Agriculture Supply Chain Challenges and Smallholder Maize Farmers' Market Participation Decisions in Tanzania

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Abstract

This paper analyses the supply chain-related challenges affecting smallholder maize farmers' market participation decisions in Tanzania. The research design adopted for this study was cross-sectional in nature. The data was gathered from 633 smallholder maize farmers from six villages in Dodoma, Tanzania, using structured questionnaires, and the results were analysed using a probit model. Findings revealed that all supply chain-related challenges were significantly related to market participation decisions. Specifically, nine supply chain-related challenges were discovered to have a positive relationship with a decision that smallholder maize farmers make on market participation, including transportation facilities, road conditions, market prices, access to market information, quality of maize, access to inputs, storage facilities, household size, and farm size, while two challenges, market distance and transportation costs, were found to have a negative relationship. Based on this, it was concluded that agriculture supply chain challenges affect market participation decisions of smallholder maize farmers in Tanzania. Therefore, agriculture supply chain-related challenges need to be controlled to enhance the market participation of smallholder maize farmers for them to realise the participation benefits.

Keywords: Agriculture supply chain, smallholder farmers, supply chain challenges, maize farmers, market participation

Introduction

For decades, researchers have been concerned about the market participation of smallholder farmers both within and outside the African continent (Alene *et al.,* 2008; Ismail *et al.,* 2015; Osmani & Hossain, 2015). Literature also identifies a variety of factors that influence smallholder farmers' market participation, the majority of which can be classified as environmental or farmer-specific (Andaregie *et al.,* 2021; Ismail, 2022; Megerssa *et al.,* 2020b). These factors are considered to be important for smallholder farmers as, through market participation, smallholder farmers enhance household food security (Manda *et al.,* 2020). Participation in the market also makes it possible for smallholder farmers to obtain sums of money, which helps them maintain their living standards. In this regard, it is critical to establish solutions to market participation challenges that smallholder farmers face. Like in many developing countries, the crop production of Tanzania is generally contributed mainly by smallholder farmers (Kissoly *et al.,* 2020; Mchopa *et al.,* 2020; Zorya & Mahdi, 2009). Furthermore, these smallholder farmers are not immune to the challenges of market participation.

Maize, like other farm produce, is grown as a food crop in various parts of Africa, including Tanzania (Abdulai *et al.,* 2018; Ismail & Changalima, 2019; Israel *et al.,* 2022; Mghweno *et al.,* 2020; Santpoort, 2020). Maize crop alone accounts for approximately 45 percent of Tanzania's cultivated area, with approximately 85 percent of maize produced

going to household consumption (Lyimo *et al.,* 2014). This shows that maize is among the food cereals that are highly consumed within the country. Given the importance of the maize crop, it is critical to investigate smallholder maize farmers' market participation in relation to agriculture supply chain challenges. The agriculture supply chain can be defined as a set of members involved in a series of activities related to farming, distributing, processing, and marketing agricultural products (from farms to the consumer's meal table) (Mirabelli & Solina, 2020). Even though effective supply chain management enables producers, primarily farmers, to access markets for agricultural supply chains, the management of agricultural supply chains is an issue among various members of the chain, particularly smallholder farmers. These farmers are allocated to various areas within the country. Those who produce maize sell it either directly to the market or through other channels (Ismail, 2020).

Smallholder farmers face a number of challenges in general, as value chains that include smallholder farmers are vulnerable to unexpected changes that affect performance (Ismail, 2021; Orr *et al.,* 2018). Their challenges may range from the point they decide to start farming until harvesting affects their products. The choice of seeds is among them as they are affected by the quality of seeds, which affects their production (Wilson & Lewis, 2015). Some smallholder farmers buy watered or expired seeds (that affect their production) from fraudulent traders (Misaki *et al.,* 2016). Smallholder farmers are supplied with inputs, including inorganic fertilizers, to enhance their farming activities (Benson *et al.,* 2012; Iticha *et al.,* 2021; Justus *et al.,* 2021; Tibugari *et al.,* 2019). However, delays in subsidised inputs necessary for farmers in production are among the difficulties they face (Aloyce *et al.,* 2014). Shortages of farming inputs (Misaki *et al.,* 2016) and postharvest losses affect the overall volume of maize produced for sale (Ismail & Changalima, 2019; Rutatola, 2018). Also, other challenges start at the time when maize is pushed to other members of the maize supply chain. This is the point when they sell them through traders (middlemen) or the market. Wilson and Lewis (2015) reported that the Tanzanian maize supply chain is unclear and not well organised due to its nature and system. Therefore, farmers are striving to bring their produce to the market or through traders who buy it at the farm gate (Abu *et al.,* 2016). In another context, most smallholder farmers and their farms are located in rural areas where feeder roads and other transport infrastructure are not adequate and not in good condition (Misaki *et al.,* 2016; Mwagike & Mdoe, 2015; Wilson & Lewis, 2015). In addition, the market price is not as stable as most agricultural products as it depends on the nature of the seasons and areas. Middlemen exploit farmers who sell at their farm's gate as they have been reported to have the authority to set the price when farmers are not aware of the market information (Misaki *et al.,* 2016), even though they play a role in agricultural supply chains (Arya *et al.,* 2015; Mwagike & Mdoe, 2015; Rutatola, 2018). Inadequate knowledge and skills related to business also pose a challenge to smallholder farmers (Misaki *et al.,* 2016; Wilson & Lewis, 2015). These challenges seem to be the case for most smallholder farmers who strive to push their products to the further channels of the maize supply chain (Ouma *et al.,* 2020). Based on these challenges and the importance of enhancing participation of smallholder maize farmers in available markets, the current study focuses on establishing the relationship between agriculture supply chain-related challenges and smallholder maize farmers' market participation decisions in Tanzania. By addressing this objective, the study is more likely to contribute to the available literature on market participation by including the agriculture supply chain challenges.

Theoretical perspectives and hypotheses

It has to be noted that farmers are rational producers, and they make rational choices. Various decision theories or theories of choice have tried to explain the relationship between market participation and smallholder farmers' decisions by concentrating on the factors influencing the participation process. Common classical theories, for example, such as comparative advantage theory, expected

utility theory, and asset-based welfare theory, have ended up explaining only the primary motivations for participation. Therefore, farmer participation in trade or markets, according to comparative advantage theory, is primarily motivated by the desire to reap the benefits of a more diverse consumption bundle of goods. Those who focus on making goods for which they have a comparative advantage and trading them for goods for which they have no comparative advantage are more likely to get the benefits of trade-related welfare gains (Ricardo, 1817).

However, in the context of market participation decisions, a smallholder farmer, as a rational producer, is assumed to take account of expected outcomes before deciding to participate in the market. Thus, they can determine whether to sell at the market or at the farm gate, depending on the expected outcomes. Although these theories have tried to show the connections between market and farmers' participation decisions, all of them have not comprehensively identified the predetermining agriculture supply chain-related challenges affecting market participation decisions. The theoretical underpinnings of what and how various factors influence smallholder farmer households' decisions on whether to participate in agricultural markets can be found in market transition theory and market transaction cost theory. The areas of departure of these two theories have been earmarked as research gaps, and some of these gaps have been part of the subject for testing. In addition, the reason for combining two theories in this study is that a single theory does not widely cover all relevant variables. So, the conceptual framework for this study (see Figure 1) was built using the parameters from these theories.

Theoretically, it is anticipated that smallholder farmers have preferences among various available market choice alternatives, which enables them to choose the most preferable option. In the context of market participation decisions, smallholder farmers are supposed to consider challenges and expected outcomes before deciding to participate in the market as any other agriculture supply chain member. They can determine whether to sell at the market or at the farm gate depending on the expected outcomes and challenges of the maize supply chain. This is supported by the theory of transaction costs, in which the concept behind it is that high transaction costs tend to limit the market participation of smallholder farmers. Compared to a firm in a market, smallholder farmers can see the trade-in of an externality as a possible act if there are sufficiently low transaction costs for bargaining (Coase, 1937). This will lead to an efficient outcome in the marketing system, especially in market participation.

Similarly, market transition theory argues that the mechanism by which the market generates equality under the redistributive system is to transform the state redistribution economy into a market like the economy, in which the move to markets unlocks other sources of rewards not controlled by smallholder farmers that may reduce dependence (Nee, 1989). The idea that a reforming market opens up other mobility channels for smallholder farmers to directly take part in the market based on the market facilities and incentives has been correctly demonstrated by Breimyer (1977). The study concluded that smallholder farmers' incomes could be increased through market reforms like improving and creating infrastructure that attracts them to engage themselves in the market. This theoretical discussion assumes that traded volume and market participation could be increased if agriculture supply chain challenges related to maize marketing are effectively addressed. Therefore, it is important to study how agriculture supply chain related challenges affect smallholder farmers' decisions towards market participation. Based on this, the study focuses on testing the following hypotheses:

H1: The availability of transportation facilities does not significantly relate to the market participation decisions of smallholder maize farmers.

H2: Road condition does not significantly affect market participation decisions of smallholder maize farmers.

H3: Market distance does not significantly affect the market participation decisions of smallholder maize farmers.

H4: Transportation costs do not significantly

affect smallholder maize farmers' market participation decisions.

H5: Market price does not significantly affect the market participation decisions of smallholder maize farmers.

H6: There is no significant relationship between market information accessibility and smallholder maize farmers' market participation decisions.

H7: There is no significant relationship between the quality of maize and the market participation decisions of smallholder maize farmers.

H8: There is no significant relationship between access to input and market participation decisions of smallholder maize farmers.

H9: There is no significant relationship between the storage facility and market participation decisions of smallholder maize farmers.

H10: Household size does not significantly affect the market participation decisions of smallholder maize farmers.

H11: Farm size does not significantly affect the market participation decisions of smallholder maize farmers.

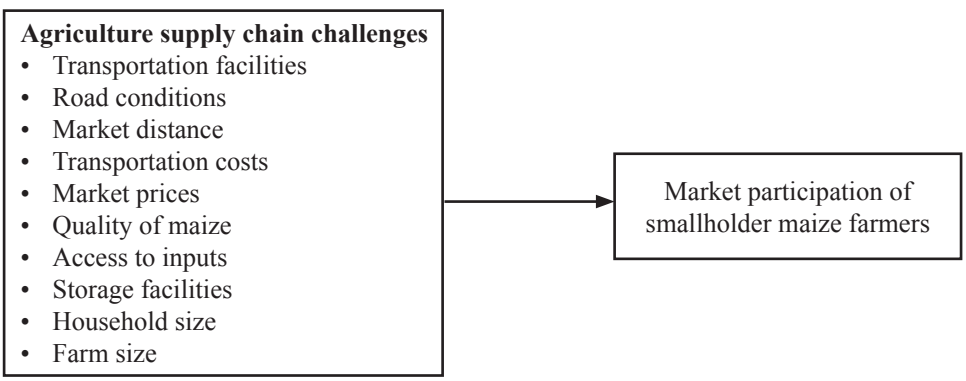

Figure 1: The conceptual framework

Methodology

The study area and research design

The study was done in Dodoma, the region which was selected based on the idea from Kessy *et al.,* (2011). The study was carried out focusing on a poverty escape route in central Tanzania and identifies difficult problems of accessing market services due to various factors. According to the report, rural households in the Dodoma region have long experienced the problem of accessing and utilising resources. All the rural communities surveyed in Dodoma Region were found not to have easy access to markets. Specifically, Kongwa and Mpwapwa districts were selected because they are considered "belts of maize production." Also, six villages, three from each district, were chosen by focusing on the maize production level and agriculture supply chain challenges related to maize marketing. These villages are Hembahemba, Njoge, and Makutupa in Kongwa district; Tambi, Mlembule, and Mwenzele in Mpwapwa district. It is from these areas where a cross-sectional research design was adopted whereby the data were collected only once from smallholder maize farmers allocated in the chosen study areas.

Population and sampling procedures

Purposive and random sampling approaches were used in this study. First, two districts producing maize were purposively selected. The choice of these two districts was based on the challenges of the agriculture supply chain concerning market accessibility in the area. Second, six villages were selected purposively based on the production level of maize. The purposive selection was conducted by considering consultations from the selected district and village officers. Third, a random sampling procedure was employed to select a representative sample of 633 smallholder maize farmers (heads of households) from the selected villages (see Table 1). This random sampling was done after specifying the

number of smallholder farmers identified and selected from a list of village registers obtained from each study village. Besides, the study considered only farmers who cultivated up to 3.5 ha of maize. These farmers are considered smallholder farmers, and the study excluded all farmers who were engaged in more than 3.5 ha of maize because they were not considered smallholder farmers.

Table 1: Number of households included in the sample

Districts	Villages surveyed	Sampled households
Kongwa	Njoge	103
	Makutupa	80
	Hembahemba	86
Mpwapwa	Tambi	125
	Mwenzele	119
	Mlembule	120
Total		**633**

Data collection and Analysis

A structured questionnaire was employed as a data collection tool to obtain primary data from 633 smallholder maize farmers who cultivated up to 3.5 ha of maize. The survey data were analysed using econometric analyses, with the probit regression model used to investigate the relationship between agricultural supply chain challenges and smallholder maize farmers' market participation decisions.

Description of variables included in the analytical model

Table 2 shows the specific variables included in the model to explain the market participation decisions of smallholder maize farmers.

An analytical model of smallholder farmer's market participation choice

A probit model was used because the dependent variable had two outcomes; 1 if they participated, and 0 otherwise. The model is useful in estimating the likelihood that an observation with specific characteristics will fall into one of the categories. In this study, there are two categories: smallholder farmers who choose to participate in the maize market and those who do not. Thus, this model helped to estimate the agricultural supply chain-related challenges affecting market participation decisions for those categories. Generally, the probit model can be done based on the use of the following standard normal cumulative distribution function:

$P(0, 1) = P(y = 1|x) = P(Z_i^* \leq Z) = P(Z_i^* \leq \beta_1$

Table 2: Description of the variables in the analytical model

Variable	Variable type	Variable measurement
Market Participation Decision	Dummy	1 if participated, 0 otherwise
Transportation facility	Dummy	1 if available, 0 otherwise
Road condition	Dummy	1 if accessible, 0 otherwise
Market distance	Continuous	Distance from farming areas to marketing areas (km)
Transportation cost	Continuous	The cost charged in TSH per trip from a farming area to a marketing area
Market price	Continuous	Price in TSH of maize charged at market per bag of 100 kg
Access to information	Dummy	1 if accessed, 0 otherwise
Quality	Dummy	1 if free from diseases and dust, 0 otherwise
Access to inputs	Dummy	1 if accessed, 0 otherwise
Storage facilities	Dummy	1 if available, 0 otherwise
Household size	Continuous	Number of active family members
Farm size	Continuous	Size of land used for cultivation (Ha)

$+ \beta_2 x_i) = F(\beta_1 + \beta_2 x_i)$……..... (1)

Where,

P(0, 1) or P(y = 1|x) is the probability that smallholder maize farmers will participate in the market; Xi is the explanatory variables hypothesized to influence market participation decisions, and Y is a dependent variable 1 for "participate," 0 "otherwise." Generally, the specified model of market participation is as follows:

$P(0, 1) = MPD = \beta_0 + \beta_1$ Transportation facilities $+ \beta_2$ Road condition - β_3 Market distance - β_4 Transportation cost + β_5 Market price + β_6 Access to information + β_7 Quality + β_8 Access to inputs + β_9 Storage facilities + β_{10} Household size + β_{11} Farm size + ε_i……(2)

Where,

MPD = is the market participation decision measured as 1 if participated, 0 otherwise.

Results and discussion

Demographic characteristics of respondents

Table 3: Demographic characteristics of respondents

	Frequency	Percentage
Sex of respondents		
Female	130	20.5
Male	503	79.5
Total	**633**	**100**
Age of respondents		
18 – 25	61	9.6
26 – 33	102	16.1
34 – 41	157	24.8
42 – 49	160	25.3
50 – 57	88	13.9
58 – 65	21	3.3
66 – 73	34	5.4
74 – 81	10	1.6
Total	**633**	**100**
Education level of respondents		
None	133	21.1
Primary	439	69.3
Secondary	61	9.6
Total	**633**	**100**

The demographic profile of respondents is shown in Table 3. Males made up 79.5% of respondents (n = 503), while females made up 20.5% (n = 130). The higher percentage of males does not mean that only males participated in this study; rather, it suggests that more males were eligible as household heads and are the ones who make most of the decisions at the household level, which convincingly affect most of the decisions at the village level, including market participation. Mchopa *et al.,* (2020) also found that in Tanzania, men are more involved in the agricultural supply chain than women

Results also show that 9.6% (n = 61) of smallholder maize farmers had between 18 and 25 years of age, while 16.1% (n = 102) had between 26 and 33 years, 24.8% (n = 157) had between 34 and 41 years of age, 25.3% (n = 160) had between 42 and 49, and 13.9% (n = 88) had between 50 and 57. Other groups included 58 and 65 years were 3.3% (n = 21), 66 and 73 years were 5.4% (n = 34), and 74 and 81 years were 1.6% (n = 10). According to these results, young and middle-aged people dominated and were able to take part in most ways of making a living, such as growing crops, raising animals, and doing small trades.

Furthermore, results show that of the total of 633 respondents, only 9.6% (n = 61) had a secondary education, 69.3% (n = 439) had a primary education, and 21.1% (n = 133) had no formal education. From these results, it is reasonable to argue that most people in the maize belt of Kongwa and Mpwapwa districts had primary education, and very few had no formal education. Thus, generally, the results show that most smallholder maize farmers have a primary level of education. On the other hand, it has been shown that primary education makes people more creative. As a result, it has been linked to farmers' willingness to add new ideas to their traditional ways of using land and running markets.

In Tanzania, literature shows that the education levels of smallholder farmers determine their participation in agricultural value chain activities (Mchopa *et al.,* 2020). For instance, in Southern Ethiopia, Megerssa *et al.* (2020a) reported that the lowest level

of education of farmers (below primary education) affected their access to agricultural information. Also, in South Africa, Ndlovu *et al.* (2021) found that formal education influences farmers' participation in value chain activities. Smallholder farmers with an adequate level of education have a good chance of participating in agricultural supply chain activities compared to those with an inadequate level of education. Hence, literate farmers are more likely to adopt modern technologies than those who are illiterate. Previously, in Tanzania, most farmers had no formal education (Due *et al.,* 1997). But in this study, most of the people who took part had at least a primary education, which means they could at least read and write.

Multicollinearity test for supply chain-related challenges

Tolerance and Variance Inflation Factor (VIF) were used to test multicollinearity across all agriculture supply chain-related challenges. The results in Table 4 present values of VIF and tolerance after checking for multicollinearity. The findings show that all values of VIF and tolerance are above the recommended thresholds. Values below 10 for VIF and values above 0.1 for tolerance reveal that multicollinearity is not a concern in the study (Adnan *et al.,* 2006).

Overall Model results

To determine the effects of agricultural supply chain-related challenges on smallholder maize farmers' decisions to market participation, the Pseudo R^2 was first computed to measure the accuracy of the prediction. The Pseudo R^2 was found to be 0.7918, which means that the quantified agriculture supply chain challenges could explain market participation decisions by 79%. The model was also statistically significant at a 5% level (p=0.0001). Also, the log-likelihood of the model was -85.657523, and L.R. chi^2 (11) was 40.66.

Table 4: Multicollinearity test for agriculture supply chain-related challenges

Variables	Collinearity Statistics	
	Tolerance	VIF
Transportation facilities	0.966	1.035
Road condition	0.528	1.895
Market distance	0.476	2.099
Transportation cost	0.495	2.020
Market price	0.498	2.008
Access to information	0.497	2.012
Quality	0.627	1.594
Access to inputs	0.572	1.747
Storage facility	0.457	2.188
Household size	0.475	2.105
Farm size	0.470	2.126

Model specification test

It was assumed that the agriculture supply chain-related challenges model was well specified; null hypotheses (Ho): (agriculture supply chain-related challenges model is well specified). Furthermore, the analysis model should be well specified if the p-value obtained is more significant than the conventional p-value (5%). So, the results showed that the agriculture supply chain challenges model was well-defined because its hat square (hatsq) had a p-value of 0.733, which is greater than 5%, as shown in Table 5.

Supply chain related challenges and smallholder maize farmers' participation

Availability of transportation facilities

The assumption was that the availability of transportation facilities in the study area increased the likelihood of the smallholder maize farmers participating in the markets.

Table 5: Linktest for the model fitness test

Market participation	Coef.	Std. Err.	z	P value	(95% Conf. Interval)	
Hat	0.8415259	0.3462292	4.01	0.000	0.4977086	1.447926
Hatsq	-0.0535728	0.0563527	-0.19	0.733	-0.2051917	0.1684354
cons	0.0231519	0.9856372	0.06	0.767	-0.5799918	0.6175352

Therefore, the first null hypothesis (H1) was rejected. The results revealed that the variable had a significant and positive coefficient at a 5% level (p = 0.021). This means there is a possibility that smallholder maize farmers will decide to sell at the market instead of selling at the farm gate by 3.79%. The plausible explanation is that readily available transportation facilities reduce transaction costs, guarantee transportation, and ensure timely transportation planning. This was found to have a direct effect on the market participation decisions of smallholder maize farmers. These findings are consistent with those of Matsane and Oyekale (2014), who opined that small-scale farmers lost their produce due to the poor and small size of transportation facilities. Consequently, the small size has increased transportation costs in most rural areas. Studies show that fast transportation facilitates and enhances the effective distribution of agricultural products to the points of demand (Mwaiseje *et al.,* 2019; Rajabion *et al.,* 2019). However, most surveyed areas in the current study reveal that the availability of trucks and vehicles for transporting agricultural products is still a challenge for smallholder maize farmers. Transportation is important in the supply chain, and transportation disruption affects supply chain performance.

Road conditions

The study findings, as presented in Table 6, show that the road condition was found to have a positive coefficient and was statistically significant with p=0.002. This implies that for every unit improvement in road conditions, smallholder maize farmers are expected to have a 3.34% increase in log-odds of the market participation decisions. This means that the second hypothesis (H2) was rejected. The justification is that good road conditions encourage smallholder farmers to transport their maize products when the number of buyers and prices increase in the marketplace. It was also observed that good road conditions reduce transportation costs because the owners of the transportation facilities charge high prices when the road is in bad shape. The same was observed by Matsane and Oyekale (2014), who noted that poor and inadequate access roads affect small-scale farmers' ability to fully utilise market potential. Besides, Okoye *et al.* (2016) pointed out that good road conditions promote successful smallholder commercialisation. It was also reported by Schipmann and Qaim (2011) that farmers who live in villages with poor road conditions are affected by the cost of transporting their agricultural products and experience fewer marketing options.

Market distance

The assumption of market distance is that short market distances from farming areas to the market increase the possibility of ensuring that smallholder maize farmers participate in the markets. The results indicate that as market distance increases, the likelihood for smallholder maize farmers to participate in the market decreases by 2.91% at p=0.005. This means that hypothesis (H3) was rejected. It was found that market distance considerably reduces the rate of sold maize in the market. This is because of the cost of transportation that exists between the buyer and the smallholder farmer. Besides, the market distances increase the chance of intermediaries exploiting smallholder farmers. Furthermore, all surveyed villages were far from rural markets, making transportation costs very high. The findings are consistent with those of Okoye *et al.* (2016), who believe that there is an inverse relationship between farm-to-market distance and market participation decisions; this is because long distances are associated with high transportation costs.

Also, the distance between agriculture supply chain actors affects the participation of farmers in the value chain (Nguyen *et al.,* 2020). This implies that market distance and distance among actors are significant determinants for smallholder farmers' participation in the market or supply chain activities. In the agricultural supply chain, the distance to market has an impact on the costs for farmers and traders. Literature also shows that the longer the distance to the location of an agricultural market, the greater the chance of farmers to sell their produce to middlemen (Suryaningrat *et al.,* 2015). The market distance also increases the price of the agricultural products that are supplied to the market.

Transportation costs

The findings revealed that market participation decisions are negatively driven by transportation costs, statistically significantly at p=0.040. The findings, therefore, indicate that an increase in transportation costs decreases the likelihood of market participation by 2.06%. The study identified two primary reasons affecting transportation costs in the study area: long distances between villages and markets and poor road infrastructure. This implies that the transportation costs charged for maize transportation in the study areas are high, hence discouraging maize's commercialization process. According to Okoye *et al.* (2016), high transaction costs such as transportation costs deter the entry of farmers into the market. This is also supported by Mérel *et al.* (2009), who noted that transportation costs reduce the desired farmers' income after the transaction. According to the current study, this is more experienced in developing countries where agriculture supply chain-related challenges are mostly experienced, especially in rural areas. It was also pointed out that transportation costs could have a direct effect on the farmers' marketing margin and hurt their market power by making it harder for them to reach buyers.

Market price

The market price has a positive coefficient and is statistically significant at a 5% significance level (p=0.004). This suggests that when market prices of maize increase by one unit, the possibility for them to participate is increased by 2.97%, provided that other supply chain-related challenges are kept constant. This is possible because those who sell at the market suggest that they prefer to sell at market areas because of the higher prices offered compared to those who sell at the market, where, most of the time, middlemen exploit them with low prices. In addition, intermediaries use a lack of education and information to exploit smallholder farmers. So, the results agree with Wollni and Zeller (2007), who pointed out that farmers could get out of their low-price crisis by making it easier for their products to get to market. This will lead to higher market prices for the farmers, which is a key factor and incentive for more sales.

Access to information

The findings in Table 6 showed that access to market information had a positive coefficient and was statistically significant with p=0.004. This suggests that when market information is increased by one unit, the likelihood of smallholder maize farmers selling in the marketplace will increase by a factor of 0.0280346 (2.8%). This means that hypothesis H6, which proposed that "there is no significant relationship between market information accessibility and smallholder maize farmers' market participation decisions" was rejected. It was observed that the necessary market information delivered to smallholder maize farmers includes information on maize buyer preferences, the quantity of maize demanded, and prices of maize, maize quality required; market requirements, and opportunities. This information was found to have a direct relationship with the decision of farmers whether to sell at the farm gate or in the marketplace (Aku *et al.,* 2018). It should be noted that information is vital in the supply chain (Huo *et al.,* 2016; Mushi *et al.,* 2021). Literature reveals that another important factor influencing farmers' profits is the price of their crops (Zhang *et al.,* 2019). The study reveals that smallholder farmers opt to sell at the marketplace if they have prior information about the selling price and the arrival of potential and reliable maize buyers. It was found out that market information dissemination is mainly done by displaying prices on the notice boards available at the market and in the villages where everyone can access them.

Further, it was observed that mobile phones are also used to get price information about the products on the market by either texting or calling intermediaries or relatives before taking maize to market. Formerly, information was disseminated in the villages through agricultural extension officers. The findings match with Fan and Salas Garcia (2018), who explain that compared to farmers who cannot access information, those with access to market information are expected to trade maize at the market. According to them, technologies have an enormous impact on information provision and have significant positive effects on the

participation of markets. Moreover, a study by Wyche and Steinfield (2016) noted that providing agricultural information to smallholders could improve economic development through market participation. So, it was suggested that mobile phones could help get important information to smallholder farmers in remote areas.

It should be noted that competitive markets can be promoted through agricultural market and marketing information accessibility. However, lack of appropriate access to markets has resulted in poor participation in the market, resulting in high exploitation by greedy traders who approach farmers in their farming areas with low prices. Subsequently, Goyal (2010) observed a strong connection between price information and an alternative marketing channel and suggested that improvement should be made to enhance the functioning of rural agricultural markets. It should be noted that trust within the supply chain is associated with the extent of members' willingness to share information (Mesic *et al.,* 2018; Nguyen *et al.,* 2020). Similarly, Megerssa *et al.* (2020a) found that most women who are engaged in agricultural production are more responsible for household responsibilities, which in turn hinders their access to agricultural information as they rely on households to supply information for them. So, male-headed households are seen as sources of information about agriculture, and women have limited access to information, which makes it hard for them to make smart decisions about where to sell their goods.

Quality of maize

Another critical challenge in supply chain management is the quality of maize produced. The results in table 6 show that the p-value was 0.0001, meaning that there is a possibility that market participation will increase by a factor of 3.96% if farmers increase the production of high-quality maize. The findings are in line with Ngwira *et al.* (2013), who noted that lack of support, especially for crop production techniques such as crop rotation and residue retention, can result in poor yield. This mainly affects smallholders who have inadequate skills and capital as compared to large-scale producers. So, it is thought that better quality is a result of different strategies that make it easier for smallholder farmers to make sure they have access to high-value markets in the maize supply chain. The study further suggested that resource availability, such as on-farm and off-farm infrastructure, water, and land, are some of the challenges facing smallholder farmers. If removed, they can increase the level of quality of products and hence increase levels of market participation.

Access to inputs

Access to farm inputs such as improved seeds, fertilizers, and chemicals on time was associated with producing high-quality maize, giving smallholder maize farmers more confidence to sell at the market. The study revealed that this variable is positive and significantly related to the market participation decisions of smallholder maize farmers with p=0.001. Therefore, there is a possibility of 3.66% of increasing decisions to participate in the market if farm inputs are advanced to the smallholder maize farmers by one unit. From this finding, it means that the null hypothesis (H8) was rejected. A study by Abebe and Alemu (2017) noted that crop production and productivity could be improved through the use of an improved seed in the first place. Increasing the quality of maize by using economical and efficient inputs to agricultural development means increasing the chances of selling it in competitive markets. The results are consistent with that Zheng *et al.* (2012), who posted that various key inputs can help improve economic benefits to farmers as they will sell maize at high market prices. Also, Elias *et al.* (2013) recommended that agricultural extension programmes as among the inputs in production increase on-farm productivity if the farmers are well involved. This can lead to high production and increase the chances for smallholder farmers to market surplus products.

Storage facilities

Table 6 shows that the storage facilities also have a positive and significant relationship with the market participation decisions of maze smallholder farmers with p=0.001. There are 0.0361825 (3.62%) chances of increasing market

participation decisions when storage facilities are improved by one score. This study observed that many smallholder maize farmers opt to sell their maize at home immediately after harvest because of the inadequate storage facilities either at home or at the marketplace. It was observed that well-functioning storage facilities could facilitate the ability to deliver high-quality maize to the market, command buyer attention, and give the farmer a competitive edge. Also, appropriate storage and postharvest handling in the chain ensure quality preservation of maize and a high price. Storage as an activity increases market flexibility. It was observed that farmers with access to well-established storage facilities are not required to trade maize immediately after harvesting (when prices are likely to go down). This enables them to stock their products and sell them when prices are higher or in their favour. These findings are in line with those of Matsane and Oyekale (2014), who explain that improved infrastructure such as storage facilities is essential for improving proper penetration into high-value markets. On the other hand, Slamet *et al.* (2017) pointed out that market opportunities for small-scale farmers should involve packaging equipment and storage facilities. Similarly, Adepoju *et al.* (2015) and Ismail (2014) suggest that storage facilities should be located at the core of market centres and should be established in areas not too far from farms.

Household size

The study results show that household size is another critical factor for market participation decisions. This is because household size was found to have a positive and significant relationship with market participation with p=0.006. This means that when household size is increased by one score, it leads to the possibility of increasing smallholder maize farmers' participation decisions by a factor of 2.94%. The most probable justification is that the size of the household constitutes the active unit of the household in most African cultures. Therefore, households with large active families produce more agricultural products and so participate more. As a result, many families in the study region choose to keep their family sizes large because they assume that larger families yield more surplus maize for the market. These findings concur with Osmani and Hossain (2015), who found that smallholders' decisions on market participation depended on various factors such as household labour force, which increased labour force in the family, and increased production, which influences commercialization. Household size is also emphasised in a study by Kyaw et al. (2018), which explains that market participation depends on factors such as household size, which determine output levels.

Farm size

The variable farm size was found to have a p-value of 0.003, meaning that, if farm size is increased by one unit, it can increase the odds of participating in markets by 3.2%. Therefore, hypothesis H11: farm size does not significantly affect smallholder maize farmers' market participation decisions. When other things remain constant, the increase in farm size increases household incomes and facilitates farmers' willingness to participate in the sale of the maize in the market. Farm size is essential in small-scale farming in developing countries (Okeyo *et al.,* 2020). The cultivated farm size determines the produced maize amount per household, contributing to the smallholder farmers' participation in the market. In this study, farm sizes ranged between 0.5 and 3.5 ha, with a mean size of 2 ha. Compared to the regional average of 0.9 ha, the average area planted per household was quite a bit larger.

Moreover, it was found that households with a large land size (not more than 3.5 ha but more when compared to others) were found to partly allocate a piece of their land for food crop production, enhancing their ability to reduce food insufficiency and effectively participate in an output market. These results are supported by Abdullah *et al.* (2019), who analysed that farm size is an essential determinant of farmer market participation. Therefore, in developing countries, farm size is an important factor for increasing production and participating in the market. Also, it should be well understood that the willingness of farmers' participation depends on farm characteristics (such as farm

size and location) (Vanslembrouck *et al.,* 2002). supply chain for agriculture and the decisions

Table 6: Probit model results for agriculture supply chain-related challenges and market participation decisions

Variable	Odd ratio	Std. Err	Z	Marginal Effects (dy/dx)	P>|z|
Transportation facilities	1.838515	0.0163874	2.31	0.0379006	0.021
Road conditions	1.724921	0.0106113	3.15	0.0333896	0.002
Market distance	0.600921	0.2524135	2.98	-0.0290906	0.005
Transportation costs	0.388767	0.0099995	2.06	-0.0205558	0.040
Market price	1.617421	0.010226	2.90	0.0296682	0.004
Access to information	1.574385	0.0098262	2.85	0.0280346	0.004
Quality of maize	1.92229	0.0111172	3.56	0.0395666	0.000
Access to inputs	1.824675	0.0106841	3.42	0.0365652	0.001
Storage facilities	1.810929	0.0108072	3.35	0.0361825	0.001
Household size	1.608718	0.010639	2.76	0.0294082	0.006
Farm size	1.682296	0.0108086	2.96	0.0320399	0.003
Constant	0.1046329	0.0915216	-2.58		0.010

Conclusion

The findings of the study led the researchers to the conclusion that issues concerning agricultural supply chains have an impact on the choices made by smallholder maize farmers in Tanzania regarding their participation in market activities. Therefore, the decisions of smallholder maize farmers regarding their participation in markets are significantly affected by issues that are associated with the agriculture supply chain. These challenges include the availability of transportation facilities; the condition of the roads; the distance to the market; the cost of transportation; the market price; accessibility to market information; the quality of the maize; access to inputs; storage facilities; the size of the household; and the size of the farm. According to the findings of this study, smallholder maize farmers have a greater chance of choosing to sell their produce at marketplaces rather than in the areas where they cultivate their crops if obstacles associated with agriculture supply chain management are eliminated. This study contributes to what is already known by establishing a connection between the challenges that are present in the that are made by smallholder maize farmers in Tanzania regarding whether or not they will sell their crops on the market.

Recommendations

Per the primary findings of the present investigation, those involved in the production of maize crops need to make certain that sufficient efforts are being made to establish and expand sales points (markets) in rural agricultural areas. This will help to shorten the distance between farming areas and marketplaces, which will enhance the ability of smallholder maize farmers to participate in market activities. It is the responsibility of those in authority to improve both the accessibility of transportation facilities and the state of the roads. Additionally, private owners, cooperative societies, and the government work hand in hand to improve both the quality and availability of the transportation facilities as well as the state of the roads, particularly the feeder roads. This will help bring down the costs of the transactions and make sure that the maize gets to the markets on time.

Also, means used to disseminate marketing

information are supposed to be improved by ensuring that simple ways such as "instant mobile texts" on mobile phones about prices and the arrival of potential buyers are implemented. On the other hand, governments and cooperative societies should create simple posts in the village responsible for providing reliable and updated marketing information. Furthermore, storage facilities need to be established in every village and at the marketing areas for easy transportation and supply of maize when needed. This will help in reducing the price fluctuations and enhance the constant supply of products. Last but not least, it is essential for smallholder farmers to participate in training sessions pertaining to the number of members in their families. It was discovered that in some households, the number of members who are dependent exceeds the number of members who are active. So, when making plans for the household, the ratio of people who depend on the household must be considered.

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