Non-Industrial Sugarcane Value Chain Analysis in Zombwe Extension Planning Area, Mzimba North, Malawi

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Abstract: Non-industrial sugarcane production sector in Malawi is under-researched and under-developed with limited support. This study used a value chain approach to map the non-industrial sugarcane value chain in Zombwe Extension Planning Area in North Mzimba, Malawi to identify key actors, relationships and constraints in the chain. Multi-staged sampling technique was used to sample the study respondents and a structured questionnaire was used to collect data from 153 non-industrial sugarcane value chain actors. Qualitative data was collected through two focus group discussions (FGD) and analysed using a value chain flow chart. Descriptive statistics and functional and regression analysis were used to analyse the data. Results indicated that production, selling and consumption are key processes in the non-industrial sugarcane value chain. The actors in the value chain were producers, retailers and consumers who participated in the two channels of the value chain. Both channels start with producers and end with domestic consumers. The results have shown that the major constraints of producers were access to credit and extension services while the major constraints of retailers were transportation, access to credit and price fluctuations. Age, education level, land accessibility and credit accessibility are significant determinants of non-industrial sugarcane production (yield). The study recommends that non-industrial sugarcane producers and retailers be supported to access credit available through the government and other financial institutions. We recommend that extension services should include producers to improve the non-industrial sugarcane value chain. The paper will help policymakers and decision-makers identify potential areas for intervention towards the commercialisation of the non-industrial sugarcane value chain.

Keywords: Non-industrial Sugarcane, Value Chain Analysis, Actors, Mapping, Constraints.

1. INTRODUCTION

This study is about non-industrial sugarcane cultivation which is largely dominated by smallholder farmers. It has been observed that from the 1960s up to date non-industrial sugarcane cultivation has been neglected in research. However, non-industrial sugarcane cultivation has provided income and food to actors involved in its value chain for centuries. Understanding its value chain could contribute to improved production which indirectly could result in improved livelihoods among the rural actors participating in the value chain in Malawi.

Sugarcane is an important crop in the tropics and sub-tropic due to its nutritional and economic uses (Zulu et al., 2019). It provides employment and income to many people as well as food. Non-industrial sugarcane cultivation has been in existence for long preceding industrial sugarcane cultivation (Richard, 2010; Mnizi & Dlamini, 2012). In the 1960s, Sub-Saharan Africa (SAA) started investing in large-scale commercial and industrial sugarcane production mainly for sugar processing (Miracle & Seidman, 1967). Since then, large-scale industrial sugarcane cultivation has gained momentum in many parts of SSA countries including Malawi, partly to overcome the challenges of importing sugar from other countries on one hand, and exporting sugar to the international market on the other hand (Miracle & Seidman, 1967). There is increased investment in industrial sugarcane production ranging from infrastructure investment, irrigation schemes and mechanisation to the formulation of farmer-friendly policies that are informed by local imperatives and export opportunities, taking care of monopsony's relations in world sugar business markets. The developments in industrial sugarcane have neglected the importance of non-industrial sugarcane.

Non-industrial sugarcane cultivation is dominated by smallholder farmers in Malawi. In contrast to industrial sugarcane production which is concentrated in a few areas of Malawi (specifically, in Nchalo in Chikwawa, Dwangwa in Nkhotakota and in Salima), non-industrial sugarcane cultivation is practised in many parts of Malawi.

Non-industrial sugarcane cultivation has employed many people of different gender and age groups. Non-industrial sugarcane provides income and food as snacks to the actors in the chain but its value chain is neglected and under-utilised in Malawi. The government has set strategic policies for large-scale industrial sugarcane production (Chinsinga, 2017), neglecting the socioeconomic importance of non-industrial sugarcane cultivation. Similarly, non-industrial sugarcane cultivation has received less scholarly attention since the available studies focused on industrial sugarcane cultivation (e.g., Isyaga & Khumbo, 2009; Salle & Dancer, 2020; Maltitz et al., 2019). Hence, this study was an exploratory conducted using a value chain approach to map the non-industrial sugarcane value chain to identify actors, relationships and constraints in the value chain. The precise objectives of the study were as follows:

1) Map non-industrial sugarcane value chain actors
2) Analyse constraints facing actors in the non-industrial sugarcane value chain, and
3) Identify determinants of non-industrial sugarcane production (Yield)

This paper has set knowledge regarding the non-industrial sugarcane value chain in Malawi. The paper informs policy and decision makers to make informed decisions concerning areas of intervention to optimise production and commercialisation of the non-industrial sugarcane value chain.

2. METHODOLOGY

2.1 Research design

The study was cross-sectional and followed an exploratory and descriptive approach. The cross-sectional data were collected from different key players of the non-industrial sugarcane value chain. Gravetter and Forzano (2003) state that explanatory design connects ideas and understands cause-effect relationships. The design involves gathering data, describing the existing conditions, identifying the standards against which existing conditions can be compared, and determining the relationship between specific events (Orodho, 2005).

2.2 Target population and sampling

Three sections of Zombwe Extension Planning Area (EPA) were targeted namely: Zombwe 1, Ekwendeni 1 and Kaluholo. The sections were purposively selected based on the prevalence of non-industrial sugarcane producers and intensive marketing activities. The study respondents included 96 non-industrial sugarcane producers and 57 retailers in the selected sections. The list of producers was obtained from agricultural extension officers in the area and Microsoft Excel Random Function was used to select the respondents. On the other hand, the snowball sampling technique was used to identify the retailers in the study area. Snowball sampling is a method typically used with unknown or rare populations, in this case, traders were asked to identify their fellow traders who were then selected for the survey. A snowball sampling technique was adopted because members of the sampling frame were not previously identified (Spreen, 1992), hence it was difficult to locate or contract them since the study was conducted during the sugarcane off-season in December 2022.

2.3 Data collection

The paper has used primary data that was collected using a questionnaire programmed in Kobo Toolbox and administered face-to-face with the respondents. A questionnaire is a research tool that consists of a series of questions designed to collect data from respondents (McLeod, 2018). The study used a questionnaire that contained both open and closed questions to collect data. The questionnaire provided a relatively cheap, quick and efficient way of obtaining large amounts of information from the sampled respondents (Saunders et al., 2012). Two focus group discussions were conducted to complement the quantitative data obtained through the survey. Focus group discussion is frequently used as a qualitative approach to gain an in-depth understanding of social issues (Nyumba et al., 2018). The method aims to obtain data from a purposely selected group of individuals rather than from a statistically representative sample of a broader population.

2.4 Data analysis

Descriptive statistics and functional analysis were done to map the non-industrial sugarcane value chain to identify actors and their functions. A chi-square test was conducted to determine the association between the constraints facing the actors in the chain and their demographic characteristics. Pearson product-moment and multiple regression model was used to identify the determinants of non-industrial sugarcane value chain production. Multiple linear regression analysis is carried out to predict the values of a dependent variable, *Y*, given a set of explanatory variables (Keith, 2015). In this study, non-industrial sugarcane production (Yield-t/ha) was the functional of age, sex, education level attained, labour, land accessibility and farming experience. The model was stated as equation 1 below.

$$Y = \beta 0 + \beta\ 1X1 + \beta 2X2 + \beta 3X3 + \beta 4\ X4 + \beta 5\ X5 + \beta 6X6 + \beta 7X7 + \beta 8X8 + e \quad (1)$$

Where Y = Sugarcane production (Yeild-t/ha); X1 = Age; X2 =Sex; X3 = Education level; X4 = Labour; X5 = Land accessibility; X6= Capital accessibility; X7= Credit accessibility; X8= Farming experience; e = Error term; β0 = Intercept (Constant term); β 1, β2, β3, β4, β 5, β 6, β 7 and β8 are coefficients of variables.

2.5 Value chain analysis

Value chain analysis includes a critical examination of the value added along the chain, the stage it is added and at what cost to improve the chain to create more value hence more benefits to the value chain participants (Rota & Sperandini, 2010). According to Dooren van Corne (2005), value chain analysis is the examination of the value-added steps in production and marketing, with the value also being assessed from a social perspective resulting in social value. Goletti (2006) reported that value chain analysis ideally requires dealing with all participants along the value chain.

Mapping a value chain means creating a visual representation of the connections between the actors or businesses in value chains as well as other market players (Rota & Sperandini, 2010). Mapping the value chain has very practical implications for a value chain initiative; it helps to illustrate and understand the process by which a product goes through until it reaches the final customer. Knowing about the different levels in a value chain is also a precondition for identifying bottlenecks that are preventing the achievement of certain targets set by the players (Daniel, 2015). Value chain mapping also serves as a way of identifying and categorizing key market players. If a value chain initiative intends to explore or understand market opportunities, value chain maps can show different market channels through which products and services reach the final customer. A value chain map can help business people or organisations investing in emerging markets to orient their activities such as to identify important stakeholders, possible marketing or supply channels, competitors, and weak links in the chain.

2.6 Reliability of the instrument

The reliability of the questionnaire was achieved by administering pilot questionnaires to selected value chain actors. The rule of thumb suggests that 5% to 10% of the target sample should constitute the pilot test (Cooper & Schilder, 2011). Thus, in the current study, the questionnaire was administered to 15 non-industrial value chain actors. Results from the pilot study were excluded from the main study.

3. RESULTS AND DISCUSSIONS

3.1. Non-industrial sugarcane value chain mapping

Figure 1 shows non-industrial sugarcane value chain mapping in the study area. The results of the mapping indicate that 6.3% of farmers sell sugarcane solely to retailers while 28.2% of farmers sell sugarcane directly to consumers. This finding indicates that the producers can take the roles of both retailers and wholesalers by selling directly to consumers and selling in bulk to retailers, respectively. The results also indicate that 59.3% of the farmers sell sugarcane to both retailers and consumers while 6.3% of farmers do not sell their sugarcane – they produce it for their consumption only. The results of the mapping also show that 100% of retailers sell sugarcane directly to consumers either at home or local markets (Figure 1).

Based on the direction of sugarcane flow, two market channels were identified in the study (Figure 1). All channels start with producers and end with either rural or urban consumers. The first channel is from producers and goes directly to consumers. The second channel is from producers, through retailers to domestic consumers.

The results from focus group discussions revealed that farmers selling at the farm gate are receiving low prices compared to farmers selling to local markets. This indicates that farmers selling at farm gate prices earn little or no profits at all. Scholtes (2009) in Brazil found that smallholder farmers producing non-industrial sugarcane were not profiting much because of no value addition.

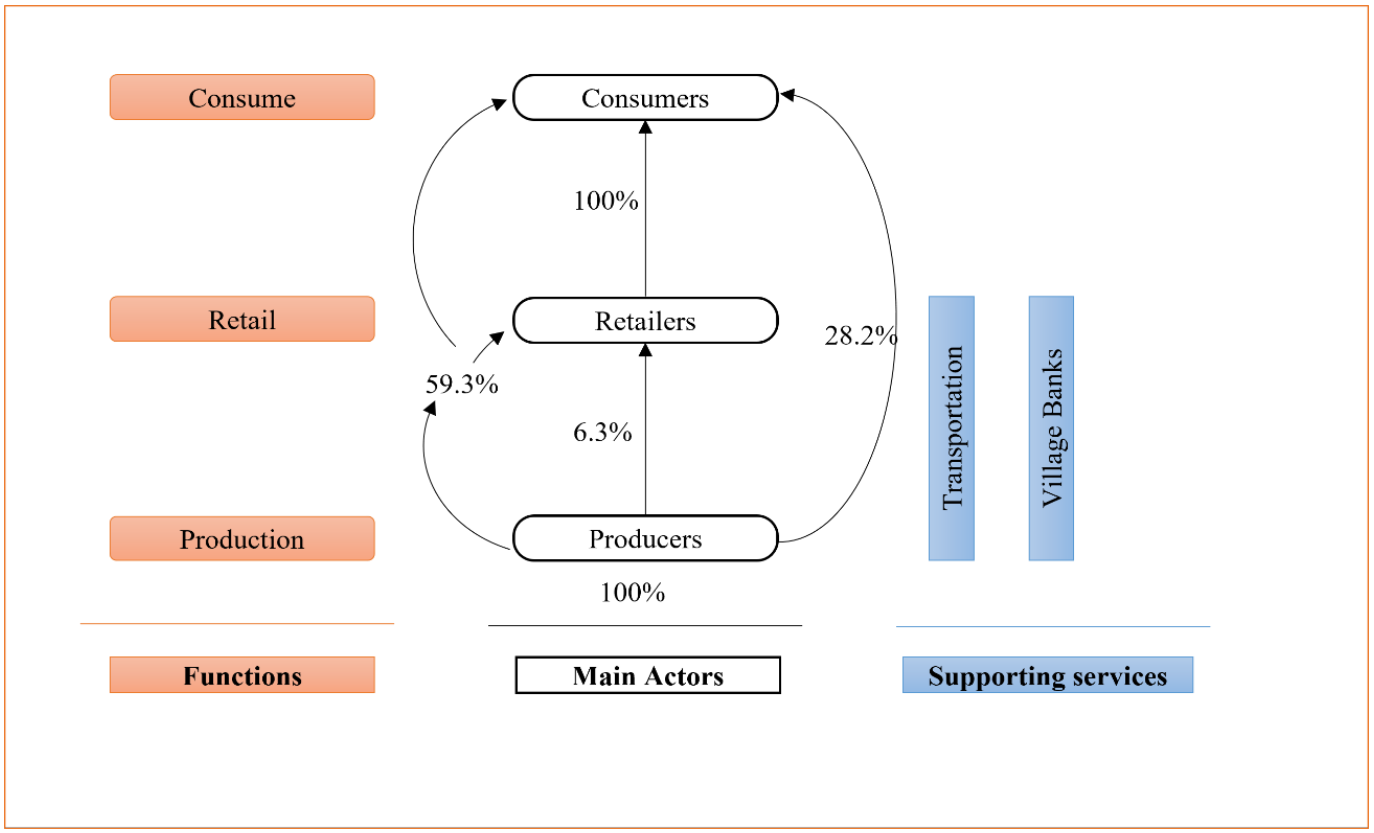

Figure 1: Non-industrial sugarcane value chain map in Zombwe EPA

Ochieng et al. (2018) argued that only formally organised groups with stable external links significantly have higher marketing performance. The findings also indicate that there is good relationship among the producers themselves. Producers were able to arrange to sell their sugarcanes in turns, one after another as one way of reducing the high supply of sugarcane since the commodity usually matures altogether in the summer season. Another reason for selling in turn was attributed to securing good prices from the buyers.

3.1.2 Non-industrial sugarcane value chain key actors and their functions

The findings of the study showed that the key processes in the non-industrial sugarcane value chain are production, selling and consumption. The results also show that key players in the non-industrial sugarcane value chain in the study area were producers, retailers and consumers. This finding is consistent with Adeoye et al. (2013) in Nigeria who reported that production, assembling, processing, marketing and consumption are the key processes in the plantain value chain.

3.1.2.1 Producers

The findings of this paper show that sugarcane is produced by smallholder producers in the study area. The average area under sugarcane cultivation was 0.24 ha per farmer. This indicates that producers were cultivating sugarcane in small pieces of land. The results of this study showed that producers performed the functions of land preparation, growing/planting, protection (from weeds and thieves), maturity checking, harvesting, transporting and selling. The results also showed that the majority of farmers (77.1%) rely on family labour. 15% of interviewed farmers were using both family and hired casual labour and only 6% of the respondents relied solely on hired/casual labour for their production. These findings are in line with the National Statistics Office (NSO, 2020) which says that 92.8% of households in rural areas were engaged in agricultural activities.

The findings of this study showed that 18.8% of the respondents were responsible for transporting sugarcane to market and 65.6% of the respondents reported that they were transporting sugarcane from farms to home for selling. The transportation was done either on the head or human shoulders, bicycle or ox-cart or a combination of these. The farmers in the study area were utilizing rudimentary implements in their production activities.

3.1.2.2 Retailers

The main functions of the retailers in the study area were limited to buying and selling sugarcane to domestic consumers. Retailer involvement in the sugarcane value chain included purchasing from farmers, transporting to homes or markets and selling to consumers. Both urban and rural retailers were identified in the study area. Rural retailers based in rural markets or roadside selling were involved in direct purchases from farmers. Some retailers not only sold sugarcane but also traded other commodities/products or offered services in the designated places. Urban retailers were also involved in direct purchases from farmers and selling in urban areas such as Ekwendeni and Luwinga markets in Mzuzu city.

The results showed that the majority of the retailers (64.9%) were using both personal and hired transport. The retailers reported that they were transporting through hired cars, ox-carts *(ngolo)* and bicycles due to the long distance covered between the markets and farms. At least thirty-five per cent of retailers relied solely on personal transport either on head (or human shoulders) and/or bicycles for transporting sugarcane from farms to their homes to markets and vice versa.

3.1.2.3 Consumers

These are the final actors in the value chain. The individual consumers buy sugarcane from either farmers, retailers or both. The findings indicated that there were consumers who produced sugarcane on their own for individual or family consumption. Sugarcane cultivated in the study area was consumed both in the area and urban areas of Mzuzu city. This indicates that non-industrial cultivation in the study area has established markets.

3.1.2.4 Supporting services

The results of the study indicate that the supporting services available in the study area are financial services from village savings and loan associations (VSLAs). Producers in the study area were not benefiting from capacity building and agricultural extension services from both government and private agencies as do producers of other commodities such as maize and vegetables. In addition, the results of this paper showed that transportation services are also critical in assisting producers and traders in the value chain. Producers and traders use local transportation modes available in the area such as bicycles, vehicles and ox-carts to transport their produce to homes or markets.

3.2. Non-industrial sugarcane value chain constraints

3.2.1 Producers' constraints

Figure 2 shows the constraints faced by farmers in the study area. The major constraints were credit accessibility (77%), access to extension services (61%) and capital accessibility (56%). Most of the farmers source their credit from friends and relatives. Other constraints impeding sugarcane farmers were thieves (47%), land accessibility (42%), lack of production inputs (30%), access to market (29%), transportation (27%) labour shortage (21%) and price fluctuations (20%). Through FGD, the respondents reported that these challenges were mainly attributed to a lack of interventions from both government and non-governmental agencies on sugarcane production in the study area. This finding is consistent with Daniel (2015) who found that Irish potato farmers face major constraints such as transportation, lack of market information and low prices among others. Adeoye et al. (2013) also found that inadequate credit accessibility, market accessibility and land availability were major challenges encountered by plantain farmers in Southwest Nigeria. Limited access to credit and lack of extension support were also reported as major constraints faced by smallholder sugarcane out-growers in South Africa and Nigeria (Girei & Giroh, 2012).

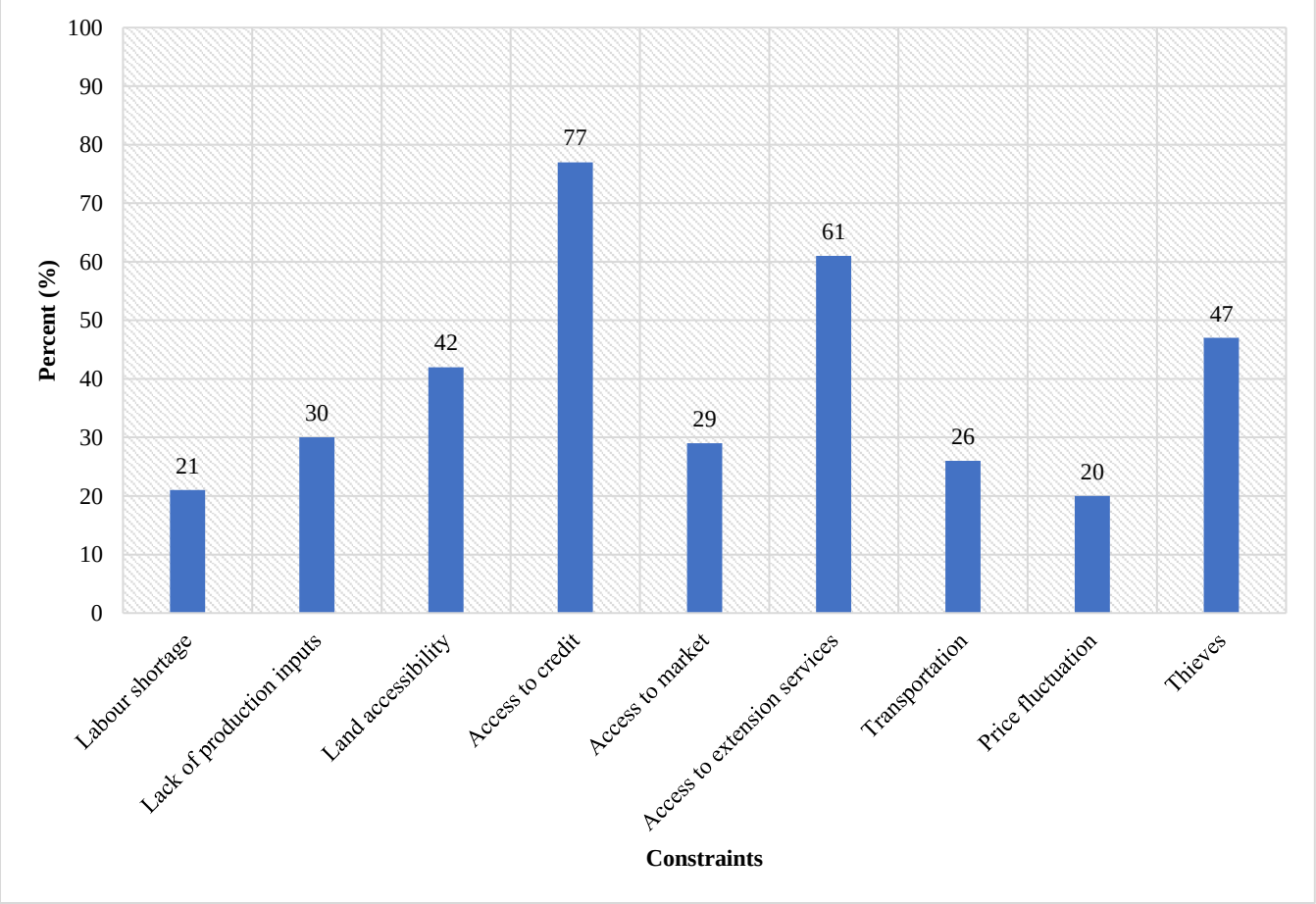

Figure 2: Constraints facing sugarcane producers in Zombwe EPA

3.2.2 Retailers' constraints

Figure 3 gives the major constraints encountered by retailers in the study area. The findings reveal that the major constraints were high transportation cost/lack of transport (93%), capital accessibility (86%), credit accessibility (77%) and change in prices (65%). Other constraints impeding the retailers were shortage of labour (14%) and information accessibility (2%) (Figure 3). The study by Daniel (2015) on the Irish potato value chain found that the major problems of traders were credit accessibility and transportation due to poor roads. The findings of this study are also consistent with Adeoye et al. (2013) who indicated that credit accessibility and transportation were major problems marketers face in the plantain value chain in Southwest Nigeria.

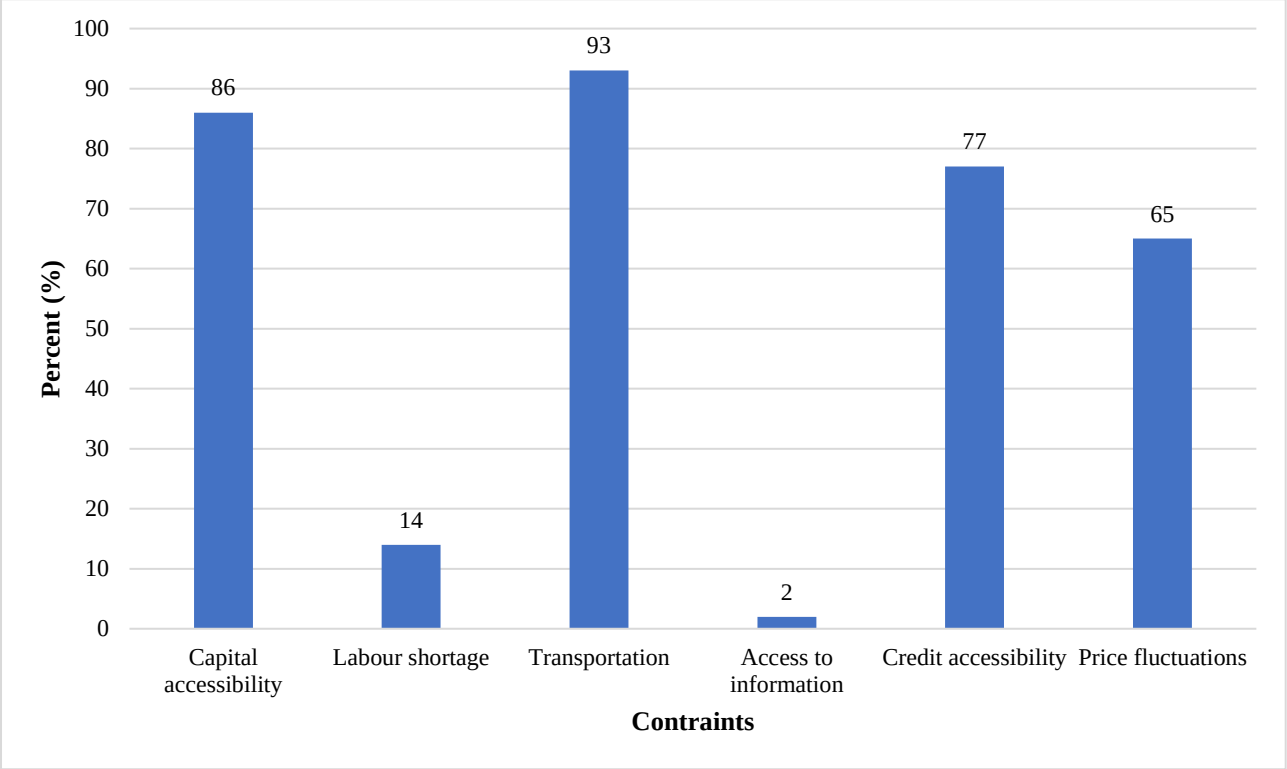

Figure 3: Constraints facing sugarcane traders in Zombwe EPA

3.2.3 Testing the Association between Constraints and Demographic Characteristics of Key Actors

Table 1 shows the results of the Chi-Square test between the demographic characteristics of producers and producers' constraints. The results show that credit accessibility was positively associated with age (X^2=4.566, p=0.033) and marital status (X^2=10.397, p=0.015) of the producers. This indicates that more aged people were facing credit accessibility problems than middle-aged people. Similarly, many married people are facing the problem of credit accessibility than other groups of marital status. Table 1 also shows that the land accessibility problem was positively associated with the marital status of the producers (X^2 = 7.147, p= 0.046). This indicates that married people have a high probability of facing the constraint of land accessibility.

Table 1: Chi-Square Test of producers' constraints against producers' demographic characteristics

	X^2 Coefficient	Sig
Age x access to credit accessibility	4.566	0.033
Marital status x credit accessibility	10.397	0.015
Education level x credit accessibility	.402	0.818
Sex x thieves	1.137	.288
Marital status x thieves	2.249	.522
Education level x thieves	1.225	.541
Sex x land accessibility	.012	.913
Education x land accessibility	4.442	.109
Marital status x land accessibility	7.147	0.046
Sex x access to extension	.212	.645

Source: Own survey (2022)

Table 2 shows the results of the X^2 test of retailers' constraints against retailers' demographic characteristics. The table shows that only credit accessibility is significantly and negatively associated with the education level of the retailers (p=0.05). This indicates that retailers with relatively higher education are better off than those with low levels of education. This can be attributed to the fact that more educated people get formal employment than their counterparts.

Table 2: Chi-Square test of retailers' constraints against traders' demographic characteristics

	X^2 Coefficient	Sig
Age x credit accessibility	0.042	0.837
Sex x credit accessibility	3.715	0.054
Marital status x credit accessibility	0.304	0.859
Education level x credit accessibility	-0.857	0.050*
Age x transportation	0.306	0.580
Sex x transportation	2.182	0.140
Marital status x transportation	0.784	0.676
Education level x transportation	5.075	0.079
Age x price fluctuation	0.720	0.396
Sex x price fluctuations	1.358	0.244
Marital status x price fluctuation	3.050	0.281
Education x price fluctuation	0.796	0.672

*= Significant at 0.05. Source: Own survey (2022)

3.3. Determinants of sugarcane production (Yeild-t/ha)

Correlation Pearson analysis tests in Table 3 show that all six (6) variables have a statistically significant (p = 0.000) association with sugarcane production (yield—t/ha). These variables are age (between 30 and 40), sex (male), tertiary education, land accessibility, capital accessibility, credit accessibility and farming experience.

Table 3: Correlation Pearson analysis results between sugarcane production (yield—t/ha) and the independent variables (n = 96).

Parameter	Pearson Correlation
Age (between 30 and 40)	0.187***
Sex (male)	0.327***
Education level (Tertiary)	0.273***
Land accessibility	0.467***
Capital accessibility	0.206***
Credit accessibility	0.761***
Farming experience	0.233***

***= Correlation is significant at the 0.001 level (2 – 2-tailed), Source: Own survey (2022)

The estimates of the inferential (production function) analysis are presented in Table 4. The variable credit accessibility was statistically significant at a 0.1% significant level (p-value = 0.000). The model predicts that a 0.1% increase in access to credit will increase sugarcane production (yield – t/ha) by 3.0%. The variable capital accessibility was statically significant at 0.1% with a regression coefficient of 0.57. The model predicts that a 0.1% increase in

capital accessibility will lead to an increase in sugarcane production by 0.57%. The variable land accessibility is also statistically significant, indicating that a 0.1% increase in land accessibility increases sugarcane production by 1%.

The model also predicts that variables aged between 30 and 40, male and tertiary education are statistically significant at 0.1% level with p = 0.000. The model suggests that men are active sugarcane producers and that the importance of tertiary education cannot be overestimated in sugarcane production. The findings of this paper are consistent with Thebethe (2013) who found that age, level of education, marital status, land size, off-farm income and experience are significant determinants of allocative efficiency in sugarcane farming among Mpumalanga growers, in South Africa. Similarly, Mengesha et al. (2019) found that the sex of the household, land allocated to mango, and farming experience were significant factors determining mango market supply in the mango value chain in Ethiopia.

Table 4: Parameters in multiple regression model

Variable	**Coefficient**	**Standard error**	**t**	**p-value**	**Lower interval**	**Upper interval**
Age						
30-40	.759	.213	3.559	.000	.340	1.177
Sex						
Male	1.003	.236	4.253	.000	.539	1.466
Education level						
Tertiary	3.420	.646	5.295	.000	2.151	4.689
Labour	-.154	.215	-.717	.474	-.576	.268
Land accessibility	1.045	.236	4.433	.000	.582	1.509
Capital accessibility	.570	.210	2.708	.007	.156	.983
Credit accessibility	3.317	.246	13.475	.000	2.833	3.800
Farming experience	-.011	.013	-.839	.402	-.035	.014
F = 77.0						
F Prob = 0.05**						

R=0.766, R Square=0.578 and Adjusted R=0.570. Source: Own survey (2022)

A goodness-of-fit for the model computed for this dataset comprises the R-Square and F-statistic. Using the R-Square and Adjusted R-Square coefficients to determine how well the final model fits the data, R-Square and Adjusted R-Square of 0.578 and 0.570 are obtained, respectively. The R-Square and Adjusted R-Square measure the “model quality” or the percentage of the variance of the results that is explained by the model.

Concerning this dataset, the R-square accounts for about 59% of the variation of the dependent variable by the explanatory variables, suggesting that the model is fit to explain the variations to the dependent variable. The coefficient of the adjusted R-squared indicates that about 57% of the factors are from the hypothesised explanatory variables. Generally, the closer to one (1) the adjusted R-Square is, the better the fit of the estimated regression line. Table 4 shows an F-statistic 77.0 (p = 0.000). Since our *p*-value (≤0.05), it means the parameters are jointly statistically significant. Therefore, this implies a statistically significant relationship between sugarcane production (yield—t/acre) and the predictor variables.

4. CONCLUSIONS AND RECOMMENDATIONS

The study used a value chain approach to map the non-industrial sugarcane value chain to identify key actors, relationships and constraints in the chain as well as to identify the determinants of sugarcane production. There are three key actors in the non-industrial sugarcane value chain namely: producers, retailers and consumers. The core processes in the non-industrial sugarcane value chain are production, selling and consumption. The producers are

responsible for carrying out all production activities using rudimentary implements. The retailers are limited to selling sugarcane to domestic consumers. VSLAs and transporters are supporting actors in the value chain.

The are two channels in the non-industrial sugarcane value chain – the first channel starts from producers and goes directly to consumers while the second channel starts from producers and goes to consumers through retailers. The majority of both producers and retailers reported that there is good relationship among the actors in the value chain.

The major constraints facing producers in the non-industrial sugarcane value chain are access to credit and access to extension services. Transportation, capital accessibility, access to credit and price fluctuations are major actors faced by retailers in the value chain. Age, sex, education level, credit accessibility, land accessibility and capital accessibility are significant determinants of non-industrial sugarcane production.

The study recommends good collaboration among producers, retailers, and consumers as well as supporting actors in the non-industrial sugarcane value chain to improve the performance of the value chain. There is also a need to intensify the use of Village Savings and Loan Associations (VSLAs) as the source of financial services by producers and retailers to support the value chain. The paper recommends 1) women and youth economic empowerment in terms of the provision of credit and capacity building since women and youth are active actors of the value chain and 2) that extension services should include producers to improve the non-industrial sugarcane value chain.

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