



Socioeconomic and Agronomic Factors Influencing Vegetable Production in Rural Wards in Tabora Municipality Tanzania

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The productivity of Tabora Municipality's small-scale vegetable producers is hampered by lack of understanding of market dynamics and agricultural practices. The purpose of this paper was to investigate aspects affecting the production and evaluate farmers' understanding of vegetable growing. A survey was carried out in Ndevelwa, Misha and Kabila Wards. The findings showed that 90% of the respondents agreed that soil fertility and quality were important factors to consider for

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growing vegetables. Four-fifths (80%), 75% and 77.5% of the respondents in Ndevelwa, Misha and Kabila Wards, respectively, followed suggested agronomic practices. Proper seed selection (51.7%) and watering (65%) were mentioned as important factors that affected vegetable production. Nine in ten (90%) of the respondents in Ndevelwa, 97.5% in Misha and 82.5% in Kabila reported to have access to agricultural extension services. Nevertheless, 60.0% of the respondents in Kabila said that the quality of the services was poor. Regarding marketing, 87.5% of the respondents looked for market pricing trends, and 99.2% of the respondents had access to market data. The commonest routes were local market places (60.8%) and wholesale (67.5%). About 70% of the respondents said that they were satisfied with vegetable pricing, and 60.8% of the respondents cited high costs as a result of supply not keeping up with demand. Agronomic practices, farm size, gender, marital status, and price satisfaction were among the important variables that influenced production. Production was adversely affected by pricing and inadequate extension services. In order to boost vegetable production in Tabora Municipality, there is a need for addressing gender inequities, improving extension services, stabilizing market pricing and promoting agronomic practices.

Keywords: Production factors; vegetable production; small-scale farmers; Tabora Municipality.

1. INTRODUCTION

Vegetable farming serves as a vital function in strengthening food security and nutrition, and increasing household income. It provides a dependable supply of vital nutrients, making a substantial contribution to the nutritional requirements of human being (Noopur et al., 2023). Delgado and Siamwalla (2018) established that vegetable production yields significant economic benefits by creating job prospects and earning revenue for rural people. The prospect of vegetable production fulfilling daily requirements has motivated farmers to participate in its growing, not just for immediate consumption but also for selling to enhance their livelihoods and well-being (Szumelda, 2019). Global vegetable production increased from 446 million tons in 2000 to 1,128 million tons in 2022 as a result of this potential being realized (Statista, 2024). Records show that, in Africa, vegetable production rose from 44.4 million tons in 2000 to 88.5 million metric tons in 2022 (Statista, 2024).

Several studies have identified factors influencing vegetable production on a national, regional, and worldwide scale. For example, growing market in agriculture, population expansion, and fast urbanization have caused substantial changes in the geographical distribution of vegetable production in China, the world's biggest producer and exporter of vegetables (Statista, 2024). The Chinese vegetable industry has difficulties such as escalating production costs, unstable prices, and increasing customer worries about the quality and safety of the products (Zhan, 2022). Similarly, the production of vegetables is seen as a vital

component of sustainable agriculture by India, the world's second-largest producer of vegetables (Ahmad et al., 2018). Vegetable growers face several obstacles, such as limited awareness of enhanced cultivating methods and varieties, dispersed farms, far-off markets, insufficient storage facilities, low produce prices during the cropping season, and expensive transportation (Oppenkowski, 2019; Gatahi, 2020).

To maximize the benefits of vegetable farming, production methods must be efficient and sustainable. Family size, educational attainment, and extension contact all had a beneficial impact on technical efficiency of agriculture production (Kitole et al., 2024; Parajuli and Thapa, 2024). Agrochemical usage, fertilizer use, farm size, and seed amount all had a beneficial effect on production (Zhang et al., 2021). Vegetable production in Tanzania boosts the local economy by offering a variety of revenue streams that lessen reliance on a single source of income and by generating jobs in the agricultural, transportation, packing and marketing sectors (van der Madenet et al., 2021). Statistical records indicate that the market value of vegetables in Tanzania was \$2.17 billion in 2024 and rose to \$2.98 billion in 2029 (Ministry of Agriculture, 2024). Despite this increase, Tanzanian vegetable growers confront a number of hindrances that lower output apart from climate change vagaries. Floods, protracted droughts, irregular rainfall patterns, and rainfall shortages in central zone of Tanzania, especially Dodoma, Singida and Tabora regions are obvious effects of climate change impacting negatively the vegetable production sub-sector (URT, 2019).

Studies on the production of vegetables have revealed a number of issues that affect yield and productivity. Saleemet al. (2023) demonstrated that soil fertility is among the important factors that affect plant growth and development. Valladet al. (2018) pointed out that the catastrophic impacts of pests and diseases not only harm crops but also call for the introduction of disease-resistant cultivars and pest management techniques. According to Gneiting and Sonenshine (2018), market access is a major barrier since small-scale farmers find it difficult to sell their goods, which reduces their ability to generate revenue. Additionally, Tenaye (2020) reported that increase in agricultural production and efficiency is hampered by a lack of financial and technological resources.

In Tabora Municipality, over 70% of the residents rely on agriculture as their main source of income, making it a vital economic activity (URT, 2023). Although the area is well known for producing fruits, vegetables, and basic commodities such as cassava, tobacco, and maize (URT, 2020); productivity levels are still uneven. Programmes to assist small-scale farmers via market connections, financial access, and training have been implemented by government and non-governmental groups. However, in spite of implementation in the region, vegetable production is still low.

The low production of vegetables indicates the need of a focused comprehensive study to ascertain the variables affecting vegetable production in the Tabora Municipality. Understanding the interaction of particular internal and external factors, such as social, economic, institutional, and political dynamics in the context of vegetable farming has received little attention in vegetable farming, despite the fact that previous studies have examined broad issues like soil fertility, pest management, market access, and financial constraints. This study, therefore, looked into factors affecting vegetable production in Tabora Municipality. Specifically, the study explored the knowledge of farmers about different aspects of vegetable farming, and quantified the variables affecting vegetable production in Tabora Municipality. Gaining an understanding of these variables informs interventions to improve production and productivity of small-scale vegetable growers in the study area.

2. METHODOLOGY

2.1 Profile of the Study Area

Tabora Municipal Council is located between latitudes 4° and 7° south of the Equator and between longitudes 31° to 34° east of the Greenwich Meridian in Tabora region, central-western Tanzania. The district was selected due to notable shift among farmers from rain-fed agriculture to irrigated vegetable production, which was prompted by adverse effects of climate change, including prolonged drought and unreliable and erratic rainfall patterns. Vegetables are particularly doing well in this environment due to their adaptability, shorter growing period and lower water requirements.

Rainfall ranges from 650 to 850 mm per annum, while the temperature ranges from 20°C to 33°C and relative humidity ranges between 25% and 65% (URT, 2023). Tabora Municipality has a total population of 308 741 (150 416 are males and 158 325 are females) and an average household size of 4.2 people (URT et al., 2022). The council is administratively structured into two divisions, and encompasses 29 wards. The council has 109 226 hectares (ha), of which 70 498.25 ha are designated for farming and livestock keeping, with an additional 4 892 ha deemed suitable for irrigation (URT, 2023). Agriculture plays a pivotal role in the region's economy, accounting for 74% of its Gross Domestic Product (GDP), while trade and small-scale industries contribute the remaining 26% (URT et al., 2022). Maize, sweet potatoes, cassava, and paddy are the main food crops, whereas tobacco, cotton, and various vegetables such as eggplant, spinach, tomato, Chinese cabbage, carrot, onion and okra serve as prominent cash crops (URT, 2018).

2.2 Research Design

The study used a cross-sectional research design which allowed primary data to be gathered at one point in time involving different methods and from different sources. The design was selected because of its efficiency in determining the relationship between variables at a time.

2.3 Sampling Procedure and Sample Size

The study utilized a multistage sampling procedure. The first stage involved a purposive sampling technique to select two divisions and

two wards from each division, prioritizing areas with higher concentration of vegetable farmers. In the second stage, a random selection process was employed to choose three wards from four thereby minimizing the risk of over-representing a homogeneous population. In the third stage, two villages were randomly selected from each ward to make a total of six villages. The sample size for vegetable growers was calculated using Kothari's (2006) formula as recommended by Hasan and Kumar (2024), which is deemed appropriate for determining sample size in finite population.

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

Where n is the sample size, Z is the confidence level 95% score, which is 1.96, p is a sample proportion = 0.1, q = 1-p where q is equal to 0.9 and e is the sampling tolerable error, which is 0.05, and N is the size of the population. For this study, the population was 900 vegetable farmers. Computing the sample using the above formula gave the sample size of n = 119.9945, which was approximated to 120.

$$n = \frac{1.96 \times 1.96 \times 0.1 \times 0.9 \times 900}{0.05 \times 0.05(900 - 1) + 1.96 \times 1.96 \times 0.1 \times 0.9}$$

$$n = \frac{311.1696}{2.5932}$$

In the final stage, an equal number of participants were purposely selected from six villages to ensure representation among individuals engaged in vegetable gardening. Purposive sampling was applied to select focus group discussion based on their being regarded to have relevant information about vegetable farming in the research area. Purposive sampling was also used to select key informant interviews based on them holding civil service and leadership in the research area. The focus group participants included experienced farmers specializing in vegetable gardening. The key informants included personnel from the Municipal Agriculture, Livestock, and Fisheries Officer's (MALFO) Office, Ward Agricultural Extension Officers (WAEOs).

2.4 Data Collection and Analysis Methods

Data collection was done using a mix of qualitative and quantitative approaches. The aim was to gain broad knowledge of how farmers employed recommended agronomic knowledge and practices in vegetable production and what the determinants that influenced or affected the

production process at household level. The mixed methods approach provided advantages of qualitative and quantitative approaches complementing each other rather than using either method independently. Additionally, the strategy helped validate and triangulate data collection methods.

A structured questionnaire was administered to household heads of vegetable growers to collect information on their production practices, socioeconomic characteristics, and factors affecting vegetable growing. Additionally, in-depth interviews were done with key stakeholders including agricultural extension officers and local market merchants, provided qualitative insights into the challenges and opportunities in vegetable production. To supplement primary data, secondary data were collected from different sources such as agricultural reports, and peer review journal papers.

Quantitative data were systematically coded, entered, cleaned, and analysed utilizing the Statistical Package for Social Sciences (SPSS) software. Through application of descriptive analysis and cross-tabulation, relationships between variables were explored, generating tables and graphs. To examine determinants influencing vegetable production, a binary logistic regression model was used. The model's goodness of fit was assessed using the Wald test and Hosmer-Lemeshow test. The independent variable in the model was farmers' response towards access to extension services and market information, which is binary in nature.

The binary logistic regression model that was used is shown below:

$$\log \frac{p}{1-p} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \dots + \beta_n X_n + \varepsilon$$

Whereby:

P is the probability of obtaining high vegetables' production, P-1 is the probability of obtaining less vegetable production, β_0 = Y intercept, β_i = Regression coefficients, ε = Error term, $X_1 \dots X_n$ = Independent variables (X_1 = Sex, X_2 = Age, X_3 = Education X_4 = Marital, X_5 = House hold size, X_6 = Soil quality, X_7 = Market information, X_8 = Access to agricultural extension X_9 = Quality of extension, X_{10} = Market channels, X_{11} = Satisfaction with price, X_{12} = Vegetable price and X_{13} = Agronomic practices.

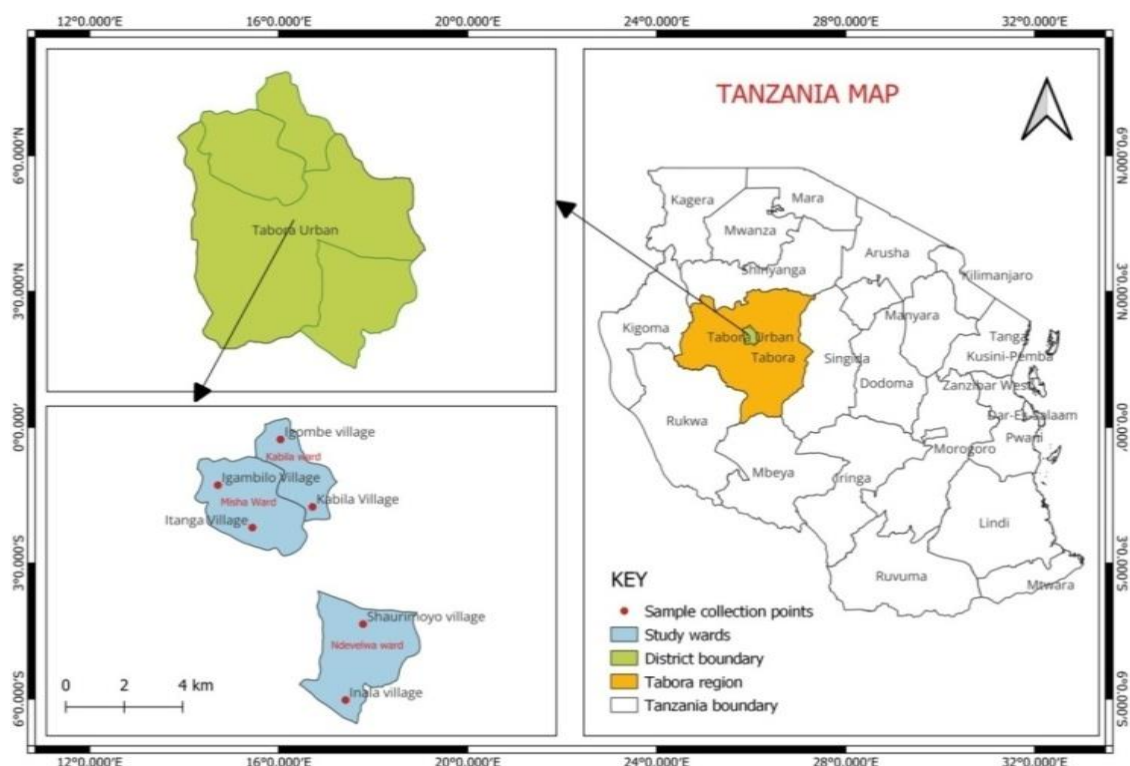


Fig. 1. Maps of Tanzania and Tabora Region showing the location of the study area (Tabora Municipality)

3. RESULTS AND DISCUSSION

3.1 Demographic Characteristics of Respondents

The results in Table 1 show that 64.2% of the respondents were male while 35.8% were females. These results show that there were more male vegetable farmers than females vegetable farmers involved in vegetable production. Vegetable production was, therefore, male dominated in the study area. About age groups, overall, the results showed that 40.85% of the respondents involved in the study were in the age group of 36 to 45 years. The respondents in this age group were energetic and adult enough to participate well in vegetable production. Members of this age group are energetic, which is required for vegetable production which is done manually (Omar et al., 2021).

The further implication of members of this age is that they are likely to be more responsive to vegetable production in the study area (Brown et al., 2019). With regard to education, the results in Table 1 show that the majority (83.3%) of the respondents had primary education, while few of

the respondents; 8.3%, 5.8% and 2.5%; had secondary, college and university education, respectively. The overall results showed that all the respondents involved in the study had formal education. The results imply that the farmers could interpret well market information, if communicated to them. They could also be able to access the information they received and sort out the information that is relevant to them (Šumanec et al., 2018). With regard to marital status, the results in Table 1 show that 70.0% of the respondents in Ndevelwa Ward, 87.5% in Misha, 90.0% in Kabila and 82.5% were married. This implies a stable population with high chances of success in agricultural production due to reduced migration (Rayasawath, 2018). It, therefore, means that they would be involved in vegetable production for a long period of time, and were interested in market information relevant to their production.

Finally, the respondents involved in the study had long experience in farming. Overall, the results in Table 1 show that 55.0% of the respondents had an experience of more than 10 years. Farmers with long experience in farming are more likely to produce more vegetables than ones with less experience.

Table 1. Respondents' demographic data

Demographic data	Ward							
	Ndevelwa		Misha		Kabila		Overall	
	n	%	N	%	n	%	n	%
1. Sex of household head								
Male	24	60.0	21	52.5	32	80.0	77	64.2
Female	16	40.0	19	47.5	8	20.0	43	35.8
Total	40	100.0	40	100.0	40	100.0	120	100.0
2. Age of household head								
25 and below	4	10.0	2	5.0	3	7.5	9	7.5
26 – 35	8	20.0	8	20.0	11	27.5	27	22.5
36 – 45	18	45.0	13	32.5	18	45.0	49	40.8
46 – 55	8	20.0	13	32.5	5	12.5	26	21.7
> 55	2	5.0	4	10.0	3	7.5	9	7.5
Total	40	100.0	40	100.0	40	100.0	120	100.0
3. Education level								
Primary	31	77.5	32	80.0	37	92.5	100	83.3
Secondary	5	12.5	3	7.5	2	5.0	10	8.3
College Education	3	7.5	3	7.5	1	2.5	7	5.8
University level	1	2.5	2	5.0	0	0.0	3	2.5
Total	40	100.0	40	100.0	40	100.0	120	100.0
4. t Marital Status of the household head								
Married	28	70.0	35	87.5	36	90.0	99	82.5
Single	3	7.5	3	7.5	2	5.0	8	6.7
Widow	1	2.5	2	5.0	0	0.0	3	2.5
Divorced/separated	8	20.0	0	0.0	2	5.0	10	8.3
Total	40	100.0	40	100.0	40	100.0	120	100.0
5. Experience in farming (Years)								
2 – 5	6	15.0	6	15.0	14	35.0	26	21.7
6 – 10	15	37.5	8	20.0	5	12.5	28	23.3
> 10	19	47.5	26	65.0	21	52.5	66	55.0
Total	40	100.0	40	100.0	40	100.0	120	100.0

3.2 Knowledge of Farmers on Different Aspects of Vegetable Farming

3.2.1 Knowledge on agricultural practices

This study investigated farmers' knowledge about the importance of soil quality and fertility in vegetable production. Overall, the results in Table 2 show that the majority (90%) of the respondents reported that soil quality and fertility affected vegetable production, indicating their awareness of soil fertility. Furthermore, the results show that there was an increase in vegetable production as a result of improvement of soil fertility. The study revealed that soil fertility and nutrient management were important factors for crop yield and quality. This finding is in line with findings by Brust (2019) who found that soil fertility in vegetable crop production was an important factor for boosting vegetable productivity.

This study also examined respondents' access to agricultural extension services. The results in Table 2 show that the majority (90%) of the respondents in Ndevelwa Ward had access to

agricultural extension services while 97.5% and 82.5% in Misha and Kabila Wards, respectively, had also access to agricultural extension services. An advisory service from extension was the main service that most respondents received from extension workers. Overall, the results in Table 2 show that 60% of the respondents in Kabila Ward reported that level of agricultural extension service provided to them was low. These results are in line with the findings by Baloch and Thapa (2018) who reported that low extension services provided to farmers affect their adaptability to recommended practices and innovative solutions. The results from the study show that the impact of the agricultural extension agents on vegetable production cannot be underestimated; it was that most of the vegetable farmers who had adopted the extension services disseminated to them had no regret whatsoever after the adoption. Most of the benefits and assistance the respondents got from the extension agents included supply of fertilizers and quality seeds which were planted by the farmers in order to have better yields than their previous yields.

Table 2. Farmers knowledge of agricultural practices

Agricultural Practices	Ndevelwa		Misha		Kabila		Overall	
	n	%	n	%	n	%	n	%
1. If soil quality and fertility affect vegetable production								
Yes	36	90.0	39	97.5	33	82.5	108	90.0
No	4	10.0	1	2.5	7	17.5	12	10.0
Total	40	100.0	40	100.0	40	100.0	120	100.0
2. Effect of soil health on vegetable production								
Increase of production	32	80.0	24	60.0	26	65.0	82	68.0
Improve quality	2	5.0	5	12.5	3	7.5	10	8.0
Reduce cost of production	6	15.0	11	27.5	11	27.5	28	24.0
Total	40	100.0	40	100.0	40	100.0	120	100.0
3. Access to agricultural extension services								
Yes	29	73.0	29	73.0	18	45.0	74	62.0
No	11	28.0	11	28.0	24	60.0	46	38.0
Total	40	100.0	40	100.0	40	100.0	120	100.0
4. Type of agricultural extension services								
Extension service	Ndevelwa		Misha		Kabila		Overall	
	n	%	n	%	n	%	N	%
Training	1	3.0	4	10.0	0	0.0	6	5.0
Technology transfer	1	3.0	0	0.0	0	0.0	2	2.0
Advisory services	38	95.0	36	90.0	40	100.0	112	93.0
Information dissemination	0	0.0	0	0.0	0	0.0	0	0.0
Total	40	100.0	40	100.0	40	100.0	120	100.0
5. Level of extent of agricultural extension service received								
To a great extent	9	23.0	13	33.0	2	5.0	24	20.0
To some extent	20	50.0	12	30.0	14	35.0	46	38.0
Less extent	0	0.0	3	8.0	0	0.0	3	3.0
Not at all	11	28.0	12	30.0	24	60.0	47	39.0
Total	40	100.0	40	100.0	40	100.0	120	100.0
6. Use of recommended agronomic practices								
Yes	32	80.0	30	75.0	31	77.5	93	77.5
No	8	20.0	10	25.0	9	22.5	27	22.5
Total	40	100.0	40	100.0	40	100.0	120	100.0
7. Types of agronomic practices use								
Crop spacing	11	27.5	12	30.0	12	30.0	35	29.2
Proper irrigation technique	25	62.5	24	60.0	29	72.5	78	65.0
Seed selection	24	60.0	20	50.0	18	45.0	62	51.7
Integrated pest management	17	42.5	12	30.0	14	35.0	43	35.8

Production of vegetables mainly depends on certain factors such as good quality seeds, improved (hybrids) seed varieties, agronomic practices, crop management technology, nutrient management, weed management as well as disease and pest management (Gupta and Thind, 2018; Kumar and Prasad; Thind and Mahal). This study established that about 80%, 75% and 77.5% of the respondents in Ndevelwa, Misha and Kabila Wards applied recommended agronomic practices in vegetable production, respectively. The results further showed that over a half of the respondents, 65% and 51.7%, had proper small-scale irrigation techniques and seed selection, respectively, which were the two commonly used agronomic practices in vegetable production in the study area.

3.2.2 Knowledge of marketing and vegetable pricing

As vegetables are highly perishable, they start to lose their quality right after harvest and continue losing it throughout the process until they are consumed. For this purpose, efficient and extensive marketing channels, facilities and equipment for vegetables are vital. Due to the perishable nature and biological nature of the production process it is difficult to schedule the supply of vegetables to market demand (Tort, 2022). Hence, this study explored the accessibilities of market information, market channels and vegetable price. The results in Table 3 show that the majority, 99.2% and 95.8%, of the respondents reported having access to market information and market channels, respectively. The study further revealed that the

majority 87.5% of the respondents mentioned price trends as their most preferred type of information sought. This result is in line with results by (Liu and Ma, 2015) about the factors affecting marketing of vegetables among Small-Scale Farmers in West Bengal. The study showed that the significant factors determining the arrival of vegetable crops positively in the market were price, production, farm size, extension contact, competition and transportation. Appropriate marketing outlets and market players are critical in ensuring that vegetables are delivered on time from growers to consumers. Marketing is the activity of directing the flow of products and services from the manufacturer to the customer or user (Mowar, 2022). The findings in Table 3 show that the majority, 67.5% and 60.8%, of the respondents involved in this study reported wholesale markets and local markets, respectively, as the types of marketing channels they preferred.

In addition to access to market information and market channels, 70% and 60.8% of the respondents reported that vegetable prices were favourable and high respectively. The reason for the satisfaction with the price could be due to high demand for vegetables.

3.3 Factors Influencing Vegetable Production

Binary logistic regression analysis was used to establish factors that influenced vegetable production in Tabora Municipality, and the results are in Table 4. Farm size, use of agronomic practices, sex, marital status, pricing satisfaction, vegetable prices and access to extension services were significant factors that influenced vegetable production ($p < 0.05$). These results demonstrate how agronomic, market, and socioeconomic variables interacted with other factors to influence agricultural outcomes.

Table 3. Respondents' knowledge about marketing and price in relation to vegetable production

Market Service	Ndevelwa		Misha		Kabila		Overall	
	n	%	n	%	n	%	n	%
Access to market information								
Yes	39	97.5	40	100.0	40	100.0	119	99.2
No	1	2.0	0	0.0	0	0.0	1	0.8
Total	40	99.5	40	100.0	40	100.0	120	100.0
2. Type of marketing information preferred in vegetable production								
Supply and demand	0	0.0	5	12.5	4	10.0	9	7.5
Competitive analysis	0	0.0	2	5.0	1	2.5	3	2.5
Consumer preferences	0	0.0	2	5.0	1	2.5	3	2.5
Price trends	40	100.0	31	77.5	34	85.0	105	87.5
Total	40	100.0	40	100.0	40	100.0	120	100.0
3. Availability of market channels								
Yes	37	92.5	38	95.0	40	100.0	115	95.8
No	3	7.5	2	5.0	0	0.0	5	4.2
Total	40	100.0	40	100.0	40	100.0	120	100.0
4. Type of market channels								
Local markets	24	60.0	22	55.0	27	67.5	73	60.8
Supermarkets	0	0.0	0	0.0	0	0.0	0	0.0
Direct sales to consumers	0	0.0	0	0.0	0	0.0	0	0.0
Wholesale markets	25	62.5	26	65.0	30	75.0	81	67.5
5. Favorable price of vegetable								
Yes	29	72.5	29	72.5	26	65.0	84	70.0
No	11	27.5	11	27.5	14	35.0	36	30.0
Total	40	100.0	40	100.0	40	100.0	120	100.0
6. Level of price of vegetable crops								
Low	13	32.5	16	40.0	17	42.5	46	38.3
High	27	67.5	24	60.0	22	55.0	73	60.8
Very high	0	0.0	0	0.0	1	2.5	1	0.8
Total	40	100.0	40	100.0	40	100.0	120	100.0

Table 4. Factors influencing vegetable production in rural wards in Tabora Municipality

Independent Variables	B	S.E.	Wald	df	Sig.	OR	Sign.
Sex	1.164	0.333	16.907	1	0.000	3.937	***
Age	0.012	0.016	0.533	1	0.465	1.012	
Education	0.027	0.278	0.009	1	0.924	1.027	
Marital status	1.000	0.151	6.094	1	0.014	1.450	*
Soil quality and fertility	0.207	0.520	0.158	1	0.691	1.230	
Availability of market Info	18.885	2.842	0.000	1	0.999	1.590	
Availability of extension	0.461	0.415	1.238	1	0.266	1.586	
Quality of extension	-1.577	0.473	6.338	1	0.012	0.304	**
Availability of market channels	-1.382	0.991	1.944	1	0.163	0.251	
Price satisfaction	-3.421	0.858	10.823	1	0.001	0.059	***
Vegetable price	0.946	0.806	11.204	1	0.001	14.836	***
Use of agronomic practices	-0.946	0.453	5.252	1	0.022	2.821	**
Household size	0.056	0.049	1.319	1	0.251	1.057	
Own farm Size	0.087	0.030	5.157	1	0.023	1.070	**
Constant	-24.248	2.842	0.000	1	0.999	0.000	

N.B. *** means significant at 0.1%; ** means significant at 1%, and * means significant at 5%

According to the findings, male respondents had higher chances to engage in vegetables production, with the odds ratios (OR) = 3.937). This Finding is in line with findings by Karakaraet al. (2024) who found that male farmers typically had better access to agricultural resources such as land, loans, and markets. Women's engagement in high-value agricultural occupations is restricted in many rural African environments by institutional impediments. All farmers may benefit from increased production and incomes if these gender gaps are addressed by focused measures, such as expanding women's access to resources.

Vegetable production was favourably impacted by marital status (OR = 1.450). Married farmers often gain from cooperative decision-making, shared work, and pooled resources, all of which increase production. The findings are consistent with ones by Takeshima (2024) who found that marital status in agricultural tasks often yields superior results. Productivity and revenue could further be maximized by promoting family collaboration via training programmes or efforts that include both spouses in agricultural choices. Vegetables production was significantly impacted by the quality of agricultural extension services. This is in line with Chowdhury and Kabir (2024), who emphasize the vital role that good advisory services play in enhancing agricultural methods. Farmers often find it difficult to embrace contemporary technology or successfully manage risks when they do not have access to high-quality information. Productivity might be greatly increased by

funding extension officers' training and making sure they provide timely, relevant, and useful advice to farmers.

Price satisfaction and vegetable pricing are two examples of market forces that significantly impacted vegetables production. While increasing vegetable prices significantly encouraged farmers to boost production (OR = 14.836), price dissatisfaction had a considerable negative impact on earnings (OR = 0.059). These results are consistent with those by Morepjeet al. (2024), who noted that, in order to motivate smallholder farmers, equitable pricing methods are essential to encourage them. Farmers may assure equitable returns and encourage more agricultural investment by strengthening market systems and stabilizing prices via regulations or cooperatives.

Productivity were favourably impacted by the use of suggested agronomic techniques (OR = 2.821). This finding is in line with Rajiet al. (2024) and Javaidet al. (2023), who showed that better agricultural methods helped to increase production and yield to farmers who used contemporary techniques. Similarly, since bigger plots allowed for higher production scaling and diversity, farm size had a positive impact on revenue (OR = 1.070). Smallholder farmers' production could be increased by policies that promote the use of agronomic best practices and encourage fair access to land. These findings highlight the intricate interactions between institutional, commercial, and socioeconomic issues that affect the results of vegetable production. To increase production, it is imperative to address

gender disparities, boost extension services, stabilize market pricing and support contemporary agronomic techniques. Policies that encourage married families and provide fair access to land might also improve production systems.

Key informant interviews (KII) revealed that soil fertility, extension services, and market instability are key factors affecting vegetable production in Tabora. Experts noted that poor soil management reduces yields, and while extension services are available, their quality is inconsistent. A market officer emphasized that price fluctuations hurt farmers due to lack of organized selling. Recommendations included improving extension support, stabilizing market prices, and promoting better farming practices.

Focus group discussions (FGD) highlighted challenges in agronomic practices, water access, and market instability. Farmers acknowledged the benefits of following guidelines but cited resource constraints. Water shortages were a major issue, with one farmer stating, "During the dry season, we struggle to water our crops." Gender disparities also emerged, with women facing land access difficulties. Farmers recommended better irrigation infrastructure, financial support, and gender-inclusive policies to enhance vegetable production.

4. CONCLUSION

This paper sought to determine level of knowledge of smallholder farmers and factors influencing vegetable production in Tabora Municipality. The key findings have uncovered some important insights into level of knowledge of farmers on soil health improvement, which is essential in increasing crop production.

Agricultural extension services were reported as essential for spreading recommended practices. Lack of reliable market for vegetable production, especially with regard to perishability vegetables, and demand-supply imbalances influence the production of the vegetable in the district. However, these were mostly lessened by having access to market information and offering competitive prices. The study revealed that improvement of vegetable production was associated with good soil health, management, and consistency access to agricultural extension services.

Notably, revenue from vegetable production was adversely improved by the quality of extension services; indicating that lower income is connected with greater perceived quality of extension services. Besides, there was a positive relationship between vegetable prices and vegetables production. The higher the vegetable prices, the higher the vegetable production. Appropriate application of recommended practices had influence on the amount of revenue generated. The study has contributed to new information of factors influencing vegetable production in Tanzania to the existing body of knowledge by emphasizing the nuanced link between extension service quality and vegetable production, indicating that perceived greater service quality does not necessarily translate into improved production and/or revenue. It also emphasizes how important market mechanisms are for reducing the impact of perishable agricultural difficulties, including price and information availability. The results support the Resource-Based View (RBV) theoretical framework as it shows how internal resources, like knowledge and soil management, along with external supports, like market access, improve competitive advantage and production in vegetable farming.

5. RECOMMENDATION

The study's findings showed that variation in the quality of extension services provided by extension agents to farmers led to high vegetable production. This shows that there is a need for policies to prioritize standardization of quality of agricultural extension services, guaranteeing that novel and useful farming methods are consistently provided to increase production.

Besides, in order to improve crop production and quality, there should be implementation of focused initiatives and incentives that motivate farmers to embrace sustainable soil fertility management techniques, such as appropriate fertilization. It is also recommended that, to better handle the perishable nature of vegetables, strengthening and diversifying marketing channels should be done. This entails creating more effective market connections to match supply with demand as well as enhancing the infrastructure for transportation and storage. It also recommended that Tabora Municipal Council management should develop training initiatives and awareness

campaigns to support the adoption of suggested agronomic practices, highlighting their beneficial effects on farmer profitability and production efficiency.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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