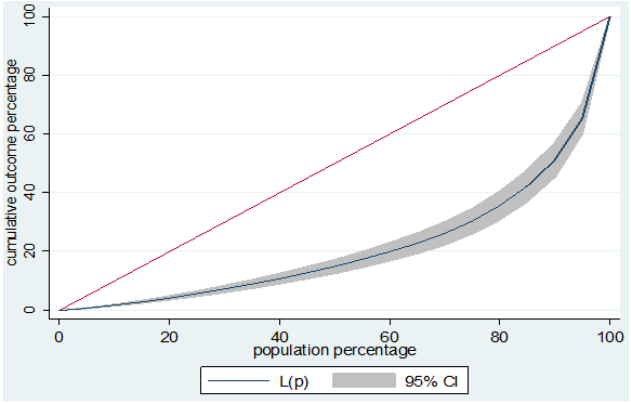

Fig. 1. Lorenz concentration curve for bean traders' shares in Lilongwe
Source: computed from the survey data by the author.

To measure the degree of inequality between rural and urban markets, the Lorenz curves were created. Markets in urban areas and rural areas were contrasted (see Fig. 2). In urban markets, it can be seen that the top 50% of merchants control 80% of sales revenue, compared to the bottom 50% of dealers who control about 20% of overall sales revenues. The findings indicate that in rural markets, the top 50% of dealers control 90% of sales revenues, compared to the bottom 50% of traders controlling about 10% of sales income. This demonstrates the stark disparity in market share between rural and urban sectors.

A comparison of the sales revenue splits between retailers and wholesaler traders was carried out. According to Figure 3, the top 50% of wholesaler traders control nearly 88% of sales revenues, compared to the lowest 50%, who control about 12% of sales revenues. Also, the top 50% of retailer traders are able to control 75% of sales revenues, compared to the lowest 50%, who only control about 25% of sales revenues. Wholesalers in this instance show greater disparities than retailers. Small quantities are typically sold by retailers.

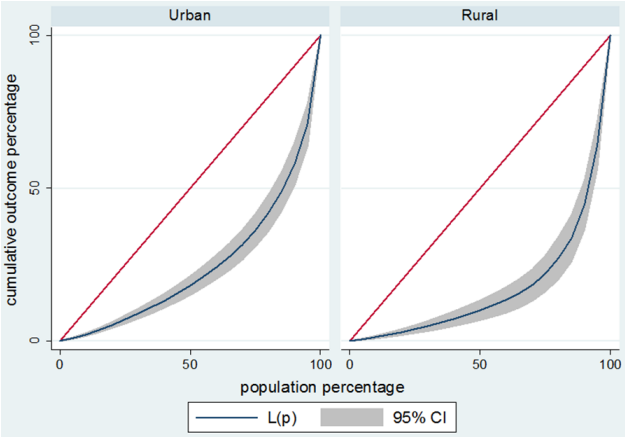

Fig. 2. Lorenz concentration curve for bean marketing in rural and urban markets in Lilongwe district
Source: computed from the survey data by the author.

Fig. 3. Lorenz concentration curve for bean retailers and wholesalers in Lilongwe district
Source: computed from the survey data by the author.

This explains why there are less discrepancies in the share distribution among retailer traders than there are among wholesalers.

The Structure of the Bean Market system in Lilongwe

Market Concentration. The study adopts the benchmark of Horizontal Merger Guidelines. According to Shapiro (2010) the Horizontal Merger Guidelines categorizes HHI as follows: "unconcentrated" if the value of HHI is less than 1500; "moderately concentrated" if the value of HHI is in the range of 1500–2500; "highly concentrated" if the value of HHI is greater than 2500. In this study, the HHI for selected markets in Lilongwe shows that Area 18, Chinsapo, Mgona, Mitundu, Nsungwi, Wakawaka, Area 23, Area 24, Area 25, Area 36, and Lizulu are unconcentrated. This means that there are a number of bean traders in such markets. Only the Kamphata and Kaphiri markets are moderately concentrated, implying that they have some level of competition and oligopolistic tendencies. Furthermore, it can be observed in Table 1 that Chigwirizano, Malingunde, Mchesi, Nathenje, and Nanjili are highly concentrated markets. This means that a few sellers are dominating the sale of beans in those markets. The highly concentrated markets show that there exist oligopolistic tendencies among such markets, which govern the pattern of behavior of bean traders. Generally, it can be concluded that 61 percent of sampled bean markets in the Lilongwe district are not concentrated. Furthermore, 11 percent of the sampled

Table 1. Market concentration

Name of Market	Herfindahl-Hirschman Index
Mitundu	536
Nsungwi	592
Area 18	643
Mgona	653
Wakawaka	753
Chinsapo	937
Area 23	1 014
Lizulu	1 051
Area 25	1 057
Area 24	1 394
Area 36	1 456
Kamphata	1 589
Kaphiri	1 869
Mchesi	2 609
Nanjili	3 514
Chigwilizano	4 502
Nathenje	7 527
Malingunde	8 380

Source: own elaboration.

markets are moderately concentrated. The remaining 28 percent of the markets are highly concentrated.

Barriers to market entry and increase in the scale of operation. Through focus group discussions (FGDs) with the traders, the study found that there are barriers to entry and an increase in the scale of operation in the bean market. Some of the barriers include lack of capital, lack of reliable markets, high purchase prices, lack of access to credit and finance, and inadequate operating capital and transaction costs. Such impediments have a significant impact on the structure, performance, and conduct of the bean market.

Market Conduct of Bean Traders in Lilongwe

Affiliation with Traders' Association

As shown in Figure 4, the study finds that 93% of traders are not affiliated with any trade associations. Nonetheless, key informant interviews with Grain Traders Association in Malawi revealed that there are some traders that the association works with. These traders have better access to market information on prices and availability of bean markets.

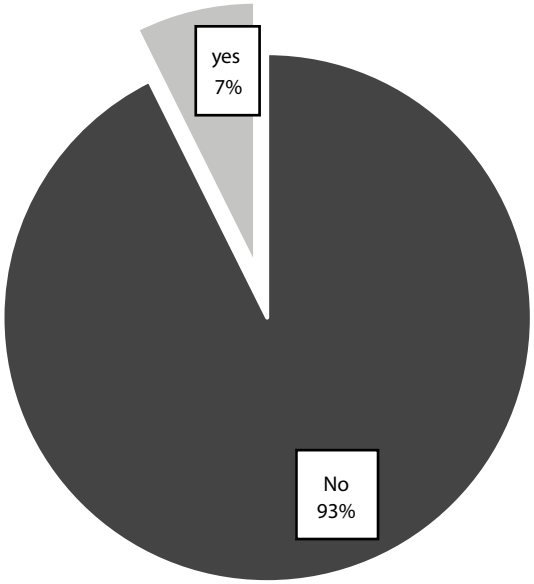

Fig. 4. Percentage of traders who are affiliated to trade associations
Source: own elaboration.

Price Setting Mechanisms

When setting selling prices for beans, traders use combinations of price-setting mechanisms. As reported in Table 2, the most adopted mechanisms include cost-plus pricing (61%), dynamic pricing of beans (54%), and taking quality into consideration (38%). Although 38 percent of bean markets are imperfectly competitive, traders did not collude in determining the prices of beans.

Table 2. Price differences across price mechanisms

Pricing method	Frequency (%), N=314	Mean (USD)	Min (USD)	Max (USD)
Cost plus pricing	61	0.86	0.43	1.67
Quality	38	0.85	0.56	1.45
Dynamic pricing	54	0.84	0.47	1.45
Collusion	10	0.85	0.61	1.45

Source: own elaboration.

Evaluating the performance of bean marketing channels

Bean Marketing Channels

Figure 5 summarizes possible marketing channels along which dry beans flow to reach the consumer. Marketing channels were created by tracing the sources of beans that traders, companies, and farmers buy and sell. Focus group discussion interviews were conducted with farmers to help identify marketing channels at the farm gate level. Vendors, wholesalers, and retailers were also asked where they bought and sold beans to establish the marketing channel that they use.

Marketing channel 1 consisted of bean producers selling directly to local consumers, as well as urban consumers. Channel 2 comprises producers, wholesalers, and consumers. This is one of the channels through which producers sell directly to companies with whom they are affiliated. It is this channel that larger traders use for exports and selling directly to institutions such as hospitals, secondary schools, prisons, and colleges. In channel 3, bean producers sell to vendors who travel with their scales to rural areas to buy beans. These vendors assemble beans from tiny, scattered farmers in the villages. They usually set up buying points in rural

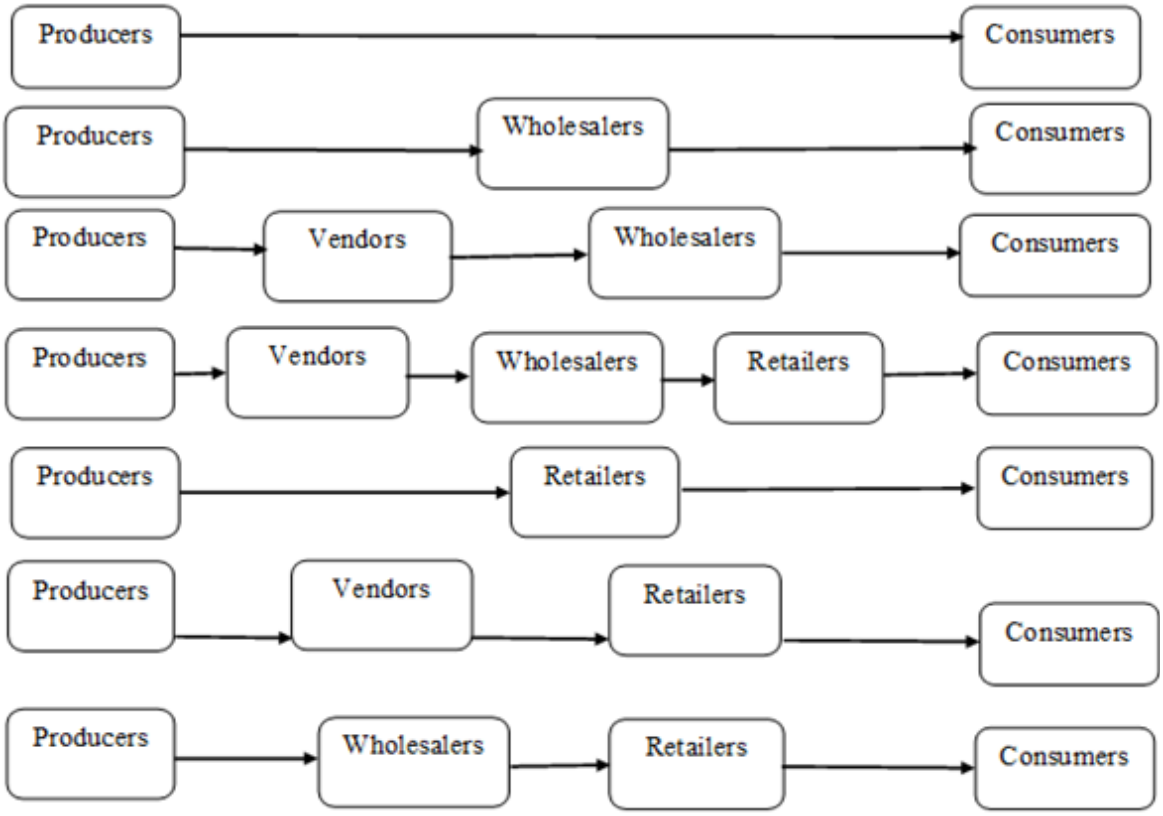

Fig. 5. Beans marketing channels in Lilongwe
Source: own elaboration.

trading centers where farmers come to sell their beans. Vendors eventually sell to wholesalers that include larger individual traders and companies. In channel 4, beans move from producers to vendors, then to wholesalers, who then sell to retailers. These retailers are shop owners and individual bean traders who sell different legumes. Marketing channel 5 comprises retailers buying beans directly from producers. In channel 6, vendors bought beans from farmers and sold them to retailers. Finally, channel 7 is composed of wholesalers who buy from bean producers and sell to retailers. In this channel, wholesalers such as those found at Mchesi Market send their agents to buy directly from the farmers. This was one of the markets that supplied beans to nearby markets in the Lilongwe district.

Performance of Marketing Channels

The performance of marketing channels is evaluated by calculating the marketing margins in each channel. A well-performing marketing channel is one with low marketing margins (Cramer and Jensen, 1982). In this study, the most efficient marketing channel is channel 1, which comprises farmers selling directly to consumers. In this channel, farmers obtained the highest producers' share (100%), as compared to the rest of the marketing channels. However, the study notes that marketing channels 2 and 7 are better than others because they have relatively lower marketing margins (24.76% and 28.46%, respectively) than other channels. These are marketing channels that do not involve vendors, but rather wholesalers buying from producers and selling to consumers in channel 2 and retailers in channel 7. Some of the wholesalers involved in those marketing channels are larger traders, such as companies, or individual traders operating at a higher scale. The results are summa rized in Table 3.

Table 3. Performance of Bean Marketing Channels in Lilongwe

Marketing channels	Marketing margins (%)	Producer's shares (%)
1	0	100
2	24.76	75.24
3	28.72	71.28
4	29.88	70.12
5	29.84	70.16
6	29.82	70.18
7	28.46	71.54

Source: own elaboration.

DISCUSSION

Firstly, the study finds that there exists a wide inequality in the market shares of the traders in the bean market, with higher inequality in rural bean markets than in urban markets. This is mostly due to poor road networks, underdeveloped market infrastructure, and poor telecommunications in rural markets. The market environment existing in rural markets leads to high transaction costs that eventually affect common bean trading. Furthermore, wholesalers were found to have higher inequalities than retailers. This is because wholesalers operate at different scales, which enables them to stock larger volumes of beans than retailers. Besides that, for a small bean trader to graduate to a larger trader, large operating capital is needed, which is a barrier to most retailers.

With regards to market concentration, the study finds that a substantial proportion of the bean markets are unconcentrated. A high percentage of markets falling under the category of "unconcentrated" show that there are a substantial number of traders involved in the bean trade. One possible explanation for this is that common bean is one of the most economically viable crops with the greatest potential to increase income levels and thus reduce poverty (CIAT, 2013; USAID, 2011). According to Katungi et al. (2009), there is an increasing demand for beans in Malawi. It simply connotes the profitability of beans in its quest to sustainably improve the income levels of various households in Malawi.

The study further found some notable barriers to entry in the bean market. First, lack of capital was the most common barrier to entry. Most traders pointed out that they would like to expand the scale of business but capital acts as the major constraint. This is because the most prominent source of capital observed amongst many traders was personal savings. Secondly, most traders do not have consistent markets where they can sell their beans. It was noted that most bean traders travel long distances in search for beans, and this increases transaction costs. This again affects the quantity that they offer at the market.

Thirdly, high purchase prices prevented traders from increasing the scale of operation more, especially for the retailer. This was common, especially on the most profitable bean variety (red kidney beans). *The phalombe* variety was reported to be the most profitable bean variety, and most traders would like to increase sales of that variety. Nevertheless, because there is high demand for that bean variety, the variety is not readily available, and as such, the purchase prices are driven up. This prevents bean traders with low operating capital from increasing the quantity of such varieties. Fourthly, lack of access to credit was another important barrier to bean marketing. Access to credit is very important considering the fact that lack of capital for bean marketing was reported to be a bigger challenge for a number of traders. Fifthly, some traders reported that inadequate operating capital was among the challenges that deterred traders from increasing the scale of their operations in bean marketing. According to traders, the average working capital was US$ 967.34, which is on the low side.

Sixthly, focus group discussion interviews revealed that high transaction costs, such as high transportation costs, affected the quantity of beans each trader handled in the market. Market information on bean prices from other markets was one of the barriers that increased transaction costs. The study further agrees with the findings of Chitete et al. (2021), who established that lack of market information on prices and quantities of groundnuts led to weak integration of the groundnuts markets in Malawi. In this study, it was observed that most traders had access to market information on prices and where to purchase beans for sale, though the source was an unreliable one. The major source of information was reported from friends, relatives, and personal observations. These modes of accessing market information is not reliable and it cannot be trusted, as alluded to by a number of bean traders in the focus group discussion interviews.

Results concerning market conduct were grouped into (1) traders' affiliation with trade associations and (2) price setting mechanisms. With regards to traders' affiliation with associations, the study found that a majority of the traders are not affiliated with any association. In Malawi, studies that have also applied a structure, conduct, and performance framework, such as Nzima and Dzanja (2015) and Nzima et al. (2014), found that traders were not affiliated with any trade organization in marketing groundnuts and soy beans, respectively. The literature suggests that affiliation with a trade association improves the relationship between traders and such associations, which eventually enables traders to sell at better prices (Abah et al., 2015). It also enables traders to more easily identify marketing channels that would otherwise increase marketing efficiency. With regards to price-setting mechanisms, the study finds no evidence of collusive behavior among the traders. The results agree with those of other legume market studies in Malawi. For instance, Nzima and Dzanja (2015) and Nzima et al. (2014) also found that traders did not collude in determining the prices of groundnuts and soy beans in Malawi.

Lastly, the study evaluated the performance of the different market channels that exist in the bean market. The study found that there are seven key channels for the commodity to move among producers, vendors, wholesalers, retailers, and consumers. Most of the wholesalers in the bean marketing channels included individual large traders selling in different markets in Lilongwe and companies such as NASFAM, Export Trading Group, Farmers World, Wills General Dealers, Auction Holding Limited, Rab Processors, Muli Brothers, Commercial Farmers Limited, and Jeds Trading. The companies do some value-adding activities such as sorting, grading, and packaging before exporting or selling to domestic supermarkets. Consumers consist of processors such as Central Poultry and Sun Gold Food Processing, institutions such as hospitals, schools, prisons, and colleges, and households both in rural and urban areas. With regards to performance, the first channel, which involved producers selling directly to consumers, was the efficient channel. Although this channel is the most efficient as compared to others, key informants contacted had different opinions. They argued that farmers cannot appropriately perform all marketing functions, citing that most farmers in Malawi are smallholders, and as such, they operate at a subsistence level with a low level of commercialization. Farmers cannot carry out all the necessary marketing functions, such as assembly, transportation, storage, labelling and packaging, distribution, financing, and risk bearing. These marketing functions add value to the bean value chain, thereby improving the performance of bean marketing. NASFAM, for instance, provides extension services to its farmers and provides markets for harvested beans. It has a commercial entity that is responsible for the value addition of agricultural commodities that also include beans. These value-adding activities include grading, packaging, branding, and then distributing to various marketing outlets such as retailers, supermarkets, and exporters in various regional markets.

CONCLUSIONS AND POLICY IMPLICATIONS

The purpose of the study was to evaluate the common bean market system in Malawi using a structure, conduct, and performance approach. The study first evaluated the distribution of market shares among bean traders using Lorenz curves. Overall, there are inequalities in market shares among bean traders. Shares of urban and rural traders were compared, and it has been observed that there are more inequalities in market shares in markets located in rural areas compared to markets located in urban areas. The study further finds that 38 percent of markets are imperfectly competitive. Most traders reported that lack of reliable markets, lack of capital, high purchase prices, access to credit, insufficient operating capital, and high transaction costs were the major barriers to entry into the bean marketing industry. The conduct of traders was observed through their methods of pricing and affiliation with large traders or organizations. The commonly adopted pricing mechanisms include cost-plus pricing, demand and supply of beans, and quality-dependent pricing. It was further observed that 93 percent of bean traders were operating independently without being affiliated with any large trader or organization. Seven marketing channels were identified. In each channel, marketing margin and producer's shares were computed. Channel 1, which involved selling directly to consumers, had a 100% producer share. However, key informant interviews showed that farmers cannot appropriately perform all marketing functions, citing the fact that most farmers in Malawi are smallholders operating at a subsistence level with a low

level of value addition. Farmers cannot carry out all the necessary marketing functions, such as assembly, transportation, storage, labelling and packaging, distribution, financing, and risk bearing. These can be best performed by other marketing agents in the marketing chain.

Since it was found that some bean markets are imperfectly competitive, the government and private sector should institute deliberate actions to reduce market concentration in such markets. In this regard, government and private stakeholders should create a conducive market environment for businesses to flourish through improvements in market infrastructure and rural road networks. Improvements in rural road networks would reduce transfer costs, which would undermine the potential of bean marketing. To eliminate the barrier to entry in bean marketing, the government should provide traders with soft loans with low interest rates. By providing and intensifying access to credit, the operating capital of traders will increase, which will eventually result in an increased scale of operation. Affiliation with associations such as the Grain Legume Association or large traders (companies) would help to further improve the functioning of the bean market system.

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STRENGTHENING THE COMPETITIVENESS OF THE LENTIL SEED SYSTEM OF NEPAL: A VALUE CHAIN APPROACH

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Abstract. A value chain approach is the most viable and pragmatic strategy to develop an effective, inclusive, competitive and sustainable seed system for many crops globally. This study was conducted in the Kailali, Dang and Siraha districts of the Terai and Inner Terai regions of Nepal to map and thoroughly analyze the value chain of the lentil seed system. Primary data were collected through a household survey, key stakeholder interviews and focus group discussions. Altogether, 300 lentil grain-producing and 100 seed-producing farmers were selected for the study. Descriptive statistics, value chain mapping, stakeholder price spread calculation and return on investment were the major tools for the study. Conventional cultivation practices along with incidence of biotic and abiotic stresses ensured non-significant differences in yield, income and benefit-cost ratio (B:C) between local seed users and improved seed users, resulting in a distorted demand pull chain and eventually leading to the lamentable lentil seed system. Total value addition from farm gate to end user was 63.84% of the total retail price. Seed conditioners and processors contributed 28.38% of total value addition. Return on Investment (ROI) per total cost was higher for seed-producing farmers (59.3%). However, ROI per added cost was higher (214.8%) for retailers followed by seed conditioners and processors (96.37%). The total price spread along the chain was 45.21% of the total consumer price, revealing the inefficient marketing system. Scaling up the major factors behind improved seed adoption, like package of practices, use of a specialized production area, the development of stress resilient varieties, technical assistance, training, and subsidy schemes based on production and efficient market system development, can economically benefit lentil-producing farmers, thereby reinforcing the major pulling force of the lentil seed value chain. Appropriate infrastructure, government prioritization, a coordinated policy environment and innovative public-private partnership models across the seed value chain are necessary for overall sectoral growth.

Keywords: Lentil, seed system, value chain, government prioritization, governance

INTRODUCTION

Legumes are a major source of dietary protein and essential nutrients, especially for poor families in developing countries like Nepal, who cannot afford expensive animal proteins. Legumes provide up to 20–25% of protein by weight, which is 2–3 times that of wheat and rice (Shahwar et al., 2017). In cereal-based cropping systems, lentils occupy a unique position among legume crops in terms of their capacity to improve human, animal and soil health (Erskine et al., 2009). The higher protein content and insignificant levels of cholesterol, fat and anti-nutrients found in lentil cotyledon are

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credited with making it the foremost preferred protein source for human consumption (Sultana and Ghafoor, 2008). Whole lentils contain 25.8% protein while split lentils contain 25% protein (Kim et al., 2016). As well as having a high protein content, lentils are a major source of minerals, vitamins and lipids. They have numerous potential health benefits, such as anti-carcinogenic, blood pressure-lowering, hypo-cholesterolemic and glycemic-load-lowering effects (Faris et al., 2013). Because of their high calorific value and plentiful nutrient load, lentils are considered a major component of the food and nutritional security of rural smallholder households in developing countries like Nepal.

Lentils are cultivated across all provinces in Nepal. In terms of agro-climatic zones, lentil cultivation is concentrated within the Terai region, with a share of more than 95% of total production. The total cultivated area, production and productivity of lentils are 212,000 hectares, 262,000 tonnes and 1,256 kg ha^{-1} respectively (MoALD, 2021). Lentil cultivation in Nepal accounts for 4.2% of the worldwide area devoted to the crop and 4.02% of global production. However, the productivity of lentil cultivation in Nepal is 5.36% below global productivity (FAOSTAT, 2022). Lentils from Nepal constitute only 3% of the total world market for lentils (ITC, 2019). Lentil production has been seen to change over time in prior years. However, from 2013 to 2015, production remained unchanged. The total production of lentils in 2016 was almost 11% higher than in 2015 (MoALD, 2020). In recent years, the total demand for lentils in Nepal has increased. During the year 2020, the total national demand for lentils was 359,000 tonnes, which is 37% higher than in 2015 (MoALD, 2020). Due to changing consumption patterns, increased health awareness and an increasing population, the demand for lentils will increase rapidly in the near future and will reach 390,000 tonnes in 2025 (Thapa et al., 2019). Currently, total national production covers only 71.2% of total national demand. Increasing domestic demand and decreasing production have combined to cause a ballooning trade deficit. In 2020, total lentil imports were almost 24 times higher than total national exports (MoALD, 2021). To meet domestic national demand and realize the foreign trade potential of Nepalese lentils, the total cultivated area, production and productivity of lentils must be extended in the near future.

Low productivity in agriculture is the result of reduced use of better-performing varieties, poor quality seeds and other inputs (fertilizer, irrigation, farm machinery, etc.) and production technologies (Gauchan, 2019). The use of quality seeds only can increase crop yields by up to 40–45% (Abebe and Alemu, 2017; Panta, 2015; Wimalasekera, 2015). The use of improved seed not only increases crop yield but also enhances the efficiency and productivity of other inputs like fertilizer, irrigation, farm machinery and human labor, ultimately helping sustainable crop production. The replacement of previous low yielding varieties and poor quality seeds with better quality seeds and improved varieties is thus a more meaningful and practical measure for increased production (Spielman and Kennedy, 2016). However, the majority of Nepalese farmers have been using locally saved and exchanged seed for many crops for many years. The present seed replacement rate of major crops is less than 15% and it is below 5% for lentils (SQCC, 2017). This scenario does not ensure farmers' access to quality seeds of a wide range of varieties of lentil. The provision of improved quality seed in sufficient quantities, on time, and with accessible and appropriate varietal options is crucial to promote the adoption of improved varieties and close the yield gap.

Efficient and sustainable seed systems can help to improve the livelihoods of small farmers, serving as an important element in strategies for agricultural development and poverty reduction (Mulugeta et al., 2010). The availability of seed of improved varieties among lentil growers largely depend on a strong competitive lentil seed value chain with an efficient and wide distribution network (ANSAB, 2011). To date, only 14 lentil varieties are available for seed production and trading (MoALD, 2022). Many public and private organizations are working on lentil seed-related business with the support of NGOs and INGOs. Government organizations are there for quality control and policy formulation, and externally the lentil seed system seems to work in an efficient, sustainable and holistic way, but actually deep issues exist, as is reflected by the lentil seed replacement rate of less than 5% (SQCC, 2017). Nepalese farmers are less willing to pay for improved seed varieties (Mishra et al., 2017), and thus studies on farmers' valuations of current improved lentil varieties, their attributes, the types of services they are willing to pay for, and factors affecting the adoption of improved lentil varieties are very scanty in Nepal. On the side of seed supply, federal transformation has created structural and legal dilemmas along with weak coordination among the three tiers

of the government system, and hindered the seed multiplication process. During 2019, the demand for lentil breeder seed was 1,350 kg, production was 1,501 kg, and only 854 kg was distributed for seed multiplication. In the same year, production of lentil foundation seed was 10,888 kg while demand was only 1,597 kg and only 912 kg was distributed (SQCC, 2019). Likewise, tonnes of improved seed remained in storage and were finally sold as grain. As the lentil-growing farmers are the end users and the major pull factor of the overall lentil seed value chain, if they are not absorbing the available supplies from the market, the lentil seed value chain cannot function properly. This is directly linked with farmers' willingness to pay and their satisfaction levels with the improved lentil seed varieties available on the market, the preferred attributes of the varieties, and other reasons related to availability, timeliness, accessibility, technology and suitability (KUBK, 2017).

The availability and accessibility of improved seed varieties among lentil growers largely depend on a competitive, sustainable and efficient lentil seed value chain. To know the functioning of seed value chain, it is necessary to identify the operators, service providers and their respective activities. The analysis of linkages between value chain operators allows for a better understanding of the functioning of the seed chain (Bélanger et al., 2013). The regular system of research on farmers' preferred attributes, the temporal and spatial dynamics of such preferences, the constraints on the market and marketing system, resource use in lentil production and barriers to the adoption of improved lentil varieties is important for the design of upgrading interventions and to make such value chains competitive (Collins, 2009). The study analyzes the level of market orientation in product development, value addition and distribution. Likewise, it identifies the reasons for inefficiencies and potential leverage points for improving the performance of the chain to enhance the competitiveness and sustainability of the overall lentil seed value chain. This study thoroughly analyzes the strengths and weaknesses in every node of the lentil seed value chain, addressing varietal development, seed multiplication, seed production, quality maintenance, key actors in the lentil seed value chain, the marketing system and the upgrading of the lentil seed value chain. Market chain efficiency and sustainability can be ensured by correcting weak areas and adopting the strengths of the key actors in the lentil seed value chain. The growth of lentil seed commercialization can thereby be accelerated to create an inclusive, competitive and sustainable lentil seed system in Nepal.

METHODOLOGY

Study area

Among all the lentil-producing districts of Nepal, the top six are Dang, Kailali, Rautahat, Bardiya, Siraha and Bara. These districts account for 58.52% of the total lentil production and 47.27% of the total area used to cultivate lentils in Nepal (MoALD, 2020). Among those districts, Kailali, Dang and Siraha were selected for this study. To analyze the current situation and functioning of foreign trade, data from potential foreign exporters from districts like Rupandehi, Banke and Bara were also collected.

Sampling method and sample size determination

Using Cochran's formula, 150 lentil grain-producing farmers using local seed, 150 lentil grain-producing farmers using improved seed and 100 lentil seed-producing farmers were selected from the study districts. Primary data were collected using simple random sampling, snowball sampling and purposive sampling techniques through a pre-designed questionnaire, while secondary data were collected from secondary sources. For the detailed value chain analysis, 15 input suppliers, 15 seed collectors and processors (including large seed companies and small farmer's groups), 15 retailers, and all the service providers of the respective districts were selected. A total of six focus group discussions were carried out to cross-validate the household survey data.

Lentil seed value chain: mapping and analysis

Before value chain analysis, different functions, actors and service providers along with their functional relationships were mapped. This mapping shows the flow of transactions from the sourcing of raw materials and inputs to production, processing, marketing and final sale of lentil seed. The mapping of the lentil seed value chain includes costs, value addition, price enabling environments, critical constraints and the relative clout of the players. In this study, each node of the value chain, from variety development, multiplication, processing, packaging, trading and distribution to the end users of the lentil seed, was critically examined. Flow of cost, value

addition, margin, return on investment and price spread were also calculated throughout the chain.

Production and marketing problems

Based on the response frequencies, an indexing technique was used to identify major problems with production and marketing. Those problems were ranked using a five-point level of influence comprising most serious, serious, moderate, low, very low or no problem at all, using scores of 1.00, 0.80, 0.60, 0.40, 0.20 respectively. The priority index for each variable was calculated as a weighted average in order to draw valid conclusions and make responsible decisions. The index of influence was calculated using the following formula:

$$I_{inf} = \sum \frac{s_i f_i}{N}$$

Where, I_{inf} = index of influence, Σ = summation, s_i =scale value, f_i = frequency of influence given by respondents, N = total number of respondents

Descriptive statistics like the t-test and Chi square test was used for the analysis in the Stata/SE 12.1.

RESULT AND DISCUSSION

Economics of lentil grain and seed production

Despite the increasing demand for lentils in Nepal, the study revealed a decreasing trend in production. However, the price of lentils has been increasing in recent years. In 2021, the average productivity of lentils using local seed was 568.8 kg/ha while it was 620.1 kg/ha using improved seed. The lentil yields of local seed users and improved seed users were statistically similar in the years 2019 and 2021 but this difference was statistically significant at the 10% level in 2020. Increasing demand but decreasing supply has caused the price of lentils to rise in recent years. The average price of lentil was NRs. 70.9/kg in 2019 and reached NRs. 85.5/kg in 2021.

For those farmers using improved seed, 33.6% of the total variable cost was accounted for by labor, 21.7% by seed, 21.4% by threshing and 11.1% by land preparation. For local seed users, 28% of the total variable cost was accounted for by labor, 10% by land preparation, 27.5% by seed and 18.2% by threshing. Likewise, for farmers who were involved in improved seed production, more than one third of the total variable cost (36.1%) was for labor followed by 25.2% for seed and 18.7% for threshing. Due to the higher labor requirements for processing, harvesting, and intercultural operation in seed production, the cost of labor was higher for seed producers than for grain producers. Analyzing the total variable cost and gross income from lentil grain and seed production, this study revealed a 23.6% higher cost for seed production than for grain production. However, revenue from seed production and grain production was statistically similar.

Table 1. Production (per hectare) and price trend of lentil grain in the study area

Variables	Overall (*n* = 300)	Local seed user (*n* = 150)	Improved seed user (*n* = 150)	Mean difference	t-value
			Total production (kg)		
2021	594.4 (301.4)	568.8 (321.9)	620.1 (492.8)	–51.3	–2.73
2020	537.8 (434.3)	507.2 (205.7)	568.4 (356.7)	–61.2*	–4.89
2019	664.5 (205.8)	656.6 (376.4)	682.5 (520.1)	–25.9	–2.21
			Price (NRs./kg)		
2021	85.5 (10.3)	82.2 (9.9)	88.8 (10.7)	–6.6	–2.1
2020	83.0 (9.2)	82.7 (8.4)	83.3 (9.7)	–0.6	–1.05
2019	70.9 (9.7)	70.8 (9.8)	71.1 (9.7)	–0.3	–0.67

Figures in parentheses indicate standard deviation. * Indicates significant difference at the 10% level.
Note: 1 USD = NRs.114.5
Source: field survey, 2021.

Table 2. Total variable cost and income (per hectare) from lentil grain and seed production

Parameters	Improved seed user		Local seed user		Seed producer	
	cost (NRs.)	share of total cost (%)	cost (NRs.)	share of total cost (%)	cost (NRs.)	share of total cost (%)
Labor cost	8 314.4	33.6	6 116.1	28	10 372.3	36.1
Land preparation cost	2 739.9	11.1	2 167.7	10	3 250.5	11.3
Seed cost	5 365.7	21.7	6 011.8	27.5	7 245.4	25.2
FYM, fertilizers and micronutrients cost	1 841.2	7.4	2 099.2	9.6	949.2	3.3
Disease and pest management cost	1 139.8	4.7	1 460.3	6.7	1 553.3	5.4
Harvesting, threshing and post-harvest cost	5 291.7	21.4	3 993.1	18.2	5 379.1	18.7
Total cost	NRs. 24 692.7		NRs. 21 848.2		NRs. 28 765.5	
Income from lentil production	NRs. 55 064.8		NRs. 46 755.3		NRs. 54 942.1	

Source: field survey, 2021.

For lentil grain and seed production, a large proportion of the total expenditure goes on variable cost items like seed, labor, land preparation and threshing. The study revealed that for improved seed users, local seed users and seed producers respectively, 66.7%, 64.43% and 83.3% of the total cost was for variable cost items (Table 3). Among improved seed users, the net profit was NRs. 29.6/kg, while it was NRs. 22.58 for local seed users. Likewise, the profit per kg from lentil seed production was NRs. 31.78, which is higher

Table 3. Cost-benefit analysis of lentil grain and seed production

Cost items	Improved seed user	Local seed user	Seed producer
1	2	3	4
Variable cost items	Cost per kg of lentil Grain production	Cost per kg of lentil Grain production	Cost per kg of lentil seed production
Labor	14.42	11.04	15.49
Land preparation (tractor/bullock)	4.42	3.81	4.17
Seed	9.65	10.57	13.02
Farm Yard Manure (FYM)	0.26	1.49	1.28
Urea	0.33	0.55	1.3
DAP	0.46	0.74	0.12
Micro nutrients	0.33	0.51	1.19
Disease/pest management	0.28	0.74	1.49
Threshing	9.31	8.02	6.61
Drying/processing	0.22	0.1	0.1
Total variable cost	39.68	38.41	44.76

Table 3 – cont.

1	2	3	4
Fixed cost items			
Land rent	11.33	13.54	4.64
Depreciation on farm equipment's	3.87	2.89	1.76
Repair and maintenance	4.31	4.78	1.35
Total fixed cost	19.51	21.21	7.75
Total cost	59.2	59.62	53.72
Average revenue per kg	88.8	82.2	85.5
Net profit per kg	29.6	22.58	31.78
B:C ratio over variable cost	2.23	2.14	1.91
B:C ratio over total cost	1.5	1.38	1.59

Source: field survey, 2021.

than for grain production. The overall benefit-cost ratio in lentil grain production was 2.18 for variable cost and 1.41 for total cost, while it was 1.91 for variable cost and 1.59 for total cost in seed production. This shows that lentil cultivation is a profitable business with good potential returns. The benefit-cost ratio was 13% higher for seed production than for grain production, implying that seed production is more profitable than grain production. A higher benefit-cost ratio has been reported in many other studies (Thapa Magar et al., 2014; Tithi and Barmon, 2018; Kumar and Bourai, 2012).

Major nodes of lentil seed value chain in the study area

Five main types of lentil seed value chain nodes were functional and found to be operating in the study area, led by private seed entrepreneurs and followed by public sector agencies, farmers' groups and cooperatives.

The lentil seed value chain in the study area starts with genetic resource collection and maintenance and extends up to the use of improved lentil seed varieties. Variety development and maintenance is mainly dominated by the public sector, especially by NARC. The private sector plays a dominant role in the quantity flow, followed by cooperatives, farmers group and the NSCL. Seed production is ultimately the task of contracted or non-contracted seed-producing farmers, and seems to be less organized and managed in the study area. Seed processing and conditioning are dominated by seed companies and cooperatives. The Grain Legume Research Program develops and maintains different varieties of lentil along with breeder and foundation

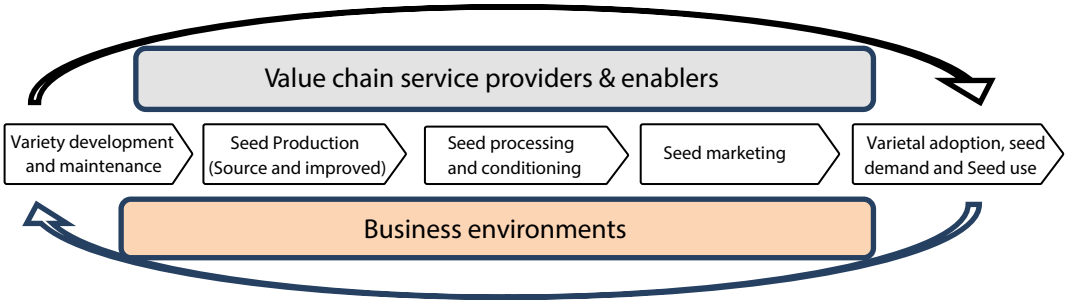

Fig. 1. Major nodes of the lentil seed value chain
Source: FGD & KII, 2021.

seed production. Breeder and foundation seed is then distributed to the private and public sector for further multiplication. There were no distinct and characteristic collectors. The collection of lentil seed was performed mainly by seed producing agencies. Varietal adoption and improved seed use was the most important driving force for the better performance of the overall chain. The stage of adoption of improved varieties of lentils, standard market assessment and information collection considering the positive and negative factors of adoption were the major factors to consider.

Flow of price, profit and value addition in the lentil seed value chain

The Grain Legume Research Program is the sole organization for breeder seed production. Seed companies, farmers' groups, the NSCL, cooperatives, NGO/INGOs and government organizations purchase breeder seed at NRs. 190/kg and foundation seed at NRs. 160/kg. Some of the registered seed companies and cooperatives also produce foundation seed following seed production standards developed by the Seed Quality Control Center (SQCC) and supply the seed-producing farmers at NRs. 160/kg for further multiplication. Seed companies add NRs. 8/kg to cover transportation and labor costs and provide foundation seed to farmers at a rate of NRs 168/kg. Cooperatives and farmer's groups provide foundation seed to the seed-producing farmers at a rate of NRs. 165, adding the NRs. 5/kg as a procurement cost. The Agriculture Knowledge Center, governmental organizations like municipalities and sub-metropolitan cities, NGOs and INGOs also provide foundation seed to the seed producing farmers either directly or through the cooperatives and farmers' group and serve as an input supplier.

The average price of lentil seed sold by the seed-producing contracted farmers was NRs. 85.58/kg, while the average cost of seed production was NRs. 53.72/kg, with a net profit of NRs. 31.8/kg. Seed-producing farmers sell their product to contracted agencies (mainly seed companies, cooperatives, farmers' group and the NSCL) for further processing. The average cost for collection and transportation was NRs. 4.4/kg for seed companies whereas it was NRs. 6.7/kg for cooperatives, NRs. 3.47/kg for farmers' groups and NRs. 5/kg for the NSCL. For seed companies, the total cost of purchasing seed from the seed-producing groups was NRs. 89.98/kg, the total collection and processing cost was NRs. 23.93/kg and the selling rate was NRs. 146.33/kg, with a net profit of NRs. 32.42/kg. Likewise, for cooperatives, the total collection and processing cost was NRs. 27/kg and the selling price for agrovets was NRs. 141.28/kg, with a net profit of NRs. 22/kg. For farmers' groups, the total cost of seed collection and processing was NRs. 112.98/kg, while the selling price from agrovets was NRs. 138.6/kg, with a net profit of NRs. 25.62/kg. Due to the lack of seed-grading machines in the NSCL, grading was carried out manually with traditional *chalno*, resulting in a higher processing cost. For the NSCL, the total collection and processing cost was NRs. 119.65/kg, while the selling price to agrovets was NRs. 146.4/kg, with a net profit of NRs. 26.75/kg. Cooperatives and farmers' groups also directly sold processed seed to improved seed users at rates of NRs. 155/kg and NRs. 153/kg respectively. For agrovets, the total cost of transportation and handling was NRs. 4.73/kg. However, the average selling rate was NRs. 161.26/kg. For seed companies, cooperatives, farmers' groups and the NSCL, Agrovet is the major retailer for improved seed sales. On average, the net profit for retailers was NRs. 10.16/kg but the profit per unit was higher when purchasing through farmer's groups.

Cost and margin analysis of the lentil seed value chain

The total cost involved in seed production by the farmers was NRs. 53.72, which is 61.87% of the total cost of the value stream. The total cost for the seed producer included production, cleaning, storage, packaging and local transportation up to the point of delivery. The total margin for the seed producer was found to be NRs. 31.8/kg, which is 45.8% of the total profit in the chain.

Lentil seed producers sold their product at a rate of NRs. 85.58/kg to the contracted agencies. Then, seed collectors and processors performed various activities to add value. Major costs involved in value addition activities were grading, packaging, processing and fungicidal treatment. The total cost of value addition was NRs. 28.38, which is 32.68% of the total value addition cost. However, such value adding actors receive a higher profit of NRs. 27.35/kg, which is 39.4% of the total profit in the chain. The average price of seed selling after value addition was NRs. 141.31/kg. Agrovets were the major retailer of value-added lentil seeds. The total cost involved in lentil seed production, collection, processing and retailing was NRs. 86.83/kg, which is

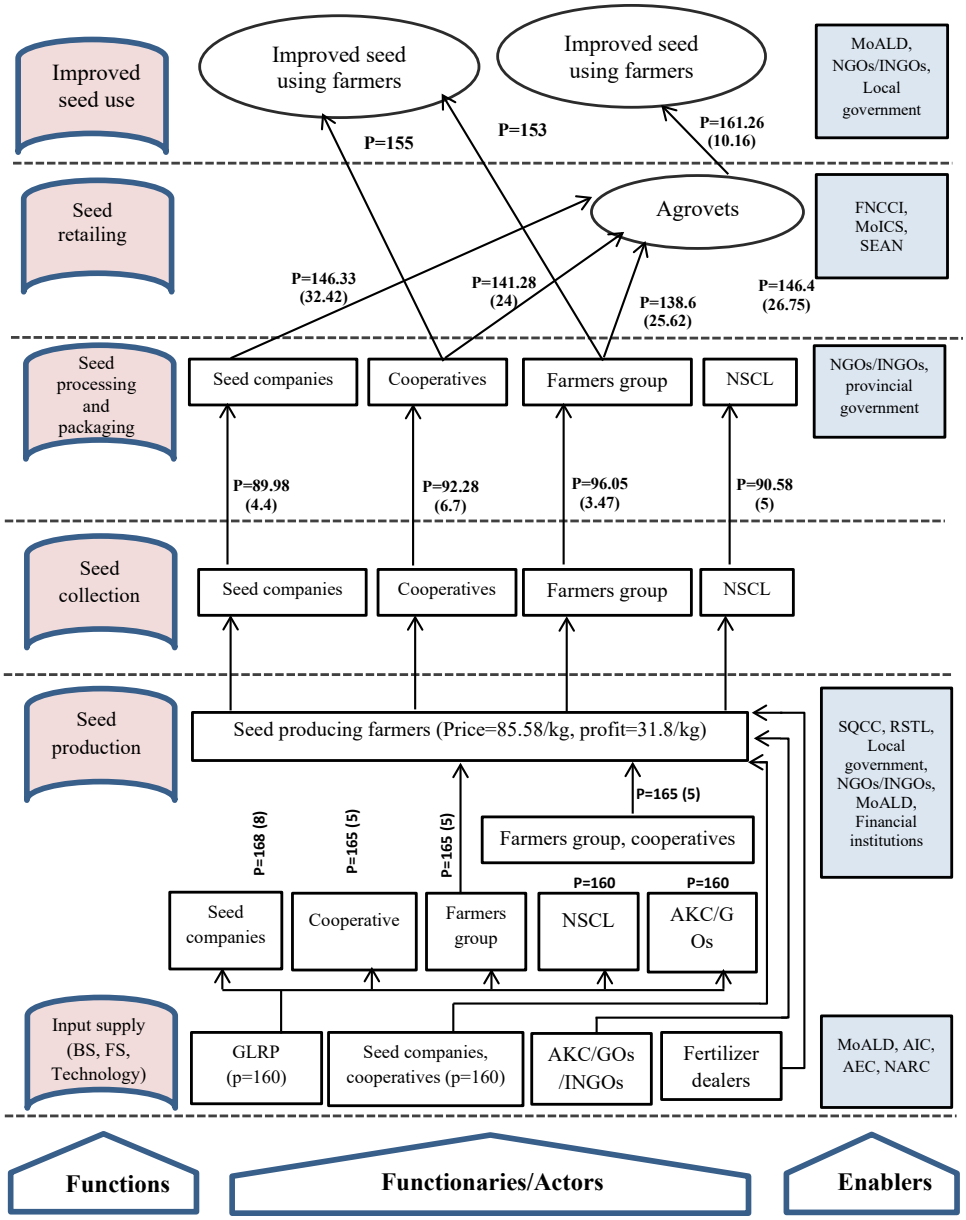

Fig. 2. Flow of price and value in the value chain of lentil seed subsector
Source: field survey, FGD & KII, 2021.

55.58% of the average retail price, while the total profit in all chains and for all actors was NRs. 69.37/kg, which is 44.42% of the average retail price. The total price paid by the improved seed users was NRs. 156.2/kg and the total price received by the seed-producing farmers was NRs. 85.58/kg, signifying a total price spread of 45.21% of the total consumer's price.

Value addition and net margin for actors involved in the lentil seed value chain

The value added from farm gate to end-user farmer level for the selected value chain in the surveyed region was 55.58% of the total retail price. The largest value addition of 61.87% was at the farmer level. The second largest value addition of 32.68% was at the collector and

Table 4. Cost and margin analysis of lentil seed value chain in the study area

Value stream	Cost involved	Cost (NRs./kg)	Margin (NRs./kg)	Selling Rate (NRs./kg)
Seed producer	Production, cleaning, storage and packaging, local transportation up to point of delivery	53.72 (61.87)	31.8 (45.8)	85.58
Seed collector and processor (Cooperative/ Farmers group/NSCL/Seed company)	Collection, storage, processing loss, packaging, processing, treating, drying and handling	28.38 (32.68)	27.35 (39.4)	141.31
Retailers/Agrovets	Transportation, handling, losses, storage, communication and taxes	4.73 (5.44)	10.16 (14.8)	156.2
Total		86.83 (55.6)	69.37 (44.4)	156.2
Price spread (%)				45.21

Figures in parentheses indicate percentages. The price spread is expressed as a percentage of consumer price-producer price/consumer price.
Source: field survey, FGD & KII, 2021.

processor level, followed by 5.4% at the retailer level. The 55.58% of value addition and its rational distribution among actors shows the better performance of the lentil seed value chain. In addition to value addition, there was employment generation and use of local materials at the local level. The ROI was 59.3% for farmers, 24% of the total cost and 96.3% of the added cost for the collector and processor and 214.8% of the added cost for retailers. The total ROI for the overall lentil seed value chain was 47.5% of the total cost and 79.89% of the value added cost.

Lentil seed value chain analysis

Study and analysis of the lentil seed value chain has shown that it operates in a competitive market but found unmanaged, weak backward and forward linkages between the actors. The integration of informal and formal seed systems creates complexity in a clear process and linkages. A similar result was found in the study by Mishra, Joshi and Dutta (2018). The GLRP is the sole government agency responsible for breeder seed production and distribution. For foundation seed production, NARC stations are the major stakeholders, followed by private seed companies and cooperatives. Research on seed sector development conducted by public institutions has found it to be weak and not competitive, as reflected by the limited varieties available in the market and poor competition in the regional and international markets. Many successful seed companies still depend on public universities or research institutes

Table 5. Value addition and net margin for actors involved in the lentil seed value chain

Actors	Costs			Revenues	Profits		Margins		ROI (%)	
	total cost (NRs./kg)	added cost (NRs./kg)	added cost (%)	price (NRs./kg)	profit (NRs./kg)	profit (%)	gross margin (NRs./kg)	retail price (%)	total cost	added cost
Seed producing farmers	53.72		60.49	85.58	31.86	45.92	85.58	58.78	59.3	59.3
Collector and processors	113.96	28.38	32.68	141.31	27.35	39.42	55.73	35.67	24	96.37
Retailers	146.04	4.73	5.44	156.2	10.16	14.64	14.89	9.53	6.95	214.8
Total		86.83	100		69.37				47.5	79.89

Source: field survey, FGD & KII, 2021.

to get germplasm and sometimes source seed (Tripp et al., 2007). The NSCL is the public organization for the supply of improved seed for many crops, including lentils, through a value chain approach. However, cereals rather than lentils have been its main focus, so that lentils have suffered from an inconsistent, poor and less competitive working model. Seed companies, cooperatives, farmers' groups and the NSCL are the dominant actors in the Nepalese seed system, but the programs of public institution like the NSCL are dominant in major cereal crops and performing in a less competitive model (Joshi et al., 2012). Agrovets are the major stakeholder for the retailing of improved lentil seed. About 65% of the total improved seed produced by the GATE Nepal seed company was marketed by agrovets in the Banke and Bardia district of Nepal (Sen, 2013). However, there exist higher profit margins for such retailers.

The adoption of different varieties of improved seeds creating demand for value-added product was the major pulling force for the overall lentil seed value chain. Mainly because of biotic and abiotic stresses in recent years and the dominance of the informal seed system, farmers' demand for improved seed decreased dramatically. Poor performance of improved varieties in farmers' fields, the persistence of stresses and the lack of availability of resilient varieties resulted in heavy yield losses. A study conducted by CSISA (2018) reported that large plot demonstrations of new and pipeline varieties under best management practices were implemented by four seed companies and this initiative helped to speed up the dissemination of high-performing varieties at scale. This increased the demand for improved seed, influencing the whole seed value chain. Without the intervention of a suitable seed distribution and adoption program, it is very difficult to raise the demand for improved seed from the farmer's side. Previously, improved lentil seed was distributed by the government organization (especially DADOs) with seed purchase subsidies, but currently, due to the federal transformation, there is almost no such program, hence the demand for improved seed is very low and seed-producing organizations are unable to sell lentil seed and instead dispose of it as grain at a low price. One study revealed that there is a non-significant difference between the yield from local lentil seed and the yield from improved seed. Practices in lentil cultivation should be delivered to increase the demand for improved seed. Higher value addition was achieved by seed-producing farmers followed by processors and retailers, but ROI was higher for retailers followed by processors and seed producers. There were higher price spreads in the lentil seed value chain, signifying a higher gap between the price paid by the improved seed user and the price received by the seed-producing farmers. This result was similar to that of the study of Mishra et al. (2018), in which an analysis of the maize seed value chain has shown higher cost involvement but lower profit was taken by seed producing farmers, ensuring a higher price spread. The analysis of knowledge, technology and information flow showed areas being upgraded by quality control agencies to enforce rules, regulations and directives. Seed producers need to train on quality control and marketing aspects. Seed collectors and processor need to be empowered through quality control and capacity building to handle seed consignment without compromising the quality.

Problems with lentil seed/grain production and marketing

A lack of technical/scientific cultivation knowledge was the major problem, with the highest index value of 0.756. Most of the farmers did not have scientific lentil cultivation knowledge. They use their traditional farming experience, and a significantly lower number of farmers are adopting scientific cultivation techniques. Similarly, farmers had faced serious problems with pests/disease in the study area, which ranked as the second most serious problem, with an index value of 0.755. *Stemphylium blight* and root rot were the major diseases in the study area while lentil aphid was the major pest. Heavy rainfall just prior to flowering and at flowering was also found to be a serious problem in attaining a desirable yield of lentils. Lentil-producing farmers can realize up to a 100% yield loss, mainly due to erratic heavy rainfall at the time of flowering and incidence of *stemphylium blight* disease. Lentil *Stemphylium blight* disease, caused by *Stemphylium botryosum,* once had a less significant effect, but now it is a serious threat to lentil cultivation in many parts of the world (Das et.al, 2019). Research conducted in different regions showed that yield loss due to *Stemphylium blight* is up to 100% depending on disease severity (CSISA, 2018). Studies conducted by Sarker (2011), Kumar et al. (2013), Sharma and Joshi (2021) and Shrestha et al. (2011) have also found that *Stemphylium blight* is a major disease of lentils which can cause yield losses of up to 100%. A similar study conducted by Thapa Magar, Gauchan and Darai (2014)

also revealed that limited availability of quality seed of improved varieties, limited awareness of farmers about improved lentil varieties and production technologies, uncertain rainfall leading to heavy disease infestation, and the occurrence of early and terminal droughts during lentil growing are threatening to undermine sustainable lentil production in Nepal. Among various marketing-related problems, the values obtained from the ranking scale revealed that price fluctuation—mainly as a result of the lack of a scientific pricing mechanism—is the major trade problem, with an index value of 0.783. Farmers are getting a low farm gate price in comparison with the retail price. This higher gap between the farm gate price and the retail price was the second most important marketing problem, with an index value of 0.746.

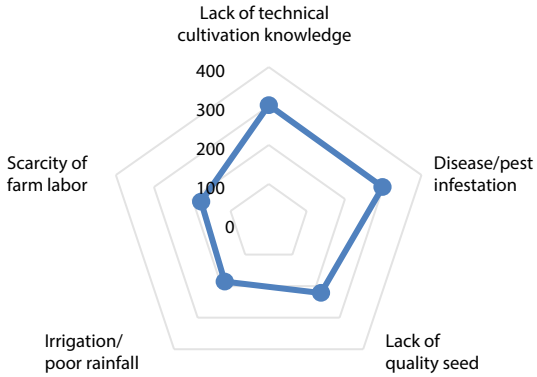

Fig. 3. Problems with lentil grain/seed production
Source: field survey, 2021.

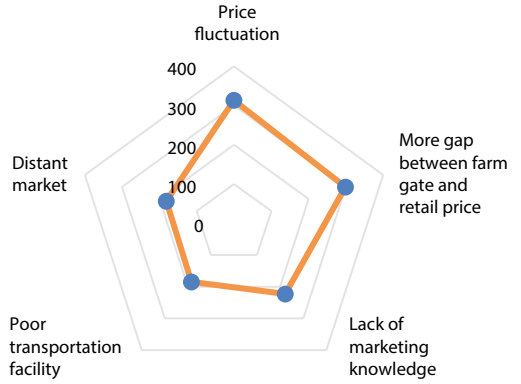

Fig. 4. Problems with lentil seed/grain marketing
Source: field survey, 2021.

Major reasons contributing to the low lentil seed replacement rate

Many socio-economic and geographical factors have affected the adoption of improved lentil seed by farmers. An analysis of the economics of lentil seed and grain production reveals that there is a statistically non-significant difference in yield, income and benefit-cost ratio when using improved lentil seed rather than local seed. The B:C ratio was 1.5 for improved seed users while it was 1.38 for local seed users. However, comparing the price of improved seed and local seed, there was a significantly higher price for improved seed. Price discrimination from agrovets was persistent and some lentil grain-producing farmers are paying up to NRs. 220/kg for improved lentil seed. However, the price of local seed was only up to NRs. 110/kg. The price of improved seed was almost double, but the return was the same compared with local seed, so why should farmers adopt improved seed? This is the most important issue to discuss while formulating any policies and programs related to the lentil seed system. A study conducted by Khojne, Manda, Alene and Kassie (2015) on the adoption of improved varieties of maize in Zambia strongly supports this finding about the relationship between improved varieties and income. The authors argue that higher adoption of improved varieties of maize is strongly related to the receipt of a higher income from improved varieties than local varieties.

This study also found that only 44.67% of local seed users have knowledge about the importance of using improved lentil seed, and very few of them are replacing local seed with improved seed annually. The majority of lentil producers do not even have any knowledge about the importance of using improved seed. The diffusion of knowledge about new technologies and innovations through an effective extension approach to smallholder farmers is one of the most important factors for higher adoption of those technologies and innovations (Mwangi and Kariuki, 2015). Higher yield loss from erratic rainfall during the reproductive stage and the incidence of disease has also prevented farmers from using improved seed. The majority of the lentil grain and seed producers follow traditional methods of lentil cultivation. Incentive schemes to improve lentil seed purchases were almost absent in many local administrative bodies within the study area and only a few were planned for the upcoming years. All these factors were found to directly affect improved seed use by lentil producing

farmers, resulting in very low lentil seed replacement rates in Nepal.

At present, the formal seed system of Nepal is dominated by major cereals (rice, wheat and maize) in market-accessible areas, where formal sector agencies are focusing their seed production, supply and quality regulation. The development of the seed industry is largely restricted to minor crops and distant (hilly and mountainous), regions where farmers continue to reuse low-yielding, locally produced, subpar seeds. This study found that lentils account for only 2.15% of total improved seed produced while rice accounts for almost 49.16% and wheat almost 37.83%. Similarly, the production of foundation lentil seed accounts for only 3.97% while rice accounts for 48.28% and wheat 45.54%. This result was similar to that of Sah (2014), who found that during 2011/12, out of total breeder seed produced by NARC, lentil seed accounted for 1% while rice accounted for almost 33% and wheat almost 55%. In the same year, out of the total foundation seed produced, lentil seed accounted for only 1.37% while rice and wheat accounted for 51.54 and 27.41% respectively. Similarly, out of the total improved seed produced by many organizations, lentil seed accounted for only 1.26% while rice and wheat accounted for 38.12% and 50.26% respectively.

Present variety development, source seed production and quality assurance services are dominated by public sector agencies. Private sector participation in varietal development, maintenance and seed research is very limited. Despite the dominance of public-sector agencies in agricultural research and development, there are critical gaps in human resource capacity and infrastructural facilities (Gauchan, 2017). Private seed companies are still low in seed system research and development and there exist constraints in public agricultural research organization and agricultural extension systems. Limited varieties dominate the formal seed market of major food crops, including lentils, with a market flow of low varietal diversity and high varietal age. To date, GLRP has released/registered 14 varieties of lentil but almost 75% of the lentil grain/seed producing farmers have adopted only six varieties. This result is consistent with the study of Thapa Magar et al. (2014), in which the adoption of local varieties of lentils was found to be higher (43%), followed by Khajura Masuro-2 (31%) and Khajura Masuro-1 (16%), while other improved varieties had very low rates of adoption.

Possible interventions for improvement of the lentil seed system in the new federal system

Capacity building of lentil seed value chain actors, the introduction of a package of practices for lentil grain/seed producing farmers, training and technical assistance, and development of stress resilient lentil varieties can all be part of the potential strategy for strengthening the lentil seed sector of Nepal. Some of the public and private sector actors are providing knowledge on new technologies, including diverse varieties of improved seed, through the pathways of Farmers Acceptance Trials (FAT), Informal Research and Development (IRD), demonstration trials, field visits, and extension visits (Gauchan, 2017). Capacity building of seed-producing farmers helps to maintain the quality of the source seed; capacity building of processors and entrepreneurs helps quality assurance as well as increasing involvement in research and development, with a timely supply of seed at an appropriate price margin. Training focused on seed dealers and retailers is also essential as they provide advisory services on crop production to farmers. Training, field visits, extension visits, on-farm research and involvement of cooperatives and farmer systems can increase the knowledge levels of seed-producing and seed-consuming farmers, ultimately benefiting the national seed system (Sisay et al., 2017).

The local seed system, which still dominates nearly 90% of seed requirements in Nepal, is under severe stress from climate change, youth outmigration and a lack of commercialization. In order to satisfy the seed demands of various crops, a resilient integrated seed system that integrates both formal and informal seed systems is required. In fact, analysis of the strengths and weaknesses of both the farmer and formal seed system shows important complementarity in strength and weaknesses between the two systems, which offers multiple opportunities to improve the effectiveness of both (Almekinders and Louwaars, 2002). Since the majority of the seed is supplied through the informal seed system, strengthening the local seed system through a community-based approach is critical for enhancing access to seeds of locally adapted varieties among farming communities. Community-based seed production and distribution programs, community seed banks and community-based seed infrastructure in rural marginal production systems are potential strategies for strengthening the local seed system. Such innovations also have the potential to pool

resources in the face of climate calamities through the sharing of accessions among community seed banks at the regional or national level as well as between community seed banks and national and international gene banks (Shrestha et al., 2013).

In the present context, the creation of an enabling environment with better provision of incentive systems is required to attract and incentivize private seed companies, cooperatives, plant breeders and agribusiness firms in order to strengthen the formal lentil seed system. Incentives for seed producing farmers based on production, performance and governance for cooperatives, seed-producing farmers, seed-producing farmers' groups, private seed companies and agrovets should be provided to encourage lentil seed production and quality control mechanisms. The government is investing a large amount of money to provide incentives in fertilizer, but no such incentive scheme can be seen in the seed sector. A study conducted by Bista et al. (2016) found that subsidy schemes help to lower the cost of production, especially for marginal farmers. There is an urgent need to implement strong seed incentives for related stakeholders to strengthen the lentil seed system of Nepal. The resulting national seed industry should be a viable and sustainable business which enhances agricultural growth to positively impact the national economy with the participation of the private, community, cooperative, non-governmental and public sectors.

Strengthening quality assurance services is another point of intervention for the improvement of the lentil seed system in the new federal system. This study found that the recently introduced seed regulatory framework assigned for flexible quality assurance services is supporting and encouraging growth of seed enterprises in the community and in the private sector. But there is an increasing flow of seeds of unregistered varieties and seeds lacking formulated quality standards, and there is a major problem in the pricing mechanism in the market, which requires strong quality and market monitoring mechanisms. A similar argument was also presented by Kandel et al. (2014), who concluded that it was necessary to improve the present situation of seed quality through proper field inspections, seed testing and certification systems.

CONCLUSION

Despite higher trade potential, the increasing consumer demand and decreasing production of lentils has led to a ballooning trade deficit in Nepal. Increased production and yield of this sector through structural transformation and innovation can stabilize this unacceptable situation. The adoption of higher quality improved lentil seed not only increases production but also escalates the efficiency of other inputs and is the most viable option to cope with this situation. An inclusive, competitive and sustainable lentil seed system can be established through a value chain approach. Stunted demand for improved seed from lentil producing farmers has engendered a distorted lentil seed value chain and overall seed system in Nepal. Scaling up the major factors of improved seed adoption activities, like specialized production areas, the development of stress-resistant varieties, technical assistance, training, subsidy schemes based on production and efficient market system development, can economically benefit lentil-producing farmers and ameliorate the major pulling force in the lentil seed value chain, thereby strengthening the seed system. The capacity-building activities of major value chain stakeholders, along with strengthening the public sector, which is responsible for technology development, is another intervention point. Value chains dominated by cooperatives and seed companies provide a higher-value product to the consumer. However, the profit margin should be adjusted by these vital chain actors in accordance with the added cost to the seed companies and retailers. Price monitoring for retailers needs to be reinforced for price regulation. The working modality of the NSCL, which has dominated the public sector value chain, should be reformed with the inclusion of value addition technology and proper governance. The higher price spread in the lentil seed value chain, signifying a higher gap between the price paid by the improved seed user and the price received by the seed producing farmers, should be brought down through an efficient marketing system, a scientific pricing mechanism and a market support program. Government prioritization along with intensive coordination and communication between the three tiers of government with respect to lentil seed system policy issues is urgently needed to create an inclusive, competitive and sustainable lentil seed system in Nepal.

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ANALYSING CONTRIBUTION AND DETERMINANTS OF INDIGENOUS LEAFY VEGETABLES (ILVS) TO HOUSEHOLD INCOME OF RURAL HOUSEHOLDS IN THE EASTERN CAPE PROVINCE, SOUTH AFRICA

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Abstract. This study aimed to analyse the determinants of Indigenous Leafy Vegetables (ILVs) and their contribution to the household income of rural households in the Eastern Cape Province, South Africa. The study covered three district municipalities within the province. Multistage Sampling and Proportional Random Sampling techniques were used to select rural households, with the household heads as the unit of analysis. A sample size of 407 households was considered for the study and a questionnaire was used to collect data. Regression estimates discovered that the amount spent on ILV production and the price of ILV per kg positively influence the income generated from ILVs.

Keywords: Eastern Cape Province, gross margin, household income, multiple linear regression

INTRODUCTION

Indigenous leafy vegetables (ILVs) are given many names by researchers, for instance, Neugart et al. (2017) refer to them as African leafy vegetables, while Essack et al. (2017) refer to them as traditional leafy vegetables (TLVs). On the other hand, Kansiime et al. (2018) describe these vegetables as African indigenous vegetables (AIVs). Van der Hoeven et al. (2013) explain that many rural households have used ILVs as a major source of food in recent years. However, the existence of commercial/conventional vegetables has caused lower production and consumption of ILVs, which has led to changes in the dietary patterns of many rural households (Van der Hoeven et al., 2013). Furthermore, Seeiso and Materecha (2014) claim that in South Africa, ILVs are underutilised and have received little attention from stakeholders in the fight against malnutrition and to improve food security. Although there has been notable use of ILVs for their nutritional value in recent years, Seeiso and Materecha (2014) further argue that these vegetables are not extensively produced and consumed on a large scale compared to conventional vegetables in South Africa. This could be a result of the fact that the production of ILVs is highly influenced by taste, preferences, and the high production of commercial vegetables, amongst other things (Mayekiso, 2016). On the other hand, the consumption patterns of ILVs in many rural communities globally and in South Africa are highly inconsistent and are subjected to factors such as poverty status, degree of urbanisation, distance to fresh produce markets and season (Mbhenyane, 2017).

Although ILVs have been found to be good as conventional vegetables that provide essential nutrients to sustain human health (Van der Hoeven et al., 2013), the production of these vegetables is limited to specific communities of the Limpopo and KwaZulu-Natal provinces in South Africa, with inferior production in

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some districts of the Eastern Cape Province (Uusiku et al., 2010; Mayekiso et al., 2017). This trend seems to be continuous even now since there is a notable decline in the production of ILVs, particularly in rural settings (Maseko et al., 2017; Nyaruwata, 2019). This could be one reason why ILVs have been largely overlooked by commercial farming, research, and development, meaning that ILVs are less competitive than commercial vegetables, and that these vegetables are gradually losing their diversity and the associated traditional knowledge (Mbhenyane, 2017). Mbhenyane (2017) further contends that regardless of the value of ILVs, these vegetables and their resulting food products are omitted from official statistics on economic values of natural resources.

In light of the information provided above, it has been noted that the consumption and cultivation of ILVs has significant potential to improve food security and boost income generation in households, particularly those in rural communities (Mungofa et al., 2018). Shonshai (2016) further explains that the contribution of ILVs in relation to income generation should not be underrated. This could be one reason why most households have constant income benefit from the sales of ILVs which may cover costs such as hospital bills and educational fees (Shonshai, 2016). In addition, Mulaudzi et al. (2019) have pointed out that there is currently a growing interest and awareness of ILVs due to their nutritional benefits and massive potential to generate farm incomes. The study by Mulaudzi focused on analysing the technical efficiency of AIV production in the Vhembe district of Limpopo province, South Africa. Regardless of the economic recognition observed from the production of ILVs, there are various factors which may inhibit households from benefiting from the marketing of ILVs. These factors include ILV production along the supply chains of value addition (Senyolo et al., 2018; Mulaudzi et al., 2019).

Different ILVs are popularly used to generate income within African countries such as South Africa, Kenya, Zimbabwe, Ethiopia, and Nigeria, to mention but a few. These vegetables include *C. olitorius* (jute mallow), Amaranthus *cruentus* (pigweed), *Citrullus lanatus* (bitter melon), *Vigna unguiculata* (cowpea), *Cleome gynandra* (spider plant), *Cucurbita* spp. (pumpkin), *Brassica rapasubsp*, and *Chinensis* (Chinese cabbage) (Wemali, 2015). Amaranth is also one of the most commonly grown ILVs in South Africa (Wemali, 2015). Shonshai (2016) further emphasises that various studies in South Africa have indicated that ILVs play a dual role. Firstly, they provide money to poor households and, secondly, households that sell these vegetables can also save money by consuming ILVs rather than purchasing exotic vegetables.

With the given background information, only inferior research has been conducted at both local and international levels concerning the contribution of ILVs to household income and the income of rural farmers. The available information about ILVs mainly focuses on production, marketing, consumption, value addition, and perception, amongst others. Regarding relatable available reviews, Mahlangu et al. (2021) state that indigenous vegetables, in alignment with their high nutritional value and hardy attributes, could offer potential trade opportunities for rural farmers and households in South Africa. This is because there is a functional market that can be explored for ILVs, particularly with the growing demand for high nutritional value food in the country. On the other hand, Nyaruwata (2019) conducted a study on the contribution of selected indigenous vegetables to household income and food availability in the Wedza District of Zimbabwe. The study concludes that ILVs can be a possible source of reliable income, and reliability can only be observed when the production, commercialisation, and consumption of these vegetables is not overlooked by many stakeholders, including rural households and farmers (Nyaruwata, 2019).

For further elaboration, ILVs are an essential part of the diet in many Sub-Saharan African (SSA) countries. This is because previous reviews have indicated that the market for these vegetables will continue to grow (Ngugi et al., 2006; Pichop et al., 2016; Rampa and Knaepen, 2019). For example, in Nairobi, approximately 30% of all vegetables sold are ILVs grown around the city (Bokelmann et al., 2022). In addition, low capital requirements for entry enable even the poorest households and farmers to participate in the production and marketing of ILVs (Weinberger et al., 2011). Recently, Vivas et al. (2022) stated that ILVs have remained underutilised despite their potential benefits in Sub-Saharan African countries, although the demand for these vegetables is currently growing due to a recognition of their contribution to employment and incomes. In addition, several studies, including ethnobotanical ones, have shown that indigenous vegetables continue to play an essential role in the livelihoods of rural communities, particularly

on the African continent, including in South Africa (Chivenge et al., 2015; Mabhaudhi et al., 2019; Mashile et al., 2019).

Recently, ILVs have been acknowledged for their commercial value by many reviews, and these vegetables are now facing a sudden strong market demand (Gido et al., 2016; Mahlangu et al., 2021; Vivas et al., 2022). To be precise, seed companies are beginning to explore and develop ILVs and their products, thus establishing the formal seed sector for ILVs, particularly within the African continent (Gido et al., 2016). If the demand for ILVs and their products suffices, this may also improve the livelihoods of rural households and farmers. Thus far, lower participation in the production and marketing of ILVs has inhibited the benefits from ILV sales that could be vital to households and farmers through income generation. Hence, this study aimed to analyse the determinants of indigenous leafy vegetables (ILVs) and their contributions to household income in rural households in the Eastern Cape Province (ECP), South Africa, by addressing the following objectives:

1. To identify and describe the socioeconomic characteristics of rural households in ECP.
2. To identify and describe the ILVs grown by rural households in the ECP.
3. To estimate the contribution of ILVs to the household income of rural households in ECP.
4. To determine factors influencing the income generated from the ILV sales of rural households in ECP.

MATERIALS AND METHODS

The study area and justification for the selection of the study area

The study was conducted in the Eastern Cape Province (ECP) of South Africa, which is classified as the second largest province in the country. It is located in the south-eastern part of South Africa. According to ECDC (2018), the ECP is divided into six district municipalities, namely OR Tambo, Alfred Nzo, Chris Hani, Amatole, Joe Gqabi, and Sarah Baartman, as well as two metropoles of Nelson Mandela Bay and Buffalo City, and has a population of about 7 million. In 2004, the South African Department of Agriculture informed people that many in the province depended mainly on the land and its natural resources, which include ILVs to supplement their household needs, and this tendency does not seem to have changed, even now (ECDC, 2018). The study focused on three district municipalities within the province, including OR Tambo (OTRDM), Alfred Nzo (ANDM), and Joe Gqabi (JGDM). These three district municipalities were selected because the ECDC (2018) reported that these three district municipalities are among the districts that are affected by poverty and food insecurity within the province. These districts are also rich in several ILVs which could assist households and individuals in sustaining their livelihoods.

Data collection methods

Every local municipality within the three selected district municipalities was considered for the study. The ORTDM consists of five local municipalities, with ANDM covering four, and JGDM three, making a total of 12 local municipalities within these three district municipalities. The study employed Multistage Sampling (MSS) and Proportional Random Sampling (PRS) techniques to select rural households, with household heads as the unit of analysis. The MSS is used to divide a large population into groups to make the sampling process more practical. A combination of stratified sampling or cluster sampling and simple random sampling is usually used when employing the MSS procedure (Statistics handbook, 2018). For this study, the first stage divided the ECP population into its six district municipalities and its two metros. From the three district municipalities, those where ILVs are mostly grown were selected for the purpose of the study, thus making the second stage of dividing the large population of the ECP. The third stage divided the three district Municipalities into their local municipalities and ward areas. A PRS was used up to the household level to select the households to participate in the study. This means that ward areas that are classified as rural were used to select the households for the study.

For consideration of the sample size for the study, the ORTDM has five local municipalities with 248,075 rural households, ANDM has four local municipalities with 107,102 rural households, and JGDM has three local municipalities with 31,402 rural households. To calculate the sample size, the following formula (according to Kothari, 2004) was used:

$$n = \frac{z^2 \cdot p \cdot q \cdot N}{e^2(N-1) + z^2 \cdot p \cdot q} \quad (1)$$

where:

n – desired sample size,

z – value of standard deviation at 95% confidence level (in this case 1.96),
e – desired level of precision (±5%),
p – sample proportion in target population,
q – 1 – p,
N – size of population.

This gave a total sample size of 407 households for the study, comprising 136 households in each of the ORTDM and ANDM districts respectively, and 135 households in JGDM. From the sample size, a proportional random sampling technique was used to select the households to participate in the study in each local municipality.

Data analysis tools

To address the first objective (identifying and describing socioeconomic characteristics of households) and the second objective (identifying and describing the ILVs grown in the study areas) of the study, descriptive statistics were used in the form of percentages, frequencies, means, and standard deviations. To estimate the contribution of ILVs to household income, a gross margin analysis was used. For the study, a gross margin analysis modelled the costs and returns of ILVs per production cycle. This means that a physical amount of each ILV (per kilogram) was multiplied by the unit price of ILV sold to estimate the returns.

The total revenue (TR), which is equivalent to the gross income from each ILV, was calculated as:

$$TR_i = P_i \times Q_i \quad (2)$$

where:
P_i – is the farmgate price of ILVs,
Q_i – is the total amount produced for each ILV.

Total variable cost (TVC) was calculated using the following expression:

$$TVC = \sum_{i=1}^{2}(K + S + L) \quad (3)$$

where:
K – is fertiliser expenditure,
S – is total expenditure on seeds/seedlings,
L – is total labour expenditure in ILVs.

The gross margin analysis of selling ILVs was expressed as:

$$GM = TR - TVC \quad (4)$$

where:
GM – is gross margin,
TR – is total revenue,
TVC – is total variable cost, as gross margin analysis considers only variable costs.

To determine the factors influencing the income generated from the sales of ILVs by households, a multiple linear regression model was used. This model was used to estimate the association between the socio-economic characteristics of the households and related factors linked to income generated from ILVs by the households. According to Bremer (2012), a multiple linear regression model is an extension of a simple linear regression model and is used to measure the association between two or more independent variables and a single continuous dependent variable. For this study, the gross income obtained by each household from selling ILVs was treated as a continuous dependent variable and regressed against explanatory variables, as shown in Table 1.

The multiple linear regression equation is as follows:

A multiple linear regression model can be expressed as follows (Bremer, 2012):

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} \quad (5)$$

where:
Y – income generated from ILV sales,
β_0 – intercept term,
β_1 to β_{13} – regression coefficients,
X_1 – age of household head,
X_2 – gender of household head,
X_3 – education level of household head,
X_4 – household size,
X_5 – farm income per month,
X_6 – employment status of household head,
X_7 – size of land for production of ILVs,
X_8 – quantity of produce marketed,
X_9 – hiring of labour,
X_{10} – irrigation of ILVs,
X_{11} – seasonal production of ILVs,
X_{12} – costs of production per season,
X_{13} – price of ILVs per kg.

RESULTS AND DISCUSSION

This section gives a detailed description of the observed results for the socioeconomic characteristics of the

Table 1. Description of the hypothesized variables specified in the multiple linear regression model

Dependent variable	Description of variable	Anticipated sign
Y = Income generated from ILVs sales (ZAR)	Continuous	
Explanatory variables		
X_1 = Age	Actual age of a household head (years)	+
X_2 = Gender of a household head	Dummy: 0 – male; 1 – female	+/–
X_3 = Education level for a household head	Categorical: 0 – never went to school; 1 – primary education; 2 – secondary education; 3 – tertiary education	+/–
X_4 = Household size	Actual size of household members (numbers)	+/–
X_5 = Farm income per month	Actual income earned (ZAR)	+
X_6 = Employment status of a household head	Dummy: 0 – employed; 1 – otherwise	+/–
X_7 = Size of land for ILVs' production	Actual size of land (hectares)	+/–
X_8 = Quantity of produce marketed	Amount sent for marketing purposes in kilograms (continuous variable)	+/–
X_9 = Hiring of labour	Dummy: 0 – hire labour; 1 – otherwise	+/–
X_{10} = Irrigate ILVs	Dummy: 0 – irrigate ILVs; 1 – otherwise	+
X_{11} = Seasonal production of ILVs	Dummy: 0 – production of ILVs is seasonal; 1 – otherwise	+/–
X_{12} = Costs of production per season	Cost of production in ZAR (continuous variable)	+/–
X_{13} = Price of ILVs per kilogram	Selling price of ILVs in ZAR (continuous variable)	+/–

Source: own compilation, 2021.

households in ORTDM, ANDM, and JGDM. The section also provides a description of the ILVs grown and produced based on the observed results from ORTDM, ANDM, and JGDM respectively.

Socioeconomic characteristics of the households

When comparing the three district municipalities in terms of age, both the oldest and youngest respondents were recorded at ORTDM, as indicated in Table 2. Regarding the household size, the descriptive results revealed that, from the three district municipalities, ORTDM has the largest number of household members, as shown in Table 2. This could be why ORTDM is described as the largest district municipality in the ECP (ECDC, 2018). The descriptive results indicate that women dominate in the sampled households in all the three district municipalities regarding the production of ILVs. Maseko et al. (2017) also share similar findings, stating that the availability of ILVs depends on the means of collection rather than cultivation, and women commonly collect ILVs. With reference to the level of education in the three district municipalities, the results revealed that most household heads who are participating in the production of ILVs are educated up to primary level education in all the districts. However, ORTDM recorded the highest number of household heads holding tertiary level education.

Concerning farm income generated by the households, in all three districts, the majority of households are not earning adequate farm income. Those households that earn farm income focus more on exotic vegetable production and livestock farming. As stated by the households, this is because these two enterprises seem to generate more income than ILVs. Regarding the employment status of the household heads, the descriptive results revealed that in all three district municipalities, the household heads are unemployed, with ANDM having the highest unemployment rate. Regarding the production status of ILVs, the descriptive results

Table 2. Descriptive statistics of socioeconomic characteristics in ORTDM, ANDM, and JGDM

	ORTDM, ANDM & JGDM	ORTDM	ANDM	JGDM
Variable	Age	Household size	Household size	Household size
N	136	136	136	135
Mean	52, 51 & 53	7	7	7
Std deviation	14, 13 & 12	3	2	2
Minimum	21, 28 & 27	3	3	3
Maximum	78, 77 & 76	15	14	13
Index	Outcome	Percentage (%)	Percentage (%)	Percentage (%)
Gender	Male	36.2%	42%	42.3%
	Female	63.8%	58%	57.7%
Level of education	Never went to school	28.3%	23.2%	17.5%
	Primary education	46.4%	54.3%	48.9%
	Secondary education	16.7%	18.1%	29.2%
	Tertiary education	8.7%	4.3%	4.4%
Farm income	No income	43.5%	67.4%	56.9%
	R1000-R3000	14.5%	5.8%	3.6%
	Income from exotic vegetable sales	15.2%	7.2%	10.2%
	Income from livestock sales	3.6%	1.4%	2.2%
	>R3000	23.2%	18.1%	27%
Employment status	Employed	27.5%	23.9%	29.2%
	Unemployed	72.5%	76.1%	70.8%
ILVs production status	Produce ILVs.	63.8%	61.3%	64.2%
	Do not produce ILVs	36.2%	38.7%	35.8%
Size of land for ILV production	0.1 ha to 0.5ha	52.8%	57.4%	56.2%
	0.6ha to 2ha	11.6%	3.7%	8.8%
	Exotic vegetable production land size	35.5%	38.8%	35%
Reasons for not producing	Do not eat ILVs	32.7%	37.7%	27.1%
	ILVs grow naturally	63.3%	62.3%	72.9%
	Old to participate in ILV farming	4.1%		
Source of seedlings/seeds	Purchase ILVs seeds	1.1%	57.6%	1.1%
	Harvest seeds freely	51.7%	42.4%	41.6%
	Purchase and harvest seeds	47.2%		57.3%
Irrigation of ILVs	Irrigate ILVs	16.9%	18.8%	14.6%
	Do not irrigate ILVs	83.1%	81.2%	85.4%
Sources of water	Community tap	81.2%	13%	46.2%
	Community taps and river	12.5%	53.8%	23.1%
	Community taps and dam	6.3%	33.2%	30.8%
Reasons for not irrigating	Require no irrigation	46.6%	43.3%	43.1%
	Rain feed is enough to grow ILVs	50.7%	56.7%	55.6%
	Scarcity of water	2.7%	–	1.4%

Source: research survey, 2019.

revealed a higher production of ILVs in all three district municipalities, with an observed higher production rate in JGDM. When it comes to land size for production of ILVs in the three district municipalities, the descriptive results established that most of the arable land is used for exotic vegetable production, with many households producing ILVs from less than 0.5 ha. For the households that are not producing ILVs, the descriptive results established that, in most cases, in all three district municipalities, ILVs grow naturally, with JGDM recording the largest amount of ILVs growing naturally.

Regarding the source of seeds/seedlings, the descriptive results revealed that in ORTDM and ANDM, harvesting seeds/seedlings from the wild or home gardens is the major source for acquiring seeds/seedlings. The results also revealed that in JGDM, producers rely highly on both purchasing and harvesting of ILVs seeds/seedlings. Concerning the irrigation of ILVs, the descriptive results in Table 2 show that in all three district municipalities, producers do not usually irrigate ILVs. For households that irrigate ILVs, the results revealed that, in ORTDM and JGDM, producers depend highly on community taps to irrigate ILVs, while in ANDM, most producers rely mostly on community taps and dams to irrigate ILVs. For producers that do not irrigate ILVs, the descriptive results explain that in the three districts, the major reason for not irrigating ILVs is that rainwater is enough to grow these vegetables.

ILVs grown in ECP

This section gives details on ILVs grown within the selected districts of the Eastern Cape Province. The details are provided by ranking the ILVs grown the most to those grown the least in the selected district municipalities of ECP.

Within the 18 ILVs which are produced in ORTDM, the ILVs that are commonly grown are Amaranth, which is the most highly produced vegetable, and Chinese cabbage, Melon leaves, and *Physalis peruviana* L., *Caudatus* L., which are the least produced ILVs, as shown in Table 3. The ILVs produced in the district are ranked in a list, with number one on the list presenting the most highly produced ILV and the last vegetables on the list representing the least highly produced ILVs in the district. For ANDM, Table 3 shows that there are 18 ILVs which are produced in the district. Of these ILVs, Amaranth is the most highly produced vegetable in the district, as is indicated in the table, with Chinese cabbage

Table 3. Indigenous leafy vegetables produced in ORTDM, ANDM and JGDM

Indigenous leafy vegetables	Number of times mentioned	Rank
ORTDM		
Amaranth	84	1
Nightshade, Blackjack	64	2
Pumpkin leaves	41	3
Sonchus asper L. *(Irwabe*)	23	4
Common sow thistle (*Ihlaba*)	21	5
Lambs quarter, Hog plum (*Iyeye*)	18	6
Turnip	13	7
Pigweed	6	8
Sweet potato leaves, *Coriacea Nannfd., Laportea peduncularis*	5	9
Spider plant	2	10
Chinese cabbage, Melon leaves, *Physalis peruviana* L.*, Caudatus* L.	1	11
ANDM		
Amaranth	83	1
Nightshade	68	2
Blackjack	43	3
Pumpkin leaves	41	4
Physalis peruviana L.	28	5
Hog plum	23	6
Lambs quarter	20	7
Common sow thistle	17	8
Sweet potato leaves	12	9
Sonchus asper L., *Coriacea Nannfd.*	9	10
Turnip	7	11
Laportea peduncularis	6	12
Cucurbitaceae, Caudatus L.	3	13
Tomato leaves, Pigweed	2	14
Chinese cabbage	1	15
JGDM		
Amaranth	86	1
Nightshade	78	2
Blackjack	55	3
Pumpkin leaves	49	4
Lambs quarter	34	5
Caudatus L.	13	6
Sweet potato leaves	11	7
Turnip	6	8
Pigweed	3	9
Laportea peduncularis	1	10

Source: research survey, 2019.

being the least highly produced ILV in the district. For JGDM, there are 10 ILVs that are commonly grown, as shown in Table 3, and these vegetables are ranked in a list in the table. From the ILVs produced within the district, Table 3 shows that Amaranth is the most highly produced vegetable, with *Laportea peduncularis* being the least highly produced ILV in the district.

Contribution of ILVs to household income

To estimate the income generated from ILVs, a gross margin analysis was used, and the analyses for gross margin and total revenues for ORTDM, ANDM, and JGDM are shown in Table 4. The gross margin was measured per production season as descriptive results observed that many producers are cultivating ILVs on less than one hectare of land, so it was difficult to express gross margin per hectare.

The gross margin analysis revealed that the highest returns per Rand invested in ORTDM are obtained from Amaranth, Nightshade, Lambs' quarter, Pumpkin leaves, Melon leaves, and Blackjack. Amaranth, Nightshade, and Chinese Cabbage are the ILVs observed to have higher returns per Rand invested in ANDM. In JGDM, Amaranth and *Caudatus* L. are noted to have higher returns per Rand invested. In light of the observed results, Amaranth is the ILV which was found

Table 4. Gross margin of ILV marketing per production season in ORTDM, ANDM, and JGDM

ILVs	TVC ZAR	TR ZAR	Gross margin	RRI (GM/TVC)
	per production season			
1	2	3	4	5
		Grown in ORTDM		
Amaranth	R 23 545	R 131 438	R 107 839	4.58*
Nightshade	R 4 050	R 49 800	R 45 750	11.29*
Lambs quarter	R 4 800	R 39 000	R 34 200	7.12*
Turnip	R 15 500	R 42 000	R 26 500	1.70
Sonchus asper L.	R 1 800	R 4 375	R 2 575	1.43
Pumpkin leaves	R 15 500	R 136 125	R 120 625	7.78*
Pigweed	R 900	R 2 450	R 1 550	1.72
Common sow thistle	R 150	R 350	R 200	1.33
Laportea peduncularis	R 450	R 1 750	R 1 300	2.88
Melon leaves	R 250	R 1 500	R 1 250	5.00*
Sweet potato leaves	R 5 450	R 15 000	R 9 550	1.75
Hog Plum	R 1 800	R 7 400	R 5 600	3.11
Blackjack	R 150	R 850	R 700	4.66*
Coriacea Nannfd.	R 200	R 700	R 500	2.50
Chinese cabbage	R 750	R 1 500	R 750	1.00
		Grown in ANDM		
Pumpkin leaves	R 45 000	R 124 875	R 79 875	1.77
Nightshade	R 24 000	R 148 500	R 124 500	5.18*
Hog Plum	R 7 200	R 27 000	R 19 800	2.75
Sweet potato leaves	R 34 020	R 66 750	R 32 730	0.96

Table 4 – cont.

1	2	3	4	5
Amaranth	R 30 000	R 222 000	R 192 000	6.40*
Lambs quarter	R 3 080	R 14 000	R 10 920	3.54
Blackjack	R 100	R 350	R 200	2.00
Coriacea Nannfd.	R 1 200	R 3 850	R 2 650	2.20
Tomato leaves	R 600	R 1 500	R 900	1.50
Pigweed	R 1050	R 2 100	R 1 050	1.00
Caudatus L.	R 1200	R 2 450	R 1 250	1.04
Common sow thistle	R 150	R 350	R 200	1.33
Cucurbitaceae	R 600	R 1750	R 1 150	1.91
Physcalis peruviana L.	R 4050	R 17 250	R 13 200	3.25
Sonchus asper L.	R 600	R 2 100	R 1 500	2.50
Laportea peduncularis	R 1050	R 3 150	R 2 100	2.00
Chinese cabbage	R 670	R 4 500	R 3 830	5.71*
Turnip	R 13 900	R 31 500	R 17 600	1.26
ILVs grown in JGDM				
Amaranth	R 30 000	R 208 500	R 178 500	5.95*
Nightshade	R 37 405	R 103 000	R 65 595	1.75
Pumpkin leaves	R 101 050	R 228 000	126 950	1.25
Turnip	R 8 000	R 18 000	R 10 000	1.25
Sweet potato leaves	R 21 000	R 46 500	R 25 500	1.21
Lambs quarter	R 20 090	R 49 500	R 29 410	1.46
Pigweed	R 200	R 500	R 300	1.50
Laportea peduncularis	R 150	R 500	R 500	3.33
Caudatus L.	R 1050	R 7 500	R 6 450	6.14*

TVC – total variable costs, TR – total revenue, GM – gross margin, RRI – returns per rand invested. *Denotes higher RRI (> 4.00).
Source: research survey, 2019.

to have high returns in all three district municipalities. This could be explained by the higher demand for this vegetable leading to larger amounts being produced, ultimately triggering higher returns. Again, the higher return observed for Amaranth indicates efficiency in the production of this vegetable, which has the potential to generate income for households.

In addition, in ORTDM, Chinese Cabbage had fewer returns per Rand invested. This could be because of the low demand for this vegetable within the district or possibly the lower production due to the poor resistance of this vegetable to disease and some weather conditions, which therefore prompts inconsistent supply and consequently triggers lower returns. Sweet potato leaves had a minimal return per Rand invested in ANDM and JGDM. The reason for this may be that this vegetable does not grow in large amounts in ANDM and JGDM, which therefore limits its availability. The limited availability of sweet potato leaves may therefore result in a lower demand, hence less returns are realised in comparison with other ILVs sold within the districts.

Determinants of income generated from ILV sales

For determining factors influencing the income generated from ILV sales by rural households in ECP, a multiple linear regression model was used. The estimated results are presented in Table 5. The independent variables that were quantified included socioeconomic and other factors related to the marketing of ILVs. For all the independent variables with a positive coefficient, this means that as any of these variables increases, so does the income from ILV sales, as is indicated in Table 5. For the independent variables with a negative coefficient, it implies that as these variables increase, the income generated from ILVs decreases.

The amount spent on ILV production was found to be positively significant at a 1% level in ORTDM and a 5% level in ANDM, as shown in Table 5. This implies that, as household farmers invest more in ILV production,

Table 5. Factors influencing income generated from ILV sales in the Eastern Cape Province

Variables	B	Std. Error	*T* statistics	Sig.
1	2	3	4	5
ORTDM				
Constant		4.592	–.231	.819
Gender	–.163	1.200	–1.057	.301
Age	.154	4.211	1.012	.322
Education	–.037	7.572	–.241	.811
Household size	–.132	1.805	–.974	.340
Farm income	.025	3.910	.190	.851
Employment status	–.362	1.554	–2.401	.024**
Hiring of labour	.133	1.961	.940	.357
Amount spent on ILV production	.502	.955	3.773	.001***
Irrigation of ILVs	.065	1.068	.474	.640
Seasonal production of ILVs	.199	1.356	1.508	.145
Price of ILV per kg	.315	2.093	2.194	.038**
F value – 4.64, *R* square – 0.680, adjusted *R* square – 0.533, observations – 136.				
ANDM				
Constant		3.888	–.280	.782
Gender	–.184	1.230	–1.339	.195
Education	–.142	8.431	–.990	.334
Household size	.118	2.114	.867	.396
Farm income	.093	4.174	.736	.470
Employment	.016	1.390	.115	.909
Amount spent on ILV production	.305	.843	2.099	.048**
Seasonal production of ILVs	.245	1.141	1.786	.088*
Price of ILV per kg	.377	2.164	2.547	.019**
F value – 6.83, *R* square – 0.723, adjusted *R* square – 0.617, observations – 136.				

Table 5 – cont.

1	2	3	4	5
		JGDM		
Constant		1.817	.633	.536
Gender	–.362	1.745	–1.571	.137
Education	.142	1.555	.614	.548
Household size	–.557	4.816	–2.513	.024**
Farm income	–.151	3.035	–.766	.455
Employment	.213	2.010	.894	.385
Amount spent on ILV production	.084	2.279	.331	.745
Price of ILV per kg	.477	2.505	2.421	.029**
Age	.130	8.398	.451	.659
Irrigation of ILVs	.051	2.027	.204	.841
Seasonal production of ILVs	–.296	1.921	–1.248	.231

F value – 2.09, *R* square 0.583, adjusted *R* square – 0.503, observations – 135.
***, ** and * indicate significance levels at 1%, 5%, and 10% respectively.
Source: research survey, 2019.

there is a higher likelihood of increased income from ILV sales. Up to this point, there few if any previous reviews linking the money invested in ILV production with income generation. Again, in ORTDM, employment status had a negative coefficient and was statistically significant at a 5% level. These results could mean that as the number of employed members increases in a household, there is the possibility of decreased income from ILVs. The reason for this could be that household members are likely to participate less in ILV production due to time spent at work, thus triggering inferior production output and ultimately lowering sales. Similarly, Khoza et al. (2019) argue that livelihoods in rural areas are strongly affected by household socioeconomic factors, which in turn influence the economic behaviour within households, thus affecting market participation decisions.

In ANDM, seasonal production of ILVs was statistically significant at a 10% level with a positive coefficient. These results could be explained by the fact that, as ILVs become available on a seasonal basis, there is a higher chance of increased income from ILV sales. This can be further explained by the fact that producers possibly increase prices of ILVs when it is not the season to grow these vegetables, therefore resulting in greater revenues due to higher demand. Mahlangu et al. (2021) also report that the demand for ILVs has the potential to be an essential income stream, especially for rural households.

Regarding the price of ILVs per kg, this variable was statistically significant at a 5% level, with a positive coefficient in all three district municipalities (ORTDM, ANDM, and JGDM). These results reveal that, as the price of ILVs increases per kg, there is a greater possibility of income generated from ILV sales to increase. Lastly, in JGDM, regression estimates confirmed a negative relationship at a 5% level between household size and income generated from ILVs. This implies that, as the number of household members increases, there is a likelihood of decreased income from ILV sales. Mahlangu et al. (2021) also observed similar comparable findings that most ILV producers set their prices based on the market price, with few setting their prices as uttered by buyers, and this is likely to lead to lower income generated. However, producers seemed not to have a problem with the pricing strategy as they managed to sell larger quantities of these vegetables. This means that, regardless of the pricing strategy used, producers can still generate income from ILVs to supplement the family income and provide for the basic needs of the household (Mahlangu et al., 2021).

CONCLUSION

This study concludes that there is high dominance of women in both the production and marketing systems of ILVs, with most of these producers having completed primary education. Sellers generate income greater than R3000 per production season where most ILV producers and sellers are classified as unemployed. Producers produce ILVs from a land size ranging between 0.1 and 2 hectares of land since these vegetables are commonly grown in all three district municipalities covered by the study. All three district municipalities covered in the study either purchase seeds of ILVs or harvest the seeds from home gardens and open fields. In all three district municipalities, ILVs are generally not irrigated since rainwater is sufficient to grow these vegetables.

The study further concludes that in ORTDM, ILVs such as Amaranth, Nightshade, Lambs' Quarter, Pumpkin leaves, Melon leaves, and Blackjack have the potential to contribute significantly to household income. In addition, in ANDM, Nightshade, Amaranth, and Chinese cabbage show the potential to contribute towards household incomes in the district, while in JGDM, Amaranth and *Caudatus* L. show a positive contribution towards income generated from ILV sales. In addition, regression estimates confirmed that, in all three district municipalities covered by the study, the price of ILV per kg has a positive influence on the income generated from ILVs. Again, in ORTDM and ANDM, the amount spent on ILV production has a positive influence on the income generated from ILVs. In ORTDM, the employment status of the household head negatively influences the income generated from ILVs, while in JGDM, household size negatively influences the income generated from ILVs. Lastly, in ANDM, seasonal production of ILVs positively influences the income generated from ILVs.

POLICY RECOMMENDATIONS

The Department of Agriculture in the Eastern Cape Province should empower women with training and workshops on the production of ILVs for improved participation in ILV production because women are found to dominate in both the production and marketing systems of ILVs. This can lead to improved production output and ultimately attract larger markets for ILVs. For this to be successful, stakeholders involved in the food production system in South Africa should also strengthen the policy for ILVs as a valid food source and source of income. Indigenous Leafy Vegetables like Amaranth, Pumpkin leaves, and Nightshade seem to be dominant and highly produced ILVs, this means that improved investment from the department of agriculture could be vital. This can be done by improving both the production value chain and marketing channels for ILVs where government officials disseminate information to both producers and sellers of ILVs about standard procedures which can guide producers to not only sell ILVs at informal markets but to participate at formal markets as well. In addition, the Department of Agriculture should offer workshops to ILV producers on understanding the nature of marketing since the price of ILV per kg and the amount invested in ILV production seem to influence revenues in a positive way. This may assist producers to be innovative in pricing and marketing strategies or even to adopt pricing and marketing strategies which are commonly used with agricultural commodities so as to have a larger market gain for ILVs. Lastly, further research should look at the ILV production value and marketing channels as it is acknowledged that these areas of research are weaker throughout the South African Provinces.

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PEARL MILLET, THE HOPE OF FOOD SECURITY IN MARGINAL ARID TROPICS: IMPLICATIONS FOR DIVERSIFYING LIMITED CROPPING SYSTEMS

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Abstract. Pearl millet has great potential to withstand climate-related risks in marginal areas. However, much remains unknown as to how it contributes to income and food security at the smallholder level. As a result, this study assessed the contributions of pearl millet to the farmers' income and food security, its production constraints, and connections between stakeholders in the marginal arid tropics of Northeast Amhara. The technology was promoted for five (2015–2019) production years, and data from 223 samples were analyzed. The new pearl millet technology provided better yield (1420 kg·ha^{-1}) and net return (42328 ETB ha^{-1}) than sorghum, even in difficult climatic conditions. Despite the higher cost of production, its additional returns (31638) and effective gains (28838) were higher across the years. The results of the sensory evaluation revealed that "Enjera", "Tella", Bread, and Porridge were the farmers' 1st, 2nd, 3rd, and 4th food type choices of pearl millet, respectively. The trend towards acceptance of the technology made up a large number of the farmers, as 79.5% of those who participated applied the full technology package. Those who did not apply the full package did so due to labor shortages, technological complexity, and insufficient practical training. Therefore, climate-smart pearl millet crop technology is recommended for better and consistent production in marginal arid-tropical areas.

Keywords: climate change, food security, pearl millet technology, stakeholder connections

INTRODUCTION

Farmers in arid and semi-arid regions have been badly affected by climate change, but most of them continue to derive their livelihood from farming using different drought-resistant crop varieties (Choudhary et al., 2021). In this context, climate-smart small millets such as pearl millet (*Pennisetum glaucum* (L.) R. Br.) can play a critical role in addressing water scarcity and high temperatures as they can endure drought and other extreme conditions (Heuzé and Tran, 2015). They also benefit resource-poor and rain-fed farmers by reducing the crop duration and water requirement by almost 30 days and 75%, respectively (Zhang et al., 2021). Pearl millets are cereals grown globally in dry, semi-arid, and sub-humid drought-prone agroecosystems. Millets have been common food staples in human history, particularly in the semi-arid tropics of Africa. They are major sources of energy and protein for about 130 million people in sub-Saharan Africa (Alexandratos, 2009). Therefore, to recognize the benefits of millets for better production and nutrition, a better environment and life in the face of climate change, the United Nations General Assembly declared 2023 to be the 'International Year of Millets' (http://www.fao.org/millets-2023).

Worldwide, there are nine types of pearl millet varieties, of which six are available in Africa (Shivhare and Lata, 2019). The area where pearl millet is important

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falls within low agricultural potential, low market access, and low population density production domains in Eastern and Central Africa. These include, among others, the lowland areas of Eritrea, Ethiopia, and western and northern Sudan (Jukanti et al., 2016). In the arid lowlands of Eastern Amhara, where goats and sorghum are the main source of livelihoods, crop production has deteriorated over time due to the short and erratic rainy season and distribution (Mihiretu et al., 2019b). Pearl millet also provides the opportunity for reliable harvest, food, and nutrition under erratic and scanty rainfall with low soil fertility (Jaiswal et al., 2018). Upgrading production, storage, and utilization of pearl millet may significantly contribute to household food security in the area. The substantial importance of pearl millet in agricultural extension and rural development efforts is due to its better adaptability to marginal areas with narrow livelihood options (Faye et al., 2019).

In Ethiopia, only one pearl millet variety, named 'Kola-1', has been released for production in marginal dryland parts of the country (Saba et al., 2015). Even in the fragile climatic conditions of Eastern Amhara, where sorghum is not productive, pearl millet bids yield within 60–70 maturity days on average. Having all these vital traits of pearl millet, the Sekota Dry Land Agricultural Research Center stretched the adaptability of the nationally released variety to its parched lowland mandate areas and found it to be successful. The study was carried out mainly to promote pearl millet technology as an alternative to sorghum-based cropping systems in the marginal arid tropics of Northeast Ethiopia. The specific objectives were to:

a) Introduce and promote the contributions of pearl millet technology[1] to smallholder farmers' income and food security in marginal dryland areas,
b) Identify the major constraints in pearl millet production and technology demand creation,
c) Assess the trend lines and stakeholders' connections in technology multiplication and diffusion.

MATERIALS AND METHODS

Description of the study area

About 23 districts in the Tekeze lowland sorghum and goat livelihood zone are classified as arid agro-pastoral (AAP[2]) farming systems and vulnerable to severe water stress and drought (Mihiretu et al., 2019a). Two districts that represent the AAP farming system in Northeast Ethiopia were selected for the study. Abergelle district is located at 13° 01′ 37.50″ N latitude and 38° 58' 36.50" E longitude, having an altitude range of 1150-1500 meters above sea level (m.a.s.l) (Mihiretu et al., 2021). Its annual mean rainfall ranges between 250-750 mm, while its average temperature varies between 23-43°C annually. Ziquala district is located at 13° 09' 60.00" N latitude and 38° 29' 59.99" E longitude, with an altitude of 1462 m.a.s.l. The annual average rainfall and temperature of the district were 255 mm and 42°C, respectively (Mihiretu et al., 2021). The districts' annual rainfall is bimodal, short, and erratic, with two months duration usually from the end of June to mid-August (Mihiretu et al., 2019a). Crop farming in these areas is limited to the cultivation of some drought-resistant sorghum and lowland pulse crops (Mihiretu et al., 2020).

Design and sampling procedure

The study adopted a mixed research approach. The first phase of the study was demonstrating the contributions of pearl millet to smallholder farmers' income, food, and nutritional security as an alternative crop to sorghum. Two districts in the AAP farming system, i.e., Abergelle and Ziquala, were selected purposively based on adaptation trial results in Northeast Ethiopia. The promotion was launched for five production years (2015–2019) involving 750 farmers who had farmlands in a cluster. The average farm size allocated per farmer was between 0.25-0.5 ha, to reach a large number with the new pearl millet technology. Training was given to participant farmers to create awareness about the crop and its production packages. Planting and other agronomic management practices were done as per the recommendations (Mihiretu et al., 2019b).

[1] In this study, "Pearl millet technology" stands for planting/sowing improved pearl millet (Kola-1) variety in a row, using recommended fertilizer (100/50 kg ha^{-1} DAP/UREA) and seed (10 $kg \cdot ha^{-1}$) rates, as well as optimum (3×) tillage and proper weed management (2×) (Mihiretu et al., 2019b).

[2] AAP system is characterized by a dry and hot climate with annual precipitation ranging from 300 to 750mm with average daily minimum and maximum temperatures of 21 and 41°C, respectively (Dudhate et al., 2018).

The second phase of the study was focused on wider technology demand creation, major production constraint documentation, and potential stakeholder identification and connection building, which are likely to aid the subsequent up-scaling and diffusion of pearl millet. A familiarization workshop was organized to share duties and responsibilities among the key stakeholders, who signed a memorandum of understanding (MoU) (Mihiretu, 2019). The main stakeholders were agricultural development experts, researchers, and Non-governmental Organizations (NGOs) working for rural development in the area. The study was hence not only designed to increase the farmers' knowledge but also to improve stakeholders' connections and sense of duty in the technology promotion process. Using systematic sampling, about 223 (30%) farmers were selected using an approximate sampling interval of 3 (Eq. 1) from the total 750 pearl millet-producing population.

$$K = \frac{N}{n} \quad (1)$$

Where: K – sampling interval, N – total pearl millet producing population, n – sample size.

Data collection and analysis

The quantitative data, such as the socioeconomic characteristics of the studied farmers, farm management practices, grain, and biomass yield, as well as the benefits and costs of pearl millet technology were collected using a semi-structured questionnaire. The qualitative data, i.e., perception and demand of pearl millet technology, sensory preference of food items, technology application and constraints as well as stakeholder connections in the promotion were collected. Field days were also organized per year to promote the technology to the wider community. The collected quantitative data were analyzed in descriptive statistics, percentage yield increase (Eq. 2), technology gap (Eq. 3), extension gap (Eq. 4), and technology index (Eq. 5) using the formula of Mihiretu et al. (2019b). In this study, the technological index was operationally defined as the technical feasibility attained due to the implementation of full production package components.

$$YI\ (\%) = \left\{\frac{Y_{pearl} - Y_{sorg}}{Y_{sorg}}\right\} \times 100 \quad (2)$$

$$TG = Py - Dy \quad (3)$$

$$EG = Dy - P_r y \quad (4)$$

$$TI = \left\{\frac{Py - Dy}{Py}\right\} \times 100 \quad (5)$$

Where: Py – potential yield, Dy – demonstration yield, Y_{pearl} – yield of pearl millet in farmers' field, Y_{sorg} – yield of sorghum in farmers' field, YI (%) – percentage yield increase, TG – technology gap, EG – extension gap, TI – technology index.

To assess the profitability of pearl millet technology, total variable cost (TVC), gross return (GR), net return (NB), benefit-cost ratio (BCR), additional cost (AC), additional returns (AR), effective gain (EG), and sensitivity analysis were calculated (Meena and Singh, 2017). The prevailing farm gate price was used to value the costs and returns of production on a hectare basis. TVC is the sum of input costs that vary, while GR is the product of total yield by the farm gate selling price. NR is the difference between GR and TVC. BCR is the ratio of GR to TVC, and if the ratio is less than 1, the technology is not profitable. AC is the production cost difference between sorghum and pearl millet, but AR is the change in GR between them. The EG is the variation of AR and AC (Meena and Singh, 2017). As well as this, farmers' perceptions and demands were assessed using descriptive statistics and Likert scale to calculate the sum of the scores (Eq. 6) and average scores[3] (Eq. 7) of different items (Mihiretu, 2019). The Cronbach's alpha was checked for internal consistency among Likert-type questions (Table 5b). The sensory preference of different pearl millet food items was evaluated using the pair-wise ranking method (Mihiretu et al., 2019b). The major constraints of pearl millet technology application were ranked according to their severity and converted into percentage positions using Garrett's ranking method (Garret and Woodworth, 1969). The position (Eq. 8) of each rank is converted into a score and referenced with Garrett's table (Table 6b). The positive and negative sides of the stakeholders involved in pearl millet promotion were assessed via SWOT (strengths, weaknesses, opportunities, threats) analysis (Mishra et al.,

[3] If the average score is greater than 3.51, the farmers have a good perception of the technology. If the average score is 2.51–3.50, the farmers have no confidence in the technology. If the average score is below 2.50, the farmers do not have a good perception of the technology (Mishra et al., 2018).

2018). The qualitative field day data were explained in thematic-oriented narration.

$$SS = \sum_{i=1}^{S} SD, D, NAD, A, SA \quad (6)$$

Where: SS – sum of scores, SD – strongly disagree, D – disagree, NAD – neither agree nor disagree, A – agree, SA – strongly agree

$$\text{Average score} = \frac{\text{Sum of score}}{\text{Sample size}} \quad (7)$$

$$\text{Percent position} = \frac{100\left(R_{ij} - 0.5\right)}{N_j} \quad (8)$$

Where: R_{ij} – rank given for i^{th} constraint by j^{th} individual, N_j – number of constraints ranked by j^{th} individual.

RESULTS AND DISCUSSION

Socioeconomic features and agronomic practices of farmers

The socioeconomic characteristics of farmers are described in Table 1. The average age and farm experience of the farmers were 43 and 19.3 years, respectively. Most of them were married, and the majority of the households were male-headed, while the rest (16.8%) were female-headed (Table 1). The family size per household was 5.6 on average, which indicates that there was sufficient labor per household for the technology package application. The educational status of farmers defines their technology application habits. 29% of the farmers were illiterate but the rest were literate, with knowledge ranging from reading and writing to primary education, but the literate farmers' role in the community is only limited to religious involvement.

All the farmers who participated in pearl millet promotion got training, but 21.3% of them agreed that the training provided was not adequate to apply the technology (Table 1). The agronomic literature suggested that 'three times tillage is an optimum level' for pearl millet production (Saba et al., 2015). Therefore, 81.2% of the farmers tilled at a sufficient level (3x), while the remaining ones tilled below and above the optimum level.

Yield performance and gaps in pearl millet technology

The mean yield of pearl millet (1420 kg ha^{-1}) had a 102.9% yield advantage over the existing sorghum yield (700 kg ha^{-1}) in similar production years. The stalk

Table 1. Household and farm characteristics of participant farmers, *n* = 223

	Variables	Freq.	%	Mean
Socioeconomic characteristics	Age (years)	–	–	43
	Farming experience (years)	–	–	19.3
	Family size (numbers)	–	–	5.6
	Female headed households	38	16.8	
	Educational status			
	· Literate	158	71	
	· Illiterate	65	29	
	Community participation			
	· Religious positions	67	41.3	
	· Political positions	9	5.8	
	· No participation	82	52.9	
	Farmers who got training	223	100	
	Was it sufficient for practice			
	· Yes	176	78.7	
	· No	47	21.3	
Agronomic practices	Farmland tillage frequency/status			
	· Poor	9	4.9	
	· Enough	180	81.2	
	· More than enough	31	13.9	
	Planting time			
	· On time	191	85.8	
	· Late	32	14.2	
	Weed management			
	· Weed problem	12	7.7	
	· Good management	211	92.3	
	Full technology package usage			
	· Yes	177	79.5	
	· No	46	20.5	
	Constraints in package application			
	· Yes	155	69.5	
	· No	68	30.5	
Technology demand	Interest to use by next years			
	· Yes	192	85.9	
	· No	31	14.1	
	Suggested for neighbours to use			
	· Yes	201	90	
	· No	22	10	

Source: own elaboration

Table 2. Likert item statements' reliability test statistics

Cronbach's alpha	Cronbach's alpha based on standardized items	Number of items
0.735	0.788	11

Source: own elaboration

yield of pearl millet was also comparable to sorghum stalk yield (Table 1). The increase in pearl millet yield over sorghum was because the former is better resistant to water scarcity and higher temperatures than sorghum in the study areas. Singh et al. (2018) similarly stated that the yield increase of new pearl millet technology over the usual crop might be due to better adaptability or being quite environmentally friendly. The yield of pearl millet was compared with the potential yield and demonstration yield in frontline farmers' fields to estimate the technology gap, extension gap, and technology index.

Technology gap: The results (Table 3) revealed that the technology gap was on average 400 kg·ha^{-1}. The technology gap may be attributed to variations in soil fertility status, inconsistent weather conditions, and the management practices used for specific crop cultivars under trial and demonstration fields. This result was found to be similar to the findings of Mishra et al. (2018), who identified that location-specific recommendations appear to be necessary to bridge gaps.

Extension gap: The extension gap between the frontline demonstration plots and the farmers' land was recorded at 180kg ha^{-1} on average (Table 3). The extension gap in this study indicates that there is a need to motivate farmers to adopt all of the recommended pearl millet production technologies. Improvement in local farmers' practices for the adoption of area-specific farm technology is an option for scientists for enhanced crop productivity (Mihiretu et al., *2*019b). Extension yield gaps are indicators of a lack of awareness of the adoption of improved farm technologies by farmers. This result is similar to Yadav et al. (2021), who reported that location-specific mediations may have a massive effect on crop productivity improvement.

Technology index: The 20% technology index demonstrates the gap between technologies developed and demonstrated in frontline farmers' fields (Table 3). It depicts the possibility of increasing pearl millet yield through full-package technology promotion in the future. The higher technological index revealed that there is still room for improving the pearl millet yield through intensive package application. The social environment, in terms of irrational attitudes, illiteracy, and impassive behaviors toward the adoption of new technologies, is a major limiting factor to improving agricultural productivity (Yadav et al., 2021).

Economic analysis and profitability

The benefit-cost analysis shows that the gross return (50328 ETB ha^{-1}), and net return (42328 ETB ha^{-1}) of pearl millet technology were higher than those from existing sorghum production. The increased returns of pearl millet might be due to its better adaptability to marginal areas, as well as the use of improved management practices. These findings are in line with Singh *e*t al. (2017), who described that farmers who did not adopt new production technologies and/or were unable to afford the input costs ended up with low yield returns and financial benefits. Despite pearl millet technology having a higher average additional cost, it also had higher additional returns and effective gains compared to sorghum production (Table 4). The greater additional

Table 3. Productivity, technology gap, extension gap, and technology index of pearl millet

Pearl millet	Range yield index (kg·ha^{-1})	Mean yield (kg·ha^{-1})	SD	Yield index (%)	Technology gap (kg·ha^{-1})	Extension gap (kg·ha^{-1})	Technology index (%)
Grain	980-1700	1 420	1.787	102.9	400	180	20
Stalk	1300-2150	1 570	6.233	–7.6	500	430	25

Note: Farmers' grain (stalk) yield of sorghum = 700 (1700) kg ha^{-1}.
Potential grain (stalk) yield of pearl millet = 2000 (2500) kg ha^{-1}.
Demonstration grain (stalk) yield of pearl millet = 1600 (2000) kg ha^{-1}.
SD – standard deviation.
Source: own elaboration.

Table 4. Profitability and benefit-cost analysis of pearl millet technology

Cost-benefit items	Pearl millet (ETB ha^{-1})	Sorghum (ETB ha^{-1})
Cost of seed	400	300
Cost of fertilizers	2 500	2 500
Cost of package application	5 100	2 400
Total variable cost (TVC)	8 000	5 200
The selling price of grain yield	35	25
Selling price of stalk yield	0.4	0.7
Gross return (GR)	50 328	18 690
Net return (NR)	42 328	13 490
Benefit-cost ratio (BCR)	6.3	2.6
Additional cost (ETB ha^{-1})	2 800	
Additional return(ETB ha^{-1})	31 638	
Effective gain (ETB ha^{-1})	28 838	
1 Dollar = 45 ETB on average in the study years		
ETB = Ethiopian Birr.		

Source: own elaboration.

returns and effective gains of pearl millet may have been attained due to the application of improved technology, i.e., the use of ideal crop varieties and the timely operations of the required crop management practices.

Farmers' perceptions of and demand for pearl millet

Most of the farmers had a positive view and good perception of pearl millet technology in most parameters (Table 5). However, a large number of the farmers had no confidence in its pest resistance capacity since it is very susceptible to bird attacks, especially during the ripening stage. Still, a large number of the farmers remained neutral in their views on its disease resistance capacity because there is no disease record on the variety.

As displayed in Table 6 below, the average score of the responses is 4.24, which implies that the farmers perceived and accepted the technology with full confidence. Cronbach's alpha reliability analysis was carried out to test internal consistency among Likert scale items (Mihiretu, 2019).

The alpha coefficient ($\alpha = 0.78$) demonstrated that the questions used were consistent and reliable (Table 1).

Table 5. Farmers' perception of pearl millet technology, $n = 223$

Parameters	SD	D	NAD	A	SA	SS	MS
Germination performance of the crop is good	–	–	4.5	43.2	52.3	694	4.48
The vegetative performance of the crop is good	–	–	–	26.5	73.5	734	4.74
Seed setting performance of the crop is good	–	16.1	–	27.1	56.8	658	4.23
The crop is resistant to diseases	–	7.7	77.4	11.0	3.9	482	3.46
The crop is resistant to different pests	14.8	46.5	21.9	16.8	–	399	2.87
The crop is early maturing	–	–	–	24.5	75.5	737	4.76
The crop is adaptable to marginal areas	–	–	2.5	12.0	85.5	742	4.82
The grain productivity of the crop is good	–	–	–	54.8	45.2	690	4.45
Stalk productivity of the crop is good	–	–	24.2	58.0	25.8	436	3.20
The palatability of the stalk is good	13.6	36.4	20.2	20.0	9.8	364	2.78
The food quality of the crop is good	–	–	12.9	28.4	58.7	691	4.49
Average score = 4.24							
Cronbach's 'α' coefficient = 0.78							

Note: values are in percentage points (%); SD – strongly disagree, D – disagree, NAD – neither agree nor disagree, A – agree, SA – strongly agree, SS – sum of scores, MS – mean of scores.
Source: own elaboration.

Table 6. Sensory evaluation and ranking of food items prepared from pearl millet

Food types	Enjera	Bread	Porridge	Tella	Scores	Ranks
Enjera		Enjera	Enjera	Enjera	3	1
Bread			Bread	Tella	1	3
Porridge				Tella	0	4
Tella					2	2

Note: "Enjera" is a common stable food in the daily food dishes, while "Tella" is a local alcoholic beverage in Ethiopia, and the study area in particular.
Source: Mihiretu, 2019.

Thus, 85.9% of the farmers were highly interested in adapting pearl millet technology in the future, and most of them (90%) convinced their neighbouring farmers to use the technology (Table 2).

In addition, field days involving farmers, agricultural experts, and journalists were held. After attending these field days, farmers' opinions about the new pearl millet technology was summarized as follows:

> The pearl millet technology is very adaptive to our moisture deficit area and can give yield even in warm and low moisture situations. At germination, a single seed would have up to 20 tillers of good performance; as a result, we termed it the "crop of the poor". As an agro-pastoral community, we negate the variety for its low stalk palatability, because in this area livestock forage is worth as much as grain yield. Some of the positive aspects of the variety are that it is resistant to drought and early maturing, resistant to Striga and with better production, a good source of house roofing and household fuel wood, and a quality staple food. However, they negatively described that the variety has a higher lodging problem and needs tying at maturing. In addition, the stalk has low palatability to livestock and is susceptible to bird attacks at the maturity stage. Clustering as an approach was also appreciated for creating competition in farm management among farmers, reducing the risk of pest damage, and having "eye-catching" power to impress individuals.

Since pearl millet is a new crop to the community, food recipe demonstration is required, thus different food items were prepared in the form of staple foods and local beverages, then tasted by a set of panellists, i.e., farmers and experts. The results of the sensory taste evaluation revealed that "Enjera", "Tella", Bread, and Porridge were the panellists' first, second, third, and fourth food choices, respectively (Table 7).

Technology application and constraints

Among other factors, applicability plays a significant role in new technology adoption, hence with expert follow-up, 79.5% of the farmers applied the full package (Table 1). Despite better package application, 69.5% of the studied farmers identified constraints in package application and ranked them according to their severity. The percentage position of each rank is converted into scores using Garrett's table (Table 7b). The mean scores of all constraints are arranged to make the final rankings, thus attributes with the highest mean score are considered the most influencing factors. The results (Table 7a) showed that shortage of labor in the household, the complexity of the technology, and inadequate practical training were the top three challenges experienced by farmers when attempting to apply the full technology package of pearl millet in the study areas.

Stakeholder connections and technology exchange

Sharing duties among stakeholders would consolidate the triple connection of farmers-extension-research, and that is in turn vital to sustainable technology promotion. Therefore, in this study, all participant farmers hand over the technology to interested fellow farmers. The agricultural experts at different levels were also handling tasks to facilitate technology dissemination via continuous follow-up and consultation. Being innovative stakeholders, different NGOs were involved in technology dissemination to other target areas using earlier farmers

Table 7a. Constraint of pearl millet technology production and package application

Constraints	Ranks						Total sample	Total score	Total mean	Rank
	1	2	3	4	5	6				
Complexity of the technology	42	68	26	6	5	8	155	9 661	62.3	2
Inadequate practical training	59	46	14	12	16	8	155	9 585	61.8	3
Lack of experience (skill gap)	72	18	24	21	5	15	155	9 512	61.4	4
Shortage of labour	95	31	16	7	4	2	155	1 069	69.0	1
Shortage of finance	39	46	15	10	30	15	155	8 687	56.1	5
Pessimist about technology	7	10	7	20	23	88	155	5 359	34.6	6

Source: own elaboration.

Table 7b. Percentage positions and their corresponding Garett's table values

Ranks	Percentage position		Garrett table value
1	100 (1–0.5)/6	8.3	77
2	100 (2–0.5)/6	25	64
3	100 (3–0.5)/6	41.7	55
4	100 (4–0.5)/6	58.3	46
5	100 (5–0.5)/6	75	37
6	100 (6–0.5)/6	91.7	23

Source: own elaboration.

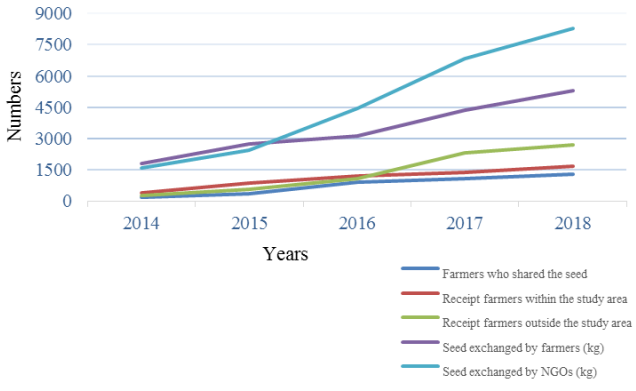

Fig. 1. The diffusion and exchange trends of pearl millet technology
Source: own elaboration.

as a source. The cooperation among those involved in and affected by the promotion increased compared to previous years, and the strengths, weaknesses, opportunities, and threats in the process are described below (Table 8). Moreover, the solid seed exchange system takes the front line in the diffusion of improved varieties (Mihiretu, 2019), hence the number of farmers who delivered the variety to interested fellow farmers in different arrangements showed an increasing trend in the study years. The amount of seed disseminated to interested farmers in/outside the study areas by participant farmers and NGOs also showed a consistently increasing trend across the years (Fig. 1).

CONCLUSION AND RECOMMENDATIONS

Conclusion

The global food system faces many complex challenges, including climate change, depletion of natural resources, and hunger. However, an ever-growing population needs sufficient and healthy food. In the face of climate change, when other crops are at risk, pearl millet ensures better yield and income for resource-poor farmers. Pearl millet can thus become a key crop with the potential to improve the livelihood and nutrition of smallholder farmers in the marginal areas of Northeast Ethiopia. Therefore, the results of the current study revealed that the average yield of pearl millet had a 102.9% yield advantage over the yield of the dominant crop grown in the area, i.e., sorghum. Its stalk yield was also comparable with that of sorghum in similar production years. Financially, the gross and net returns of pearl millet technology were far higher than

Table 8. SWOT analysis of stakeholders' linkage in pearl millet promotion and diffusion

Strengths	Weaknesses	Opportunities	Threats
Farmers • Being optimist and high technology demand • Good contact with other stakeholders throughout the promotion process • Sowing in a cluster and used as a seed source Experts • Good contact in the promotion process • Including NGOs in the process • Inviting media for broadcasting Researchers • Good contact in the promotion process • Involving NGOs in the process • Avail inputs and training on time • Collect and analyse the data on time	Farmers • Gap in full technology package application • Problem of maintaining the seed quality Experts • Insufficient follow-up by the nearby actors • Stumpy technical backup to farmers Researchers • Stumpy technical backup to farmers	• Presence of NGOs working on technology upscaling • Technology usage suits the government's focus on rising production • Farmers have good information and experience with pearl millet • Existence of seed exchange culture in the community via local arrangements, i.e. cash, kind, free for non-eligible	• Being arid with low and erratic rainfall with high temperature • High-risk experience of drought within 3-4 years of occurrence • Low willingness to pay for inputs due to the expensive price • Increasing dependency on relief food aids

Source: own elaboration.

sorghum from an equal land size. Despite higher average additional costs, the pearl millet technology had better additional returns and effective gains than sorghum. Technological acceptance was high, thus 79.5% of the farmers applied the all of the technology. Those who did not apply the technology fully did so due to labor shortages, technological complexity, and inadequate practical training. Durable technology demand was also created for stakeholders working on food security and agricultural development in the areas. Moreover, different food types of pearl millet were prepared and tasted by farmers, the sensory comparison revealing that the panellists' preferred "Enjera", "Tella", Bread, and Porridge as their 1st, 2nd, 3rd, and 4th choices, respectively. Agricultural extension experts at different levels handle tasks to facilitate technology dissemination. The cooperation among those involved in and affected by the promotion increased compared to the preceding years. The number of farmers who delivered a variety to interested fellow farmers in different arrangements showed an increasing trend in the five years of the study years. The amount of seed disseminated to interested farmers in/outside the study areas showed a consistently increasing trend across the years.

Recommendations

The authors safely recommend the introduced pearl millet technology for further up-scaling to similar agro-ecologies to diversify sorghum-based cropping systems. Since the crop is suitable for marginal areas, further adaptation and breeding studies are required to offer technology options in the future. The stalk is ineffective as a livestock feed in agro-pastoral communities, thus undertaking thorough research in this area is compulsory to resolve the palatability problem. Finally, organizing workshops to connect stakeholders is worthwhile to devise ways to forward the technology to the wider community in a sustainable manner. In this regard, farmers are advised to use the prevailing 1:5 extension networking to hand over the technology to fellow farmers easily. Seed-producing and marketing cooperatives should work together to make pearl millet technology multiplication and transfer viable.

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DETERMINANTS OF FARMERS' DECISION TO CHOICE MARKET OUTLETS: EVIDENCE FROM MILK PRODUCER FARMERS IN ADA'A BERGA DISTRICT ETHIOPIA

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Abstract. In Ethiopia, many initiatives have been implemented to empower smallholder dairy farmers to develop viable livelihoods from the sector. The problem with these policies is the inability to reach farmers at large, and dairy farmers in rural areas are always challenged to deliver milk and milk products faster to the final market. The study was aimed at investigating factors that influence market channel choices among dairy producers in Ada'a Berga district Ethiopia. This paper uses data from a survey of 123 dairy producer households in four rural kebeles to analyse the factors that influence the choice of a milk marketing channel. Multivariate probit econometric model results show that income from dairy source, market information and educational level of household affected wholesaler outlet. The choice of consumer outlet is influenced by family size, membership in a dairy cooperative, market information, non-dairy income and income from dairy source. Number of milking cows, membership in a dairy cooperative and non-dairy income determined the choice of dairy cooperative outlet. The choice of district retailer's market outlet was affected by sex of households, membership in a dairy cooperative and income from dairy sources. Choice of rural collector outlet is negatively influenced by non-dairy income and access to an extension contact. Therefore, policies should be designed that encourage farmers' cooperatives, contract farming and collective action in order to lower transaction costs, expand market information for dairy producers, expand extension services and expand infrastructures such as road and transportation facilities, which are needed to promote the effective marketing of milk through all outlets.

Keywords: multivariate probit, milk marketing channels, dairy farmers Ada'a Berga District, Ethiopia

INTRODUCTION

Agriculture is the primary source of food and income for Africans and provides up to 60% of all jobs on the continent Diop (2016). More than 70% of Ethiopia's population is still employed in the agricultural sector CIA (2019). Dairy is a staple product in Ethiopia and mainly depends on indigenous livestock resources: cattle contributes the largest of the total national annual milk output at (81.2%), followed by goats (7.9%), camels (6.3%) and sheep (4.6%) and managed under extensive grazing and uncontrolled breeding CSA (2020). In developing nations, demand for milk and milk products is increasing and the drivers of change to the dairy sector are demography, growing economies, underserved markets, conducive policy and enabling environment, globalization and market opportunities (Shapiro et al., 2017). Dairy is a source of income and food, thereby reinforcing the overall reduction of poverty in Ethiopia (Tegegne et al., 2013).

Meeting the increasing demand for milk and milk products cannot be realized without reducing the transaction costs prevailing along the supply-chain by identifying cost-effective marketing channels and coordinated supply chains Kilima and Kurwijila (2020). The dairy

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sector transformation process requires periodically identifying critical challenges and opportunities and designing interventions and investment options for the public and private sector Gebreyohanes et al. (2021). It is important to understand how the marketing channel is organized and what factors limit farmers in their choice of market as part of the dairy improvement programs in Ethiopia. Farmers have alternative market outlets for selling their agricultural produce. These outlets offer different prices and sales services, which determine farmers' choices as to which market outlet they should send their produce Geoffrey (2015). Choice of market outlet plays an important role in improving incomes. Farmers choose a particular channel if the expected utility gained by selling through the selected channel is greater than all the other channels (Mamo et al., 2021).

The inability of dairy farmers to reach the national or international markets is a key challenge for dairy production and marketing in Ethiopia. To tackle challenges and support the dairy sector, different interventions have been made by the government, national and international research institutions. For instance, Ethiopia's Livestock Master Plan (LMP) set out predicted growth opportunities, and within the LMP an ambitious programme was drawn up for the dairy sector Shapiro et al. (2015). The LMP was planned to increase milk production from 167 million to 1,490 million litre and increase the contribution of dairy to Gross domestic product from 1.1 billion to 10.0 billion Ethiopian Birr (ETB) by 2020. With the Livestock Master Plan, the government planned to empower smallholder farmers with access to markets to create viable livelihoods from dairy and encourage growth of the formal market (National Planning Commission, 2016). Also, the Ethiopia agricultural transformation agency has established a plan and intervention on solving systemic bottlenecks within the agricultural sector to catalyse transformation from a subsistence oriented, low output agricultural sector to a high performing sector (Bachewe et al., 2018).

However, in Ethiopia, the problem of these policies is the inability to reach farmers at large. Informal channels are dominant in rural areas, especially where there are not strong dairy cooperatives operating actively (Brasesco et al., 2019). Most of the milk consumed by most urban consumers is mostly supplied through the informal sector, whereas rural and peri-urban producers supply directly to traders as well as local kiosks, hotels and shops. In Ethiopia, raw milk is a missing market link between the formal milk processing companies and dairy producers. As a result, formal milk processing companies in Ethiopia are operating at less than half of their full capacity (Mulugeta et al., 2019). On the other hand, dairy producers that operate in and around major cities in Ethiopia face milk marketing problems, especially during fasting periods resulting in low milk prices and high milk wastage (Adam et al., 2019). Also, producers are not benefitting from the opportunity of high demand for milk due to poor value chain governance and the absence of strong linkages between producers and buyers (Brasesco et al., 2019). Zegeyesh et al. (2017), rural poor farmers are always challenged to deliver milk to the final market. Jaleta and Gardebroek (2007) showed that inadequate market channels and poor information regarding prices were among factors affecting commercialisation of agriculture. Smallholder farmers are excluded from international markets (Arinloye et al., 2015) and small-scale dairy farmers are forced to sell their dairy products through informal marketing channels for myriad factors AGP-LMD (2013).

Previous studies showed that the decision of milk farmers on their choice of milk market outlet is influenced by the characteristics related to membership in a cooperative, form of payment, volume of milk produced, level of education and marketing costs (Jaiswal et al., 2016), being in rural areas, breed type, separate milking place, supply of hay (Ketema et al., 2016), transaction costs and socio-economic variables such as sex, dairy farming experience, dairy cooperative membership, number of milking cow owned, frequency of extension contact, non-farm income (Ayyano et al., 2020), milk buyers' related factors such as purchase frequency and quantity purchased (Berem et al., 2015), institutional factors such as access to credit and financial strength (Innocent et al., 2018), characteristics related to the seller (reputation, desire to control channel) and market information (Ishaq et al., 2017; Singh, 2018; Zegeyesh et al., 2017). Past studies on the dairy market show more attention given to participation of producers in the dairy market and marketing efficiency of the chain (Ordofa et al., 2021). However, limited work was done on the choice pattern of farmers when it comes to channel choice and the factors influencing those choices regarding outlet of milk market. Another limitation of the past studies was the methodological approach. The analytical model widely utilized for the econometric analysis was the multinomial logit (MNL) model, which

fails to address interdependent decisions to sell milk to more than one channel. The exceptions were the studies by Ayyano et al. (2020), Mamo et al. (2021) and Zegeyesh et al. (2017) who utilized the multivariate probit (MVP) model.

In recent years, various actors in Ada'a Berga district such as traders (wholesaler, retailers, collectors), cooperatives and processors companies have frequently joined the milk market due to increased demand for milk products in urban and pre-urban areas. The emerging new market and network is an opportunity for producers to maximize the benefit if they make an appropriate decision on the choice of market outlet where they should sell their product. However, there are various factors that affect households' decisions in selecting appropriate channels for delivering their products to the market. Identifying these factors is very important in terms of pinpointing possible areas of intervention that may help farmers to maximize benefits from their milk production and marketing activities. In addition, given the potential of Ada'a Bega for milk production, processing, marketing and consumption, the results of the study are essential in terms of providing vital and valid information in relation to the choice of appropriate market outlets. In doing so, the study attempts to analyse factors affecting milk channel choice decisions of milk producer households in Ada'a Berga district, Ethiopia.

METHODS

Study area

This study was conducted in Ada'a Berga District, West Shewa Zone of Oromia National Regional State, Ethiopia (see Fig. 1). Geographically, it is located 64 km Northwest of Addis Ababa on the road of Mugher cement enterprise at 9°12'to 9°37 N latitude and 38°17' to 38°36' E longitude. The district is bordered by Walmara district in the South, Ejerie district in the South West, Meta Robi, district in the West and Muger River in the East. The Ada'a Berga district is composed of 34 rural *kebeles* and three urban *kebeles*. This case *kebele* is a peasant association and the smallest administrative unit of Ethiopia that was used to manage household surveys. The Ada'a Berga district is characterized by a crop-livestock mixed farming system where in general livestock contribute to a farmer's livelihood as a source of food, cash income, source of traction power and means of transpiration. Dairy production significantly contributes to smallholder farmers as a means of income, nutrition and employment. The Ada'a Berga district milk production is predominantly a smallholder mixed part of the subsistence dairy production system. In this system, all feed requirements are derived from native pasture and a balance comes from crop residues and stubble grazing. Cattle are the main source of milk even though they are kept primarily as a draught power source with very little or no consideration given to improving their milk production capabilities. The milking months of local breeds exist for almost seven months of lactation and the potential average milk yield per cow per day is about 1.48 liters per a day (CSA, 2020). The majority of the dairy products are sold in the local market. Milk and milk by-product prices vary between different seasons and locations. The increase in the amount of milk sold during the wet season was high in the mixed crop- livestock system. The increase of milk yield and supply to the market is mainly due to more cows calving in the wet season and increased feed availability. The dairy farmers in Ada'a Berga have many market outlets for selling their milk, such as cooperative, wholesaler, rural collectors, hotels and direct to consumers. However, low amount of milk produced, distance to the market and high cost of transport were the major constraints faced by milk producers.

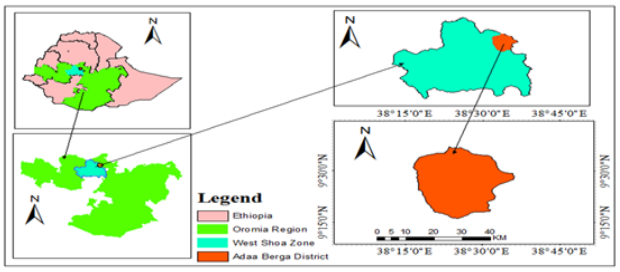

Fig. 1. Map of study Area

Sampling techniques and sample size determination

The multistage sampling techniques were applied to divide the large population into smaller clusters in several stages to make primary data collection more manageable. First, the West Shewa Zone was selected from four main milksheds in Ethiopia. Second, considering the

potential of milk production and marketing, Ada'a Berga district was selected. Third, from 34 *kebeles* of the Ada'a Berga, 20 milk producing *kebeles* were selected and clustered into three agro climatic zones, and four *kebeles* namely, *Ittaya, Ejre, Biyhowogiide and Sireberga* were selected using simple random. Finally, a total of 123 households allocated to four *kebeles* based on the proportional to sample size (Table 1). Yamane (1967) formula was employed to calculate the sample size. Although it is common to use 5% significance level to estimate the sample size, this study used 9% due to the financial and time constraints of using a large sample size.

The sample size was determined using the following formula:

$$n = \frac{N}{1 + N(e)^2} = \frac{1831}{1 + 1831(0.09^2)} = 123 \qquad (1)$$

Where, n = sample size, N = Population size and e = level of precision assumed 9%.

Table 1. Sampled distribution of dairy farm households

No	Kebeles	Total numbers household's	Sampled household's
1	*Ittaya*	298	20
2	*Ejre*	719	47
3	*Biyho wogiide*	413	28
4	*Sireberga*	401	27
Total		1 831	123

Source: Ada'a Berga Office of Agriculture (Animal and Fish Resource Department), 2020.

Empirical model specification

The theoretical basis for choosing an appropriate econometric model to analyse factors affecting milk marketing channel choice decisions of the dairy farms is derived from the random utility theory (McFadden, 1986). The underpinning assumption of this theory is that a decision-maker is rational who has perfect information to make decisions of choosing an alternative that offers the highest utility from a choice set. However, considering dairy producers as rational decision makers with perfect information is unrealistic because they have cognitive limitations, limited time and do not have full information to make rational decisions. This leads to the bounded rationality theory, which means they cannot make utility maximizing decisions but a nearly optimal decision that is sufficient to compare alternatives (Simon, 1955). It has become common practice to apply logit models for data which are individual (household) specific (Green, 2000). The application of logit models depends on the number of marketing channels involved to study decisions related to market participation and channel choice (Lu, 2007). When the choice set consists of only two options, binary or probit models are the most frequently used econometric models for an empirical analysis. However, if the choice sets are more than two, then the multinomial logit discrete choice model is used (Green, 2000). When the choice set consists in estimating several correlated binary outcomes jointly and the influence of the set of variables on the choice of markets outlets, then the multivariate probit (MP) is used (Green, 2000). Multivariate probit is used over multinomial logit (ML) because ML is not viable since the market channel choice might not be mutually exclusive given the possibility of simultaneous choices of channel and the potential correlations among these market channel choice decisions.

The model assumes that the decision to participate in a particular marketing channel is based on the maximization of an underlying utility function and a farmer selects his/her market channels based on his/her expected utility (McFadden, 1986). A farmer's decision whether or not to participate in each market channel is made by evaluating gains in expected utility, taking into account the related investments, benefits and costs. If this expected utility is positive and higher than the alternative options, this market will be selected by a farmer and it is assumed that given farmer i in planning, considering exclusive alternatives that constituted the choice set i^{th} dairy marketing outlet, the choice set may differ according to the decision maker. Consider the i^{th} farm household ($I = 1, 2\ldots..$ N), facing a decision problem on whether to choose available market outlets, let is dairy market outlet and represent the benefits to the farmer who chooses wholesalers, and let U_k represent the benefit of farmer to choose the Kth market outlet: where K denotes choice of wholesalers (y_1), retailers (y_2), consumers (y_3), Dairy cooperative (y_4) and rural collectors (y_5).

$$y^*_{ik} = U^*_k - U_0 > 0 \qquad (2)$$

(y^*_{ik}) the net utility which is unobserved that farmer derives from choosing a market outlet is determined

by observed explanatory variable (X_i) and the error term (ε_i).

$$y^*_{ik} = x'_i \beta_{ki} + \epsilon_i$$
$$k = y, y_2, y_3 y_4 \wedge y_5 \quad (3)$$

Whilst it is not possible to directly observe the utilities, the choice made by the farmer revealed which marketing outlet provides the greater utility (Greene, 2012). Hence, the utility was decomposed into deterministic (V_{ij}) and random (ε_{ij}). The unobserved preferences in equation (1) translate into the observed binary outcome equation.

$$\text{Yik } \{1 \textit{ if } y_{ik} > 0 \; 0 \text{ otherwise}$$
$$k = y_1, y_2, y_3, y_4 \wedge y_5 \quad (4)$$

Where: y_1 – wholesaler, y_2 – retailer, y_3 – consumer, y_4 – dairy cooperative and y_5 – rural collector.

In the multivariate model, where the choice of several market outlets is possible, the error terms jointly follow a multivariate normal distribution (MVN) with zero conditional mean and variance normalized to unity (for identification of the parameters) where the symmetric covariance matrix is given by ($\mu_{y1,}$ $\mu_{y2,}$ $\mu_{y3,}$ μ_{y4}, $\mu_{y5)}$ MVN ~ (0, Ω) and the symmetric covariance matrix is given Ω by

$$\Omega = \begin{bmatrix} 1 & \rho y1y2 & \rho y1y3 & \rho y1y4 & \rho y1y5 \\ \rho y2y1 & 1 & \rho y2y3 & \rho y2y4 & \rho y2y5 \\ \rho y3y1 & \rho y3y2 & 1 & \rho y3y4 & \rho y3y5 \\ \rho y4y1 & \rho y4y2 & \rho y4y3 & 1 & \rho y4y5 \\ \rho y5y1 & \rho y5y2 & \rho y5y3 & \rho y5y4 & 1 \end{bmatrix} \quad (5)$$

Of particular interest are off-diagonal elements in the covariance matrix, which represent the unobserved correlation between the stochastic components of the different types of outlets. This assumption means that equation (4) generates an MVP model that jointly represents the decision to choose a particular market outlet. This specification with non-zero off-diagonal elements allows for correlation across error terms of several latent equations, which represents unobserved characteristics that affect the choice of alternative outlets.

RESULTS AND DISCUSSIONS

Data

Out of 123 dairy farmers interviewed about 56% were male headed and the remaining 44% were female headed. The overall mean family size of households was found to be 6 family members per household. The mean years of education level of the household was 4 years. The average distance in kilometres between dairy farmers' residential location and nearest market centre was 11 km on average. The mean incomes from non-dairy sources for butter market participants were 1482 USD. and average income from dairy sources for milk market participants were 995 USD. The estimated total milk and butter production by sample household was 258,098 litres and 4,672 kilograms respectively. The marketed surplus of milk and butter by household was 161,204

Table 2. Socio-economic and institutional characteristics of producers

Variables	Mean	SD		
Family size (number)	6	3.3		
Age(year)	45.33	11		
Distance from market (Kilometre)	11	10.6		
Non-dairy income (USD)	1 240	1 413		
Numbers of milking cows (number)	3	2		
Education level (year)	4	1.5		
Volume milk produced (Litre)	6	4.26		
Income from dairy (USD)	446	280		
Variables	Yes	No		Overall %
Access to extension contact	70	30		100
Access to credit	63.4	36.6		100
Access to market information	66.67	33.33		100
Membership of dairy cooperative	54	46		100
Breed type	Exotic	Local	Both	
	15	60	25	100
Sex	Male	Female		
	56	44		

Source: own survey result, 2020.

litres and 3,956 kilograms, respectively. The survey results show the average milk produced by a sample household was 6 litres on average. The mean of milking cows owned by the household was 4 cows. The survey result shows that 70% of the households had access to extension contact and 63.4% of sample households had access to credit. The survey shows that about 66.67% of the sample household had access to market information. The result of the findings show that about 54% of the sample households were members of a dairy cooperative. The survey result found that about 60% of households owned locally bred milking cows, 25% own both exotic and local breed milking cows and 15% own exotic breeds.

Milk market channel

Market channel choice is linked to the theory of utility maximization. The theory assumes that producers are rational and attempt to choose marketing channels that maximize their utility. The major marketing outlets were identified and characterized by many intermediaries along the chain (Table 3). A large number of milk farmers choose direct wholesaler, followed by dairy cooperative, district retailer, rural collector and direct consumer marketing channels respectively. Of the total volume of milk supplied by sample households, about 34%, 26.6%, 18%, 11.2% and 9.7% were sold to wholesalers, followed by dairy cooperative, district retailer, rural collector and direct consumer marketing channels, respectively. The large number of milk farmers choose direct wholesaler, followed by dairy cooperative, district retailer, rural collector and direct consumer marketing channels respectively. Of the total volume of milk supplied by sample households, about 34%, 26.6%, 18%, 11.2% and 9.7% were sold to wholesalers, followed by dairy cooperative, district retailer, rural collector and direct consumer marketing channels, respectively.

Econometric model result

Determinants of dairy producers' market outlets choice

The model fits the data reasonably well. The Wald test (70) = 139.73, p = 0.00) was statistically significant at the 1% level, which indicates that the subset of coefficients of the model are jointly significant and that the explanatory power of the factors included in the model is satisfactory. Furthermore, the results of the likelihood ratio test in the model (LR χ^2 (10) 56.039, P > χ^2 = 0.00*** is statistically significant at 1% level, indicating that the independence of the disturbance terms (independence of multiple market outlets) is rejected and there are significant joint correlations of the several estimated coefficients across the equations in the models. The likelihood ratio test of the null hypothesis of independency between the market channel decision (ρ_{21} = ρ_{31} = ρ_{41} = ρ_{51} = ρ_{32} = ρ_{42} = ρ_{52} = ρ_{43} = ρ_{53} = rho_{54} = 0) is significant at 1%. Therefore, the null hypothesis that all the ρ (Rho) values are jointly equal to 0 is rejected, indicating the goodness-of-fit of the model. Hence, there are differences in market outlet selection behaviour among farmers, which are reflected in the likelihood ratio statistics. The ρ_{21} is the correlation between the choice of district retailer and wholesaler outlet) and ρ_{41} (correlation between the choice of rural collector and district

Table 3. Proportion of milk supplied to each milk market channel

Market channel	Total (N)	Supply of milk in litres		
		Total	Mean	SD (Standard deviation)
District retailer	26	29 435	1 811	1 915
Wholesalers	42	55 099	1 839	1 841
Consumer	35	15 725	233	1 680
Dairy cooperative	48	42 977	2 249	1 911
Rural collectors	37	18 893	1 832	1 976
		161 204	1 554	1554

Source: survey result, 2020.

retailer outlet) and statistically significant at the 1% probability level, indicating a competitive relationship of collector outlet with retailer outlet and consumer outlet while ρ_{32} correlation between choice of consumer and consumer outlet) are positive and statistically significant at 1% level of significance indicating complementarity relationships between wholesaler and consumer outlet. ρ_{43} (correlation between the choice of rural collector and consumer outlet) is significant at less than 10% probability level (Table 4).

Table 4. Multivariate probit results (Coefficients and Std. Err.) of market channel choices

Variables	Wholesaler	Consumer	Dairy Cooperative	District Retailer	Rural collector
	Cofe (SE)	Cofe (SE)	Cofe (SE)	Cofe (SE)	Cofe (SE)
Constant	2.61 (1.120)	–3.10 (1.34)	0.756 (1.45)	3.0** (1.5)	–2.4 (1.02)
Distance from nearest market	0.01 (0.019)	0. 034 (0.18)	0.022 (0.02)	0.03 (0.02)	0.02 (0.018
Sex of household	0.43 (0.34)	–0.18 (0.29)	–0.07 (0.29)	0.64** (0.3)	0.49* (0.3)
Family size of household	0.03 (0.05)	0.08* (0.05)	0.01 (0.04)	0.04 (0.05)	–0.03 (0.05)
Age of households	–0.01 (0.014)	0.016 (0.01)	–0.01 (0.013)	–0.05 (0.01)	0.02 (0.02)
Education level household	1.32** (0.48)	0.64 (0.37)	–0.05 (0.351)	0.13 (0.37)	0.68* (0.4)
Membership of dairy cooperative	0.43 (0.445)	1.24*** (0.42)	1.2*** (0.44)	1.4** (0.48)	–0.64 (0.44)
Number of milking cow	0.01 (0.228)	0.34 (0.204)	0.39*** (0.1)	–0.02 (0.129)	0.09 (0.14)
Access to extension contact	–0.43 (0.4)	–0.35 (0.382)	–0.25 (0.2)	–0.35 (0.38)	–0.74* (0.4)
Access to credit	–0.33 (0.395)	–0.12 (0.357)	–0.01 (0.01)	0.28 (0.365)	0.41 (0.39)
Market information	0.72** (0.37)	0.77** (0.32)	0.092 (0.04)	0.53 (0.33)	0.16 (0.33)
Types of breeds used	0.346 (0.24)	0.34 (0.2)	–0.256 (0.2)	–0.4** (0.22)	0.18 (0.2)
Income from dairy	0.10** (0.03)	0.04*** (0.02)	–0.04 (0.01)	0.02* (0.013)	0.04 (0.02)
Milk output	0.09 (0.04)	–0.08 (0.19)	0.09 (0.036)	0.033 (0.04	0.098 (0.22)
Non-dairy income	–0.23 (0.19)	0.04** (0.2)	0.09** (0.04)	0.13 (0.21)	–0.1** (0.04)
Predicted probability	42.63%	43.77%	50.73%	31.78%	41.45%
r_{21}		0.31* (0.17)			
r_{31}		0.26 (0.16)			
ρ_{41}		0.73*** (0.12)			
ρ_{51}		0.23 (0.15)			
r_{32}		0.72*** (0.12)			
ρ_{42}		0.05 (0.18)			
ρ_{52}		–0.05 (0.175)			
ρ_{43}		0.267* (0.16)			
ρ_{53}		–0.2 (0.156)			
ρ_{54}		0.26 (0.1)			
Wald chi2 (70)		139.73			
Log Likelihood		273.33			
Joint probability (success) =7.23%, Joint probability (failure) =15.18%					

Likelihood ratio test of: $r_{21} = r_{31} = \rho_{41} = \rho_{51} = r_{32} = \rho_{42} = \rho_{52} = \rho_{43} = \rho_{53} = \rho_{54} = 0$: c^2 (10) = 56.04*** Prob > chi2 = 0.0000. ***, ** and * means statistically significant at 1%, 5%, and 10%, respectively.
Source: model output of survey, 2020.

Milk producers use different rural channels or substitute one channel over other outlets in Ada'a Berga district. The simulation results indicate that the probability that milk producers' chose a wholesaler, district retailer, consumer, rural collector and dairy cooperative market outlet were 42.63, 31.78%, 43.77%, 41.45%, and 50.73%, respectively. The joint probabilities of success and failure of the five variables also suggest that it would be unlikely for households to choose all five market outlets simultaneously, for their likelihood to do so was only 7.23%. As depicted in (Table 4), out of 14 explanatory variables included in multivariate probit model, three variables significantly affected wholesaler market outlet; five variables significantly affected district retailer outlet; six variables significantly affected consumer outlet; three variables significantly affected dairy cooperative and four variables affected collector outlet choices at 1%, 5% and 10% probability levels.

The MVP model results showed that most of the explanatory variables included in the econometric model had a significant effect on choosing at least one market channel. The sex of the household was significantly associated with the use of a district retailer and rural collector outlet at 5% and 1% significance level, respectively. The male headed producers were more likely to deliver milk to collector and district retailer outlets than female headed households. This implies that male farmers had a higher chance to sell milk to different market outlets. This finding is supported by Ayyano et al. (2020); Girma and Abebaw (2012), who reported that male headed producers are less likely to deliver milk to the collector outlet than female headed household. Income from non-dairy sources affected the choice of dairy cooperative, consumers and rural collector. Income from non-dairy enables producers to cope with different risks in production and assess the best channel. This is supported by Zegeyesh et al. (2017); Abebe et al. (2018).

Income from dairy sources affects producers' decisions to choose district retailers, wholesalers and consumers' milk market outlets. This dairy income motivates dairy producers to intensify production and choose the best channel that maximizes higher income. This result agrees with the finding of Ayyano et al. (2020). Type of breed used negatively and significantly affected access to the district retailer's milk market outlets. This is probably because most farmers own local breeds with low yields as a result of the farmers' choice regarding the spot market outlet rather than the distance channel. This finding is supported by Ketema et al. (2016), namely, that ownership of exotic livestock breeds influenced the choice to sell milk to wholesalers. Access to market information positively and significantly affected wholesalers and consumer milk market outlets. Access to market information enables farmers to choose the best alternative outlet. This is supported by Tarekegn et al. (2017), and Bezabih et al. (2015). Access to dairy extension services significantly affected access to rural collector milk market outlets. Access to extension services is expected to increase the ability of farmers to acquire relevant market price information and improve linkage with input and output markets. This finding is similar to Tegegn (2013).

The number of milking cows affected access to dairy cooperative milk market outlets, and this was at 5% significance level. This is because the number of milking cows can directly increase the marketable supply of milk and as milk production increases, farmers' capability to supply increases to more than one channel's milk outlet. This is in line with the finding of Ayyano et al. (2020) who stated that as the number of milk animals' increases, the probability of selling milk to market channels increases whilst all other factors held constant. Membership of the cooperative positively and significantly affected access to a dairy cooperative, consumers and district retailer outlets at 1%, 1% and 5% significance level. Being a member of a dairy cooperative contributes towards reduced transaction costs and strengthens farmers' bargaining power, compared to non-members. The findings were consistent with those of Kuma et al. (2013), who stated that the probability of accessing cooperative milk outlets increases with group membership, compared to accessing the market as an individual farmer.

Family size is significantly associated with selling milk to consumers at 10% significance level. This result shows that households with large family sizes are more likely to choose a consumer outlet. This is because a large household size implies the availability of cheaper labour, which can increase the possibility of producing marketable surplus, which in turn increases the choice of market channel to earn higher income. This finding agrees with Ozkan et al. (2022). The education level of households has a positive association on choosing wholesaler and rural collector outlets at 5% and 10% significant level, respectively. The positive association between wholesaler and education was due to the fact that education enhances the capability

of farmers in making decisions regarding the choice of marketing outlet. The findings are consistent with those of Berhanu and Moti (2012) who concluded that education enhances managerial competencies and successful implementation of improved production, marketing and processing activities. In contrast, there is a positive relationship between education level and selling to rural collector outlets because educated household heads are busy with other responsibilities like meeting, training and other office related work Zegeyesh et al. (2017).

CONCLUSIONS AND RECOMMENDATIONS

The Ethiopia agricultural transformation agenda is empowering smallholder farmers to create viable livelihoods from agriculture and enhancing their access to markets. However, poor rural farmers are always challenged to deliver milk to the final market faster and are excluded from international markets. The objective of this study was to identify determinants of farmers' choosing a milk market outlet. The study used primary data obtained from a survey conducted on 123 randomly selected households. The data were analysed using a multivariate probit. The result of the model revealed that income from dairy source, market information and educational level of household positively and significantly affected wholesaler outlet. The choice of consumer outlet is influenced by family size of household, membership of a dairy cooperative, market information, non-dairy income and income from dairy sources. Number of milking cows, membership in a dairy cooperative and non-dairy income significantly determined the choice of dairy cooperative outlet. The choice of district retailer's market outlet is positively and significantly affected by sex of households, membership of dairy cooperative and income from dairy sources. Type of breed used negatively and significantly affects district retailers' market outlets. The choice of rural collector outlet is negatively influenced by non-dairy income, access to extension contact and positively affected education level household and sex of households. Farmers' membership of a dairy cooperative increases the probability of them choosing appropriate market outlets. Therefore, policies should be designed that encourage farmers' cooperatives, increase milk production per cows and improve the breed of milking cows. The result of the study indicates that extension service and market information have a great role in increasing the choice of suitable market channels. Therefore, an intervention should be promoted that creates market information for dairy production extension services and provides adequate information on the selection of market outlet. Farmers must engage in non-dairy income generating activities which could enable them to produce more, thereby selecting market channels they need. Furthermore, access to markets and road facilities would promote the effective marketing of milk through all outlets.

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THE ECONOMIC IMPACT OF THE MAHATMA GANDHI NATIONAL RURAL EMPLOYMENT GUARANTEE ACT: A CASE STUDY OF THE BAJJU SUB-DIVISION OF BIKANER DISTRICT IN RAJASTHAN

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Abstract. The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is a program for poverty alleviation and an employment generation which provides employment to rural unskilled labourers. It can provide a guarantee of 100 days' paid employment in a financial year to a rural unskilled labourer who demands it. The program also helps to reduce hunger in rural India. It is different from earlier wage employment programs because it provides a guarantee for work, whereas earlier programs had no such provisions. This paper analyses the employment, consumption and income effects of MGNREGA, including the resulting increase in the purchasing power of rural labourers, after its introduction in the rural area. It also examines the economic and social impact of the scheme in rural areas due to asset creation as result of employment provided by MGNREGA. Lastly, the paper examines the impact of MGNREGA on women's employment and how MGNREGA changed women's income, employment and consumption patterns, which can be argued to be indicative of female empowerment. This study concludes that MGNREGA brought positive change to the lives of people in the rural area that was examined. MGNREGA, a landmark in the history of social security legislation in India or indeed anywhere in the world, promises to be a major tool in the struggle for securing employment guarantees in rural areas. The 100-day employment scheme, which came as a bolt from the blue, raised the living standards of rural India in terms of income, employment and consumption. Overall, the study found that MGNREGA has significantly improved the social and economic well-being of its beneficiaries in rural India.

Keywords: Mahatma Gandhi National Rural Employment Act, rural development, rural asset creation, employment guarantee, women employment, women empowerment

INTRODUCTION

India has the second largest population in the world. According to the census of 2011 more than 60% of India's population lives in rural areas and they are dependent on agriculture and allied economic activities. Most of them do not earn enough money to cover the basic necessities. They face problems due to a lack of available jobs or employment in rural areas, which can lead to a vicious circle of poverty and debt. One positive intervention that can be undertaken by the State is the provision of employment for people in rural areas targeted at the creation of some durable assets. Over time, the government of India has started many poverty and hunger alleviation programs like TRYSEM, Jawahar Gram Samridhi Yojana, Jawahar Rojgar Yojana and kaam Ke Badle Anaj Yojana, etc., but they have had limited success because they have never provided guaranteed employment in rural areas, and so have not adequately addressed the problem. The GOI started MGNREGA in 2005 to provide employment for rural people by establishing a right for unskilled labourers to work for 100 days. MGNREGA

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has three main aims: to reduce hunger, to reduce poverty and to provide employment in rural areas. It also seeks to create durable assets in rural areas to improve the well-being and economic condition of rural people.

MGNREGA provides at least 100 days of unskilled manual work to every household member in rural areas in a financial year. It provides wage employment within 5 km of a worker's residence and pay according to the Minimum Wage Act 1948. If work is not provided within 15 days of someone's application he/she is entitled to unemployment allowance according to the provisions of this act. Thus, the act provides rural people with a legal entitlement to a wage for a minimum of 100 days, with or without work.

Statement of the problem

NREGA was enacted in 2005 and renamed in October 2009 on the anniversary of the birth of Mahatma Gandhi as MGNREGA. It is the biggest policy action of the Indian government on rural employment and poverty alleviation post-independence. MGNREGA provides at least 100 days of unskilled manual work to every household member in rural areas in a financial year. It provides wage employment within 5 km of a worker's residence and pay according to the Minimum Wage Act 1948. If work is not provided within 15 days of someone's application he/she is entitled to unemployment allowance according to the provisions of this act. Thus, the act provides rural people with a legal entitlement to a wage for a minimum of 100 days, with or without work.

Original provision of MGNREGA

i. At least one adult member of every rural household is entitled to guaranteed employment for 100 days in the form of manual work.
ii. Productive work shall be considered under this program and a list of preferred work and permissible work shall be prepared by the state council. The identification of work shall be based on the economic and social needs of rural areas, its impact on rural livelihoods, and its contribution to the creation of durable assets in rural areas.
iii. The aim of this program is to provide and upgrade skills for rural unskilled workers.
iv. Wages shall be provided in cash, in kind or both, as the state council deems fit.
v. Wage employment shall be provided within 5 km of an applicant's residence, and if it is not provided within the said distance, he/she shall be entitled to a daily allowance and travel allowance according to the rules of the act.
vi. If 20 or more female workers are employed there shall be provision of crèches and one female worker shall be deputized for the care of children below six years of age. She shall receive a full wage according to the rules of the act.
vii. A portion of 5% of the wage may be deducted for contributions to social security schemes such as health insurance, accident insurance, maternity benefits and survivor benefits (National Rural Employment Guarantee Act, 2005). MGNREGA is the largest social security and employment program in the world. The government of India has had many poverty alleviation programs and many of them have succeeded, but problems remain. However, at present the government is struggling to reduce poverty and provide paid employment to rural people.

MGNREGA is a combination of many schemes and policies such as Sampoorna Grameen RojgarYojana, the Food for Work program, Jawahar Rojgar Yojana, Right to Work, etc. This act also reserves one third of employment for women and provides equal wages for equal work in equal conditions, thus bringing equal opportunities for women in rural areas and equality in the rural society. MGNREGA is a fully Central Government-sponsored scheme which is implemented by the State Government and Gram Panchayats (GPs). Gram Panchayats are the main implementing authority of MGNREGA and the involvement of middle men and contractors is forbidden. GPs work as a safeguard to promote MGNREGA's effective management and its implementation. MGNREGA provides an alternative opportunity and source of income in rural areas with an impact on poverty. MGNREGA increases the purchasing power of beneficiaries and helps to increase their expenditure. It improves village economies through the creation of durable assets in rural areas such as road connectivity, water and soil conservation, and the cleaning of traditional water tanks. For these reasons, MGNREGA has been considered one of largest poverty alleviation programs in the world. However, the success of MGNREGA depends upon effective and proper implementation.

There are eight types of works listed in NREGA: (i) Water conservation and harvesting. (ii) Drought proofing and afforestation. (iii) Irrigation canal. (iv) Special

provision to provide land irrigation facilities to Scheduled Caste (SC), Scheduled Tribe (ST). (v) Renovation and construction of traditional water tanks and bodies. (vi) Land development work. (vii) Flood control work. (viii) Rural connectivity for all-weather access. MGNREGA is intended to promote economic growth and development. This study examines the implementation procedures of MGNREGA and its economic impact on rural areas and households.

Objectives and research questions

MGNREGA is one of the largest centrally sponsored poverty alleviation schemes in India. This scheme has successfully increased income and expenditures, self-targeting, economic security, asset creation and women's empowerment. How all these components are impacted by MGNREGA is the central theme of this study. The objective of the study is to determine the impact of MGNREGA on the socio-economic and rural condition of people. It aims to investigate: (a) the creation of durable assets and infrastructure in rural areas through MGNREGA; (b) the impact of MGNREGA wages on the income and expenditure of MGNREGA beneficiaries; and (c) how MGNREGA can be linked to the empowerment of women in rural areas in terms of employment, income and consumption.

Drawing its data from a primary survey, this paper examines MGNREGA through the following research questions: (a) whether rural people are aware about MGNREGA work, (b) whether this act is appropriately implemented, (c) whether this scheme provides 100 days of guaranteed wage employment to eligible household of rural area, and (d) whether it is successful in improving the purchasing power and expenditure levels of rural households.

Data source and research methodology

The field survey was carried out in the Bajju Sub-Division of Bikaner District in Rajasthan between March 2017 and February 2018. As per the census of 2011, the area and population of Bajju are 4,350 Sq/Km and 2.3 Lakh respectively. The Sub-Division is bound by Ganganagar District in north, Jaisalmer District in south, Kolayat Sub-Division on the East and the international border with Pakistan in the west. The population is not homogeneous and consists of Hindus, Muslims, Sikhs and 'Pak Visthapith' (migrated from Pakistan).

(a) **Study area:** The primary survey was carried out in the selected Gram Panchayat (GPs) of Bajju Sub-Division of Bikaner District in Rajasthan. Bikaner District is administratively divided into 9 sub-divisions. There are 22 Gram Panchayats in Bajju sub-division.

(b) **Study population:** the population for the study was aged 18 to 59 and resided the in selected Gram Panchayat. Only beneficiaries of this act were included.

(c) **Sample size and sampling:** A total of 125 people of working age group were surveyed for this study, including both male and female workers. Beneficiaries of the scheme include marginal farmers and landless labourers. Most of the people working in the MGNREGA program are either illiterate or less educated. They work in MGNREGA to support their families. The average family size of these workers is five members. Five Gram Panchayats (GPs) were selected at random from 28 GPs with a sizeable rural population.

There are 22 Gram Panchayats (GPs) in the Bajju Sub-Division of Bikaner District. Out of 28 GPs, five (a sample of 17 %) were selected as the area for the

Fig. 1. Geographical area of Bajju Sub-Division
Source: State Remote Sensing Application Centre, Department of Science and Technology, Jodhpur.

Table 1. Selected Gram Panchayats

Gram Panchayat selected	No of willage selected and nature of work	No of women workers selected	Total no of workers selected
Bangarsar	2 Road Construction	10	25
Beekampur	2 Renovation of traditional Water Tank	10	25
Gajjewala	2 Road Construction and Community Infrastructures	10	25
Barsalpur	2 Tree Plantation and Road Construction	10	25
Gokal	2 Irrigation and Water Supply	10	25
Total number of Workers selected From 5 Gram Panchayats		Sample size N = 125	

Source: compiled from field survey.

survey. In selecting the sample of GPs, area, demography, location and specific features were kept in mind to ensure that all the GPs were fairly represented. Primary data were collected through questionnaires and secondary data were derived from various Government Reports, Research Papers and Studies. Systematic statistical methods, i.e. simple average, were used to analyze data so that certain relationships could be derived.

LITERATURE REVIEW

MGNREGA was enacted in 2005 (as NREGA) to provide guaranteed employment in the rural sector. Many studies have been conducted by Non-Government Organizations and researchers, as well as by the government, on the performance of MGNREGA.

Dey et al. (2006) concluded that NREGA is a totally unique scheme targeting the reduction of hunger and poverty alleviation. It is totally different from employment schemes like TRYSEM, the employment insurance scheme and Jawahar Rojgar Yojana (JRY) because none of these provided the guarantee of employment that MGNREGA provides.

Bhatia and Dreze (2006) conducted a survey in two districts of Jharkhand in order to examine how the scheme was being implemented. They highlighted that there were serious flaws in its implementation, which were assigned as problems associated with starting a new scheme. However, they insisted that the scheme has, at least in its initial phase, acted as a beacon of hope for the rural poor and is therefore necessary. They cited the example of Rajasthan, and stated that as the experience in Rajasthan shows, there is scope for better implementation.

Chakraborty (2007) presents a budgetary appraisal of NREGA. The study observed that the existing institutional arrangement in poorer states in not good enough to implement NREGA in an effective manner. The paper suggests that the devolution of responsibilities and strict

Table 2. Employment generated during the year 2022–2023 in Rajasthan District Bikaner Block/ Sub-division Bajju

Panchayat	No of Registered workers		Employment Demanded		Employment Offered		Employment Provided		
	Household	Persons	Household	Persons	Household	Persons	Household	Persons	Total Person days
Bangarsar	1 552	3 273	829	1 303	829	1 303	692	1 052	20 663
Beekampur	770	1 635	415	746	415	746	330	574	13 914
Barsalpur	957	1 845	459	811	459	811	387	689	20 413
Gajjewala	1 033	1 957	358	572	357	571	285	438	8 077
Gokul	1 313	2 434	935	1 651	935	1 651	829	1 444	38 547

Source: Department of Rural Development, Ministry of Rural Development, Government of India. Accessible at: https://mnregaweb2.nic.in/Netnrega/citizen_html/demregister.aspx?lflag=eng&state_code=27&state_name=RAJASTHAN&district_code=2703&dcode=2703&page=B&Block_code=2703009&Block_name=BAJJU+KHALSA&district_name=BIKANER&fin_year=2022-2023&Digest=iVneR20vTf5uaLshKiQqlA

accountability norms would accelerate capacity building at the level of the panchayat and that the scheme can effectively function as a demand-driven one.

The Institute of Applied Manpower Research (IAMR) (2007) conducted a survey of 20 districts to evaluate MGNREGA. This study generated important findings, such as that about 86% of households reported that MGNREGA was the only Government scheme from which they had benefitted. It also highlighted the importance of job cards in successfully applying for work under the scheme. Since the gram sabha managed this process, many migrants were excluded from this scheme because they didn't have job cards.

A study on MGNREGA by Pankaj (2008) examined the impact of this act in Bihar and Jharkhand. It concluded that irrigation, water conservation and harvesting and rural connectivity were examples of major work undertaken in Jharkhand and Bihar states through this scheme. This study concluded that MGNREGA significantly contribute to the creation of rural assets and infrastructure in these states due to the nature of the work undertaken under MGNREGA.

Khera (2008) studied NREGA in Pati block in Orissa state and concluded that its implementation increased the ability of residents to claim their rights. This is due to high engagement with this scheme and effective planning, implementation and monitoring. One immediate aim of MGNREGA is to provide social security to poor people by providing them with employment, but it is also expected that this scheme contributes to empowering women, activating Gram Sabhas and developing rural areas. MGNREGA contributes to village development as well as changing the balance of power in villages.

Mathur (2008) stated that if MGNREGA is implemented honestly, it could act as a big agent of socio-economic up-lift by providing employment and secure livelihoods to the poorest of the poor in rural India.

Joshi and Singh (2008) evaluate MGNREGA in Rajasthan. They observe that outmigration from the state of Rajasthan has decreased, although it has not entirely stopped. The scheme's benefits in the state included causing an increase in the purchasing power of households, leading to a reduction in debt (albeit a marginal one), increasing agricultural production and thereby farm income.

Rao's (2008) work calls MGNREGA a "lifeline for the vulnerable sections", and argues that the significance of the scheme lies in the multiple levels on which it operates. It creates a social safety net for the vulnerable by providing a fallback source of employment when jobs are scarce or inadequate. It adds a dimension of equality to the process of growth. It creates a rights-based framework for wage employment programs by conferring legal entitlements and the right to demand employment among workers and makes the government accountable for providing employment in a time-bound manner. By prioritizing natural resource management and emphasising the creation of durable assets, it holds the potential to become a growth engine for the sustainable development of an agriculture-based economy. Although not confined to BPL families, the scheme can be accessed by all vulnerable and marginal households.

Chandrasekhar and Ghosh (2009) concluded that MGNREGA is a scheme of social inclusion as there is a high participation rate of SC/ST: 52% (2009–10) and one third of the work is reserved for women. Dey and Bedi (2010) studied the implementation and performance of NREGS between 2006 and 2009 in Birbhum District, West Bengal. Their study concludes that more jobs should be provided under this scheme to make this an effective 'employer of last resort'. It reports that there is universal awareness about the NREGA and job cards are available for those who have applied in the selected area. It also states that NREGA-related information is well-maintained and accessible. There were long delays in wage payments noted in the first year of this programm which were later reduced to a maximum delay of 20 days.

Dasgupta and Sudarshan (2011), with the help of data from the 2004–05 NSSO survey and NREGA official sites, concluded that: (i) women's participation has increased through NREGA; (ii) state-wise women's participation in the program is also increasing and is positively correlated with women's participation in MGNREGA from all recoded work schemes; (iii) women's participation in MGNREGA is negatively correlated with their participation in other agricultural labour market. This implies that there is a wage gap with other agricultural labour market, where women face discrimination, thus women are attracted toward MGNREGA work rather than the private agricultural labour market. MGNREGA gives bargaining power to women and this act brings equality in the rural labour market in terms of wages, reducing gender disparities in the rural labour market.

Chaurashia (2011) stated that MGNREGA empowered women. It changed the direction and position of women within society, and led women to find

employment beyond domestic work. It has the potential to empower women by providing equal opportunities for paid work, and since one third of all work is reserved only for women, it promotes gender equality in society.

Basu (2011) examined the impact of MGNERGA on seasonal employment in rural areas. This study concluded that MGNREGA impacts the rural agrarian economy by targeting involuntary unemployment and provides employment to disguised unemployed people.

This study also asserted that there had been an impact of MGNREGA on agricultural wages and that it had played a major role in wage hikes in rural areas.

Das (2012) discusses the impact of MGNREGA on women's work participation. He explains that there are various factors which encourage women's participation in the labour force, such as the nature of the work, the minimum skills required, the working hours, the availability of work locally, a reduction in the migration of male family members, and a substantial increase in wage rates. The participation of women varies across the country, with states like Kerela (90.26), Pondicherry (80.36), Tamil Nadu (76.78) and Rajasthan (68.06) registering the highest participation in 2010–11. On the other hand, Bihar, Punjab, Bengal and most of the north-eastern states show less participation of women. In spite of this, the participation of women at the national level has increased significantly from 46.41% in 2010–11 to 48.81% in 2011–12, which exceeded the stipulated 33% share of women's participation in the scheme.

Pant and Mishra (2014) stated that MGNREGA helps to promote transparency, accountability and the participation of local organizations because it mandates the monthly updating of accounts. Public vigilance and social audits are two main accountability and transparency keys to its implementation. Social audits are mandatory in MGNREGA. The Ministry of Rural Development (MRD), in a report of 2006–07, concluded that 54% of the work was in the area of water conservation followed by 10% providing irrigation for land owned by SC, STs and other beneficiaries, 11% for land development, 21% for rural connectivity and 4% for other work. An annual report of MRD from 2008–09 stated that out of the total funds allocated to MGNREGA, 67% was given to workers in the form of wages. The program had a high rate of participation from different groups, like 54% for SC/STs and 48% for female workers. Moreover, this program strengthened rural natural wages, of which 15% were for land development, 46% for water conservation, 20% for irrigation work and 18% for rural connectivity and 1% for others.

Sharma (2014), in her work "Rural Development Scheme through the years", concludes that sustainable development interventions in rural areas largely depend on successful and effective implementation. She points out there is a need for convergence of all development interventions at the grassroots level so as to enhance the necessary infrastructure in backward regions, ensure capacity building and upgrade skills.

Dev (2015), in his work "Rural Employment – Women on the Move", states that in various states like Madhya Pradesh, Tripura and Jharkhand, field evidence suggests that MGNREGA is providing more and better job opportunities to female workers, which has resulted in higher workforce participation of women.

Sabanna (2016), in his work "Women Empowerment through MGNREGA in Karnataka", points out that the centrality of women has been marked in almost all policies since the 11th Five-year Plan. The plan recognises explicitly that women are not just equal citizens but agents of economic and social growth. According to the United Nations Report (2013), the MGNREGA in India and the Expanded Public Works Programme (EPWP) in South Africa are examples of important safety nets for women.

This review of the literature shows that the existing scholarship has addressed the impact of MGNREGA on rural-urban migration, appraisals of the MGNREGA program, women's empowerment through MGNREGA in various states and districts of the country, MGNREGA and its impact on rural wages, the evaluation of MGNREGA in Rajasthan, and capital formation through MGNREGA. It seems that limited work has been done on the impact of MGNREGA on households which have benefitted from it in Bajju sub-division in particular. This study will try to bridge this gap, or rather, contribute towards the understanding of MGNREGA as a platform which generates multi-dimensional impacts on the socio-economic parameters of households, and by extension on society.

Observation based analysis and discussion

As already mentioned, this paper is based on both primary observation and secondary data. Based on the data collected from worksites for primary observation, an 'Observation schedule' was prepared and the responses of MGNREGA workers were recorded. The

Table 3. Responses obtained from MGNREGA beneficiaries (%)

Question/Variables	Yes	No
Are you aware about MGNREGA scheme of the Government?	78	22
Do you have job card?	100	0
Did you face any problems in getting the job card?	0	100
Do you have an account in bank/post office relating to MGNREGA?	100	0
Are you involved in MGNREGA planning?	75	25
How much wages do you get under the MGNREGA scheme?	Rs 199	
Did you get work against demand?	81	19
If yes, after how much days of written/verbal application did you get work?	Within 15 days	
Did you get 100 days of guaranteed wage employment under MGNREGA?	40	60
Do you feel an increase in your income and expenditures due to MGNREGA?	71	29
Has MGNREGA improved the condition of women in your household?	84	16
Has MGNREGA eased the problem of unemployment?	89	11
Do you get the unemployment Allowance?	0	100
Has MGNREGA augmented common infrastructure and assets in your village?	78	22
Does MGNREGA need to improvements?	100	0
Is there delay in receiving wage?	91	11
Facilities of crèches / drinking water?	83	17

Source: compiled from field survey.

respondents were contacted on the worksites of selected villages. 60% of the respondents were men and 40% were women. Their responses and observations are discussed below.

Awareness and implementation

This study revealed that all the respondents knew about the MGNREGA scheme. 78% of respondents had detailed knowledge of MGNREGA. They said that MGNREGA is a social and economic act by which 100 days of wage employment are provided to rural people and that many facilities, like drinking water and crèches, were provided on MGNREGA worksites. On the other hand, 22% of respondents did not have much knowledge of the MGNREGA scheme because of poor literacy. **Workers Involvement:** 75% of village people were involved in MGNREGA planning and had guaranteed employment. On the other hand, 25% of respondents were not involved in MGNREGA planning, thus there is a need for universal participation of village people in MGNREGA planning. **Unemployment Allowance:** if employment is not provided within 15 days of an application, the government must pay unemployment allowance according to the rules of the act, but in selected areas no-one is aware of unemployment allowance and people did not receive it because of a lack of information and awareness. In some areas worksites lack proper facilities, such as drinking water and crèches.

Process and procedure

Job Card Availability: Based on the survey conducted at the worksite, it was found that all respondents have job cards and no one faced any problem getting job cards. Nobody who did not have a job card was interviewed during the survey. **Wages and Works:** All the beneficiaries of MGNREGA said that they get wages at Rs.

235 rupees per day under this act. They reported that when they wanted work they demanded it verbally and not by a written request to Rojgar Sewak. They also said that they got work within fifteen days.

100 Days of Employment: It was found that eligible workers in the selected areas got one hundred days unskilled manual employment at a statutory rate of Rs 235 per day, the minimum wage for MGNREGA in a financial year.

Economic impact

Financial inclusion: It was found that all the eligible workers and respondents had bank or post office accounts related to MGNREGA, thus MGNREGA has acted as an alternative mode of financial inclusion. **Effects on income and expenditure:** MGNREGA has positive impacts on rural households. 71% of workers/respondents reported that their income had increased due to MGNREGA, leading to increases in their purchasing power and expenditure. Their increased income creates demand due to their increased propensity to consume, thereby making MGNREGA a demand-inducing scheme. MGNREGA can therefore be considered as a scheme that promotes economic growth and development in rural areas. The respondents reported that they could fulfill their basic needs and live a normal life due to MGNREGA paid employment. On the other hand, 29% of respondents answered that they could not consider this a major life-changing scheme, because MGNREGA is only partially successful in increasing income, purchasing power and the expenditure of rural households.

MGNREGA Eases Unemployment: MGNREGA has solved the problem of unemployment in rural areas by providing 100 days of guaranteed paid employment to rural households. It is considered to make a substantial contribution in rural areas.

Female empowerment

MGNREGA has improved the condition of rural women and empowered them so that they can live on their own. They can survive more easily and fulfil their basics needs. They have been able to provide a better education for their children due to the equal opportunities available through MGNREGA wage employment. Thus, MGNREGA has created positive change in lives of female workers in rural areas and minimized the gender disparity in the rural labour market.

Creation of assets and infrastructure

During the field survey it was noted (during participant observation) that permanent and temporary durable assets were created in chosen villages, such as soil conservation, tree plantation, the construction and renovation of traditional water tanks, road connectivity and community infrastructure. Rural areas developed due to the creation of these common assets, and it can therefore be concluded that MGNREGA helped in the overall development of rural areas.

Need for improvements

It was found that all respondents desired improvements to this scheme and no-one was fully satisfied with its present structure. It has many drawbacks, such as a lack of transparency and accountability, as well as uneven treatment of people on the basis of social and political realities. Most of the respondents under observation were taking advantage of MGNREGA. It was also found that MGNREGA is a demand-inducing program because it increases its beneficiaries' purchasing power, their quality of life goes up in terms of health improvement and access to good education, and their demand for commodities increases. Thus it can be said that MGNREGA helps the economic development of rural areas. The increasing participation of marginalized sections of society in MGNREGA shows that it can be a tool of inclusive growth if and when it is implemented honestly.

Findings

This study found that MGNREGA has a positive impact on both rural people and rural areas. Many permanent and durable assets are created in the affected villages, such as soil conservation, land development, tree plantation, construction and renovation of traditional water tanks, road connectivity and community infrastructure. MGNREGA not only helps provide guaranteed wage employment to rural people, but it also helps develop Gram Panchayats through the creation of common assets in villages. The MGNREGA program is comparable to a lifeline for the rural poor and marginal farmers, because it helps them to earn additional income in hard times and improve their living standards. MGNREGA supplements their income and consumption levels. The propensity to consume was noted to increase due to the increasing purchasing power of beneficiaries, thereby leading them towards a better standard of living.

This study also found that rural women are empowered through MGNREGA in terms of incomes, employment and consumption and feel equal to men. This act did not discriminate according to gender in terms of wages, which boosts women's confidence. In the field survey, most of the female respondents reported that they are able to fulfil their basic needs and improve living standard using their own wages due to MGNREGA. This act drastically changed the life of female workers in rural areas for the better.

CONCLUSION

This study has looked at various aspect of the MGNREGS program in rural India. After a detailed analysis, MGNREGS was revealed to have had a positive impact on the level of incomes, consumption and employment in rural areas. Rural women are empowered through MGNREGA as it ensures they have employment and are equally paid, giving women a moral boost both socially and economically. Generally, when the income of beneficiaries increased due to MGNREGA paid employment, it had a profound impact on their consumption patterns. Multiplier effects are a well-established fact of economics, and MGNREGA spending clearly has a multiplier effect. The increased incomes of poor households due to MGNREGA further increased their purchasing power, creating demand for several commodities as they move towards higher consumption levels. Productions of these commodities will create further demand for raw materials and workers and so on, thus creating a growth spiral. This study found that most families were spending their additional income on food and the basic necessities of life. This shows that increased income due to MGNREGA is spent largely on improving quality of life and on human development.

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