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FACTORS INFLUENCING COMMERCIALISATION AMONG SMALLHOLDER CABBAGE FARMERS OF THE BUFFALO CITY METROPOLITAN MUNICIPALITY OF SOUTH AFRICA: A CRAGG DOUBLE-HURDLE MODEL APPROACH

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Abstract. Literature suggests that there are high levels of commercialisation by even the poorest and smallest landholders within the horticulture subsector in most rural Africa. Thus, the notion of poor commercialisation among smallholder farmers is now being challenged. Against this background, this paper estimated factors that influence commercialisation by smallholder cabbage farmers in the Eastern Cape Province of South Africa. The study used a cross-sectional survey of 120 smallholder cabbage farmers obtained through a multistage sampling procedure. A Cragg double-hurdle model was applied to analyse the factors that influence the commercialisation decision and intensity of commercialisation. In the first stage, the result of the probit regression model revealed that gender, age, access to informal credit and area planted were significant factors towards influencing smallholder cabbage farmers' commercialisation decisions. In the second stage, the results of the truncated regression model revealed that family size and area planted were the key factors determining the intensity of commercialisation. Hence, the attempts to improve smallholder farmers' cabbage commercialisation should be guided by these significant explanatory variables in the study area, given the low commercialisation index revealed.

Keywords: cabbage, commercialisation, decision, intensity, smallholder farmers

INTRODUCTION

According to the Department of Agriculture Forestry and Fisheries (2018), commercialisation of agriculture means farming with a commercial orientation where outputs are destined for formal markets. The benefits of commercialisation in agriculture are widely perceived to be positive, ranging from micro-level improvement in formal market access, premium prices, household income, food and nutritional security as a result of macro-level improvement in trade, efficiency, economic growth and welfare improvement (Carletto et al., 2017). Literature, however, cautions on the nutritional outcomes of commercialisation and its implications on the most vulnerable household members unable to benefit from increased market orientation (Carletto et al., 2017). This, therefore, suggests that although widely acknowledged, commercialisation also poses challenges that are worth noting. Against this background, South Africa emerged from an era in which agricultural production was divided into two clearly discernible systems: subsistence farming for black people and commercial farming mainly for whites (Bryceson, 2019). Subsistence farming was mainly meant for household consumption, while commercial farming was more oriented towards providing for formal local and international markets (Nekhavhambe, 2017).

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In an effort to support commercialisation among subsistence black farmers, the South African government has implemented policies and programmes and increased the budget spent on supporting smallholder farmers (Department of Agriculture Forestry and Fisheries, 2017; National Agricultural Marketing Council, 2016). According to the National Agricultural Marketing Council (2016), approximately ZAR 381 million has been invested in smallholder farming following the reprioritisation of the Comprehensive Agricultural Support Programme and *Ilima/Letsema* funds to support farmers. Sikwela and Mushunje (2013) also highlighted that there are several support schemes availed to small and emerging farmers in South Africa, which include Industrial Development Corporation (IDC), Small Enterprise Development Agency (SEDA) and established producers' associations along with non-governmental organisations (NGOs).

Despite these efforts, the literature suggests that the several strategies aimed at assisting the smallholder, predominantly black farming sector, to shift towards commercial farming by the South African government registered minimal success (Nekhavhambe, 2017). With this background, several studies report that most smallholder farmers produce for subsistence purposes with minimal commercial orientation (Abdullah et al., 2019; Khapayi and Celliers, 2016; Nekhavhambe, 2017). On the contrary, a high commercialisation rate is reported among smallholder farmers in other agricultural subsectors like horticulture. For example, Zantsi et al. (2018) noted that in the Eastern Cape Province of South Africa, the degree of smallholder cabbage market participation was 70%. Literature from other African countries also suggests high levels of commercialisation by even the poorest and smallest landholders, with market participation rates as high as 90% (Carletto et al., 2017). Thus, the notion of poor commercialisation among smallholder farmers is now being challenged, especially in the horticulture subsector. Given the claimed benefits of the commercialisation of agriculture (Nchanji et al., 2018) though being challenged mostly on nutritional grounds (Carletto et al., 2017), this study was guided by the following objectives. Firstly, the study estimated the commercialisation index of smallholder cabbage farmers from the study area. Secondly, the study estimated factors that influence the decision to commercialise and the intensity of commercialisation.

MATERIAL AND METHODS

Description of the study area

According to the Department of Economic Development Environmental Affairs and Tourism (2015), the Eastern Cape Province of South Africa primarily consists of rural areas that house more than 60% of its population, and agriculture is the key pillar of the economy. The study was conducted in three villages (Kwa-Kalikeni,

Fig. 1. Buffalo City Metro Municipality, South Africa
Source: Buffalo City Metropolitan Municipality, 2020.

Kwa-Altile and Twecu) located in the Buffalo City Metropolitan Municipality situated on the east coast of the Eastern Cape Province, South Africa. Figure 1 presents Buffalo City Metropolitan Municipality.

Buffalo City Metropolitan Municipality, on average, receives rainfall totals of 784 mm per annum. Most rainfall occurs from September to April (Department of Cooperative Governance and Traditional Affairs, 2019). This suggests a good rainfall distribution pattern across the growing season, although monthly rainfall totals are not exceptionally high. The months of September to March receive the highest rainfall totals (> 60 mm) (Department of Cooperative Governance and Traditional Affairs, 2019). Autumn and winter rainfall is low. Winter crop production will therefore require significant supplementary irrigation. Average minimum temperatures fluctuate between 9°C in June and 15°C in December (Buffalo City Metropolitan Municipality, 2020). On average, the minimum temperatures are below 10°C only in June. Maximum temperatures range from 19°C in July to 27°C in February (Buffalo City Metropolitan Municipality, 2020). The maximum temperatures are below 25°C from April to December. And the average temperatures range from 14°C in July to 22°C in February (Buffalo City Metropolitan Municipality, 2020).

Data and model specification

The study used a cross-sectional research design and followed a multi-stage sampling procedure to select respondents. In the first stage, three villages (Kwa-Kalikeni, Kwa-Altile and Twecu) were purposively selected in collaboration with agricultural advisors from the area, focusing on rural communities with a high number of smallholder cabbage farmers. On average, each village had a population of 100 households, of which most were producing cabbage. In the second stage, 120 respondents were selected randomly, targeting 40 households from each village to enhance a fair distribution of respondents across all the villages.

Theoretical framework

The study models commercialisation of smallholder cabbage farmers using a two-stage process with an output commercialisation index greater than 50% as a precondition for commercialising. The double-hurdle model is based on the underlying theory of rational utility maximisation. Smallholder cabbage farmers are assumed to be rational utility maximisation units that decide to commercialise their production or not. This decision is considered to be based on smallholder farmers' perceived utility obtained from commercialisation subject to its reservation utility, farmer characteristics and resource constraints (Mudemba et al., 2020). Therefore, the utility associated with each choice is not directly observable, while the commercialisation or other choice is observable and unordered, suggesting that smallholder cabbage farmers' commercialisation may be explained by the random utility maximisation theory (Deressa et al., 2008). Thus, a typical smallholder cabbage farmer would choose commercialisation over non-commercialisation if, and only if, the perceived utility from commercialisation is greater than that of non-commercialisation.

Econometrics estimation

Econometrics models can be used to relate observable socio-economic and institutional factors to the commercialisation choices made by smallholder cabbage farmers. Therefore, a double-hurdle approach is appropriate for avoiding sample selection bias and explaining the commercialisation and intensity drivers. Several previous studies used a double-hurdle approach in an effort to minimise sample selection bias (Cheteni et al., 2014; Kassahun et al., 2020; Mudemba et al., 2020). Therefore, the two-stage decision process is conceptualised as follows (Fig. 2): smallholder cabbage farmers decide to commercialise or not – commercialisation index greater than 50% as a precondition for a decision to commercialise (1st hurdle). Then, conditional on their commercialisation decision, smallholder cabbage farmers decide on the intensity of commercialisation – commercialisation index between 51 and 100% (2nd hurdle).

Factors affecting each of the hurdles are specified as a function of household characteristics (HC) and institutional variables (IV). These are broadly specified as illustrated in equations 1 and 2.

$$\text{Cabbage commercialisation decision (CCD)} = (\text{HC, IV}) \quad (1)$$

$$\text{Intensity of cabbage commercialisation (ICC)} = (\text{HC, IV}) \quad (2)$$

Where: cabbage commercialisation decision (CCD) is a dichotomous indicator of whether a smallholder cabbage farmer commercialises or not. Conditional on a smallholder cabbage farmer commercialisation, the intensity of cabbage commercialisation (ICC) is a truncated continuous integer (> 50%) of the ratio of the gross value of cabbage sales by household *i* in year *b* to the

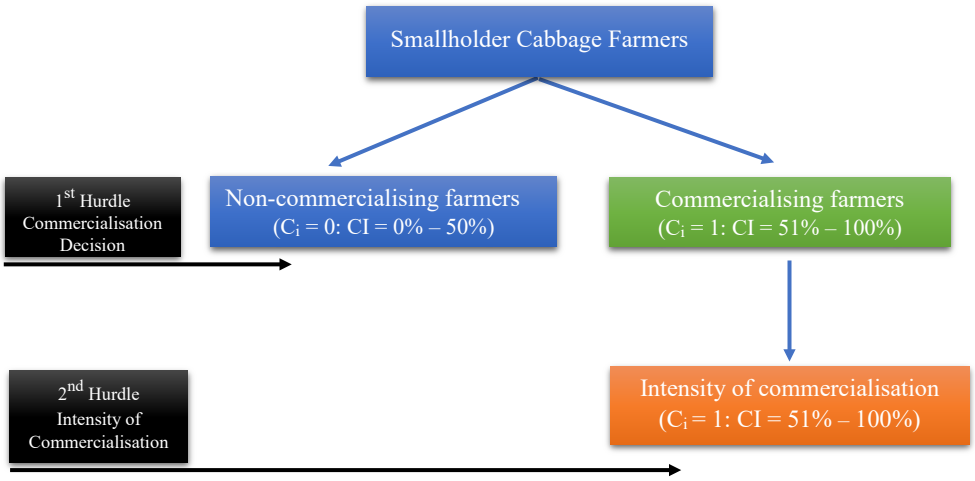

Fig. 2. Sampling and analytical procedure
Source: own elaboration.

gross value of all cabbages produced by the same household *i* in the same year *b* expressed as a percentage.

Household commercialisation index

The household commercialisation index (HCI) was used to determine the household-specific level of commercialisation as used by Agwu et al. (2013) and Govereh et al. (1999). The ratio of the gross value of cabbage sales by household *i* in year *b* to the gross value of all cabbages produced by the same household *i* in the same year *b* expressed as a percentage was measured using this index (Agwu et al., 2013). This approach analyses the commercialisation of cabbage from the output side.

$$\text{HCI}i = \frac{\text{Gross value of cabbage sold by hh } i \text{ in year } b}{\text{Gross value of all cabbage produced by hh } i \text{ in year } b} \times 100$$

where:

HCI*i* = Household commercialisation index for household *i*.

Double-hurdle model

In the econometrics analysis, the double-hurdle model was used. The double-hurdle model was applied to determine both factors influencing the commercialisation decision and the level of commercialisation. In this model, choices are divided into sequential hurdles. In the first stage, the probit regression model is used to determine whether the farmer decides to commercialise or not (output commercialisation index greater than 50% as a decision to commercialise). The second stage involved estimating the determinants of intensity of commercialisation (output commercialisation index in percentage).

The double-hurdle model involves a two-step estimation procedure, according to Cragg (1971). Initially, in the first stage, the probit regression model takes values 1 and 0 that were assigned to represent the choice of whether a smallholder cabbage farmer decides to commercialise or not. Then, following Wooldridge (2002), the standard probit regression model to assess the household's market-entry decision was specified, as illustrated in equation 3.

$$Y_i^* = x_i\beta + e_i$$
$$Y_i = \begin{pmatrix} 1 \; if \; Y_i^* > 0 \\ 0 \; in \; Y_i^* = 0 \end{pmatrix} \quad (3)$$

where:

Y_i – is the dependent variable,

e_i – is independent of x_i which is a 1 by K vector of factors affecting the decision of commercialisation for all respondents (i),

β – is a 1 by K vector of parameters and $e_i \sim N(0,1)$.

The probit model in equation 3 was therefore specified, as illustrated in equation 4.

$$Y_{i1} = \alpha_0 + \alpha_{i1}Z_{i1} + \alpha_{i2}Z_{i2} + \alpha_{i3}Z_{i3} + \ldots \alpha_n Z_n + \mu_i \quad (4)$$

Second stage: In the second stage, the truncated regression model was employed to analyse factors that affect the level of cabbage commercialisation, as illustrated in equation 5 (Wooldridge, 2002).

$$Z_i^* = x_i\beta + \mu_i,\ \mu_i \sim N(0,\delta^2)$$
$$Z_i = \begin{pmatrix} Z_i^*\ if\ Z_i^* > 0\ and\ Y_i = 1 \\ 0\ otherwise \end{pmatrix} \quad (5)$$

where:

Z_i – is the intensification of commercialisation level, which depends on latent variable Z_i^* being greater than 50% and conditional to the decision to commercialise Y_i.

If both decisions are made by the individual cabbage farmer, the error terms are assumed to be independently and normally distributed as: $\mu_i \sim N(0,\delta^2)$.

Thus far, the log-likelihood functions as the double-hurdle model that nests a univariate probit and a truncated regression model are given, as illustrated in equation 6 (Cragg, 1971).

$$\text{LogL} = \sum \ln\left[1 - \Phi(Z_i'\alpha)\left(\frac{x_i'\beta}{\sigma}\right)\right] + \ln\left[\Phi(Z_i'\alpha)\frac{1}{\sigma}\phi\left(\frac{y_i - x_i'\beta}{\sigma}\right)\right] \quad (6)$$

where:

Φ and ϕ refer to the standard normal probability and density functions respectively,

Z_i' and x_i' represent independent variables for the probit model and the truncated model, respectively,

α, σ and β – are parameters to be estimated for each model.

RESULTS AND DISCUSSION

Basic sample statistics

Table 1 present a summary of the sample statistics from the study area. A sample of 120 participants was selected from the study area, with a mean age of 54 years.

The majority of respondents (40%) had primary level education. The basic sample statistics also suggest that the considered sample had more males (56%) than females (44%), with an average monthly income of ZAR 3,892.29. In addition, basic sample results show an average household size of 5 family members, with a minimum of 1 and a maximum of 15 family members. The majority of respondents did not have access to formal credit (88%) and extension services (74%), while

Table 1. Basic sample statistics of the respondents

Categorical variables	Frequency (n = 120)	Percentage (%)
Gender		
Male	67	55.8
Female	53	44.2
Education		
No education	11	9
Educated up to primary level	48	40
Educated up to secondary level	44	37
Educated up to tertiary level	17	14
Formal credit access		
No	105	87.5
Yes	15	12.5
Informal credit access		
No	52	43.3
Yes	68	56.7
Formal market access		
No	55	45.8
Yes	65	54.2
Land ownership		
No	40	33.3
Yes	80	66.7
Extension access		
No	89	74.2
Yes	31	25.8
Membership to farming organisation		
Yes	97	80.8
No	23	19.2

Continuous variables	Mean	Min	Max
Age	53.55	24	92
Income	3 892.29	360	40 000
Family size	5.02	1	15

Source: own elaboration.

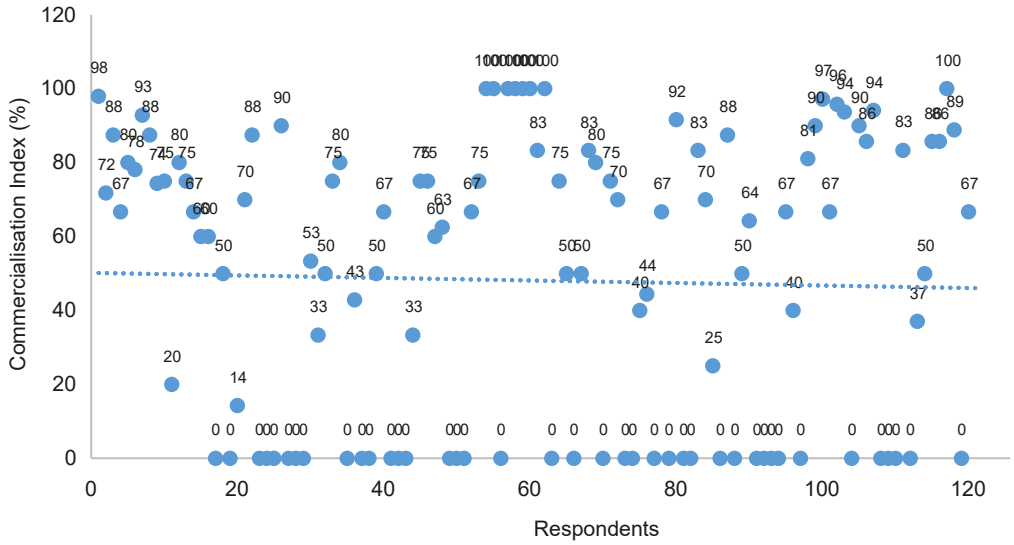

Fig. 3. Smallholder cabbage farmers' commercialisation index from the study area
Source: own elaboration.

most had access to informal credit (57%), formal market (54%) and association membership (81%).

Commercialisation status of smallholder cabbage farmers

Figure 3 presents the commercialisation status of the smallholder cabbage farmers from the study area.

The results show an average commercialisation index of 48%, which suggests a low commercialisation status. The results further reveal that 63 respondents (52.5%) had a commercialisation index between 51 and 100%, while 57 respondents (47.5%) had a commercialisation index between 0 and 50%. The trend line also suggests a downward trend of the commercialisation index. Therefore, these findings reveal that, on average, cabbage farmers' commercialisation index was low and projected to decline further.

Factors influencing commercialisation

This section presents the results for the estimated factors that influence commercialisation, as summarised in Table 2.

Factors influencing cabbage commercialisation decision

The result of the probit model estimation for factors that influence the cabbage commercialisation decision are presented in Table 2. The model chi-square tests applying appropriate degrees of freedom indicate that the overall goodness-of-fit of the models are statistically significant at a 1% probability level. The result of the probit model estimation shows that the likelihood of a smallholder cabbage farmer's decision to participate in cabbage commercialisation was affected by gender, age, access to informal credit and area planted with cabbage.

Gender negatively influence the decision to commercialise, implying male-headed households are more likely to commercialise than their female counterparts. Gender is viewed as one of the most central socio-economic variables influencing smallholder farmers' decisions to commercialise. Generally, women are known to be more actively involved in the production of horticultural crops such as cabbage, while men tend to engage in cash field crops or livestock rearing. Thus, women play a pivotal role in managing gardens which ensures household food security. Nonetheless, the negative association between gender and the commercialisation decision implies that males are more likely to be involved in cabbage commercialisation compared to females, who typically grow cabbages for domestic use. These results are consistent with the findings of Cunningham et al. (2008), who concluded that as the profitability prospects of a particular crop increase, men tend to produce and

Table 2. Craig double hurdle model results

Variables	Coefficient (p-value)
Selection equation (commercialisation decision)	
Gender	–0.4892913 (0.079)*
Age	0.0175935 (0.029)**
Family size	0.0386243 (0.487)
Access to extension services	–0.3385789 (0.313)
Access to formal credit	0.1330564 (0.742)
Access to informal credit	–0.5782849 (0.034)**
Association membership	0.152296 (0.688)
Area planted with cabbage	1.650747 (0.023)**
Access to personal delivery transport	–0.4817974 (0.114)
Cons	0.9784085 (0.419)
Outcome equation (intensity of commercialisation)	
Gender	4.047031 (0.398)
Age	–0.1208114 (0.397)
Family size	–1.302523 (0.028)**
Access to extension services	3.363463 (0.400)
Access to formal credit	1.014058 (0.833)
Access to informal credit	7.065098 (0.192)
Association membership	4.232315 (0.335)
Area planted with cabbage	22.05322 (0.099)*
Access to personal delivery transport	–4.794671 (0.277)
Cons	68.8981 (0.000)

Number of observations = 120; Selected = 63; Non selected = 57.
Wald Chi^2 (9) = 29.70; Prob > Chi^2 = 0.0005; Log Likelihood = -306.5729.
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.
Source: own elaboration.

trade that specific crop. This is because smallholder male farmers tend to be endowed with more resources for cabbage production and market information than their female counterparts. Thus, there is a higher probability of smallholder male farmers being involved in cabbage commercialisation than female smallholder farmers, since in most cases, males are the primary decision-makers in rural households of South Africa.

With reference to **age**, the results reveal a positive association between age and the decision to commercialise. An increase in the age of the household head is associated with an increase in commercialisation. Age in smallholder farming is normally associated with experience and market information critical for commercialisation. The experience triggers productivity (quantity and quality), satisfying market entry volumes needed by most formal markets, while market information provides an opportunity to understand market requirements and prices critical for commercialisation decision-making. These findings reinforce previous studies which suggested that there usually tends to be a positive relationship between commercialisation and age, such that increased production usually is found in older farmers (Bellemare, 2012; Sebatta et al., 2014; Enete and Igbokwe, 2009; Agwu and Ibeabuchi, 2011; Hailua et al., 2015; Abdullah et al., 2019).

The results also indicate that **access to informal credit** is inversely related to the decision to commercialise. Per every rand increase in informal credit, a decrease in commercialisation is expected. These findings suggest that as smallholder farmers gain access to informal credit, they are less likely to make a decision to engage in cabbage commercialisation. However, informal credit usually comes in very small amounts with high interest rates, which might not have a major impact on the cabbage commercialisation of smallholder farmers in terms of their potential to expand and buy inputs. Comparable previous studies also suggest that lack of access to formal credit is a major constrain towards smallholder horticulture farmers' commercialisation (Adekunle et al., 2012; Jaffee, 2003). Similarly, informal credit in most cases is not enough to improve farmers' knowledge and skills through the acquisition of farm inputs and modern technology, which in turn increases market orientation production and ultimately leads to higher commercialisation levels (Agwu et al., 2013; Tirra et al., 2019).

Lastly, the results reveal that the **area planted with cabbage** positively influence the decision to commercialise among smallholder cabbage farmers. Per every hectare increase in the area planted with cabbage, an increase in commercialisation is expected. This is expected because the area planted has a direct bearing on the production surplus arising from economies of scale. Therefore, an additional area planted allocated for cabbage production would increase the chances of cabbage output sold in the formal market and ultimately the decision to commercialise by smallholder

farming households. These results conform with Tufa et al. (2014), where increasing the cultivated land area for horticultural crops would boost production.

Factors influencing intensity of cabbage commercialisation

This section deals with the results of the truncated regression model, which was utilised to examine factors that influence the intensity (level) of cabbage commercialisation. The results demonstrated that the model was statistically significant at a 1% level, indicating the model's goodness of fit to explain the relationships of the hypothesised variables in terms of at least one covariate. The estimation result also showed that the intensity of cabbage commercialisation was affected by family size and area planted, as shown in Table 2.

The intensity of cabbage commercialisation is influenced negatively by **family size**. Per every unit increase in family size, a 1.302523 unit decrease in the decision to commercialise is expected *ceteris paribus*. A plausible explanation for this outcome is that as the family size of smallholder cabbage farmers increases, some of the output might be diverted for household consumption, negatively influencing the intensity of cabbage commercialisation. Thus, households with large family sizes are likely to have reduced intensity of cabbage commercialisation. This emanates from the understanding that smallholder farmers sell surplus after consumption. Therefore, as households' size increases, it is more likely that the surplus will decrease, thereby reducing the intensity of cabbage commercialisation. These results are similar to those of Hailua et al. (2015), who found that family size had a negative effect on crop commercialisation of smallholder farmers of the Tigray Region of Ethiopia. Therefore, this study argues that the labour benefits associated with a large family, which could be expected to trigger productivity, may be far outweighed by the family consumption effect, especially if production is not supported by access to affordable credit and large arable land.

Lastly, the intensity of cabbage commercialisation is also positively influenced by the **area planted with cabbage**. Per every hectare increase in area planted with cabbage, a 22.05322 unit increase in cabbage commercialisation is expected *ceteris paribus*. This is because the area under cabbage is a proxy for the quantity of cabbage produced. Therefore, the amount of cabbage produced is more likely to increase proportionately as the area increases and, as a result, the available quantity for marketing. These findings show that the land size available for cabbage production is critical for determining smallholder cabbage farmers' intensity in cabbage commercialisation. The results also concur with Melese et al. (2018), who found a positive relationship between the area planted for onion and the level of commercialisation by smallholder farmers in the Forega District of Ethiopia.

CONCLUSIONS

This paper concludes that although most smallholder cabbage farmers (52.5%) from the study area had a commercialisation index above 50%, on average, the commercialisation index was low (48%), which suggests a low commercialisation status among this subsector. Furthermore, the result of the probit estimation shows that the likelihood of the household's decision to participate in cabbage commercialisation was affected by gender, age, access to informal credit and area planted. Similarly, the estimation result of the truncated regression model also demonstrated that the intensity of cabbage commercialisation was affected by family size and the area planted with cabbage. Therefore, this paper concludes that smallholder cabbage production from the study area has a low commercialisation status, which can be improved by strategic targeting of socio-economic variables of smallholder farmers.

RECOMMENDATIONS

This paper includes the following policy insights drawn from the findings of this study:

Strategic targeting of socio-demographic factors

- Gender barriers that limit female-headed households from ownership and participation in the commercial production of crops (cabbage) may be targeted to improve the imbalance and promote women-headed households' participation.
- Targeted training for young households in cabbage production may also improve productivity, triggering decisions to commercialise when production volumes increase.
- For labour benefits associated with large family size to positively influence the decision to commercialise, there may be a need to support an increase in area allocated for cabbage production and access to affordable credit to buy inputs.

Strategic targeting of economic and institutional factors

- Public policies that promote access to affordable credit may trigger cabbage productivity and the decision to commercialise.
- An increase in the area allocated to cabbage production supported by access to affordable credit may boost productivity and promote commercialisation.

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