Assessment of youth involvement in agriculture: The case of horticulture postharvest management in Tanzania
Assessment of youth involvement in agriculture: The case of horticulture postharvest management in Tanzania

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Foreword

It is with great pleasure that we are producing this series of monographs. The series is published within the context of the project grant “Enhancing Capacity to Apply Research Evidence (CARE)” funded by the International Fund for Agricultural Development (IFAD) in partnership with the International Institute of Tropical Agriculture (IITA). CARE aims to strengthen the capacity of young African scholars in generating and disseminating evidence-based research results to inform future action plans for governments, policy makers, and rural communities.

The project presently has 80 awardees across Africa from countries such as Benin, Cameroon, DR Congo, Malawi, Morocco, Nigeria, Rwanda, Senegal, Tanzania, and Zambia to explore areas such as ICT access and use by young farmers; Youth unemployment in the development community and the role it plays in foreign direct investment; Motivating agribusiness entrepreneurship; the Employment status of youth in agribusiness in rural areas; Welfare effects of migrating youth on households, and the Rural-urban migration profile of youth. The purpose of this series of monographs is to present research and evidence-based information concerning the nature of the problem and potential solutions, to guide both policy development and program implementation on youth in agribusiness. In many instances, there is little scientific and technical data on aspects of youth growth-oriented agribusiness and rural economic entrepreneurs, despite the sector receiving significant attention.

The sustainability of agriculture and food production relies on young people remaining in rural areas and engaging in agriculture. Many organizations have started to recognize the important role of youth in the agri-food sector and they have acted upon it with success. Africa has the world’s most youthful population, with 60% of the population between the ages of 15 and 24 years. This youth population is being turned into an asset, to drive the transformation of African agriculture into a more productive and market-oriented sector. The traditional view of agriculture as a low productivity sector is now being challenged across Africa. Hordes of young agribusiness entrepreneurs across the continent, with the help of various development partners, are approaching agriculture as a business and speeding up this essential transformation from a low-income subsistence type of chore to an innovative and value-adding agribusiness enterprise. However, many challenges remain to be overcome. IITA, through CARE, is exploring further how it can
facilitate knowledge sharing to advance the work on engaging youth in the agri-food sector in Africa.

I would like to express our gratitude to the CARE awardees for their work on the monographs and their IITA research team in the social sciences, whose contributions and supervision made these publications possible. I sincerely thank IFAD for supporting this initiative. We greatly appreciate IFAD’s grant support to agricultural research and delivery, innovation, job creation, youth engagement in agribusiness, advocacy, and pro-poor technologies.

I hope that you will all enjoy reading this series of monographs, and we look forward to your feedback.

Happy reading,

Nteranya Sanginga
Acknowledgments

My appreciation goes to the International Institute of Tropical Agriculture for sponsoring my fieldwork and training course received on research methodology, data management, scientific writing, and policy brief writing. Also, my appreciation goes to my supervisors Dr Victor Manyong, Dr Aloyce Hepelwa, and Dr Mastewal Yami for constructive comments and encouragement. Also, my appreciation goes to all IITA staff, UDSM staff, my fellow researchers, and Njombe Region and district officers where field research was undertaken, the Ministry of Agriculture, male and female youth for their passion throughout the interview process, enumerators who assisted in data collection and Ms Yvonne Olatunbosun for language editing.
Executive summary

This report presents findings from a study on “the assessment of youth involvement in agriculture: the case of Horticulture Post-Harvest Management (PHM) in Tanzania”. The study uses the survey conducted between November and December 2018 in Njombe Region, Southern Highlands of Tanzania. The aim of the study is to quantify postharvest losses in horticulture farms that are managed by male and female youth in Njombe Region, determine the extent of youth participation (by gender), and factors influencing participation in horticulture PHM. In addition, the study aims at identifying innovations adopted to mitigate horticulture PHLs as an incentive for agribusiness to youth, both male and female. To achieve the study objectives, a field survey was conducted in three districts (Njombe District Council (DC), Njombe Town Council (TC), and Makambako Town Council (TC) on a random sample of 576 male and female youth. Data were analyzed using descriptive analysis, Kruskal-Wallis test, gross margin analysis, and regression analysis (ordered logit model) to ascertain correlations and relationship between social, economic, and agronomic factors as far as farming activities are concerned. The results are that male youth are dominant (59%) in horticulture agribusiness compared to female. In terms of crop losses per district Njombe TC experienced high losses (39%) followed by Njombe DC (37%) and Makambako TC (24%). Severe postharvest losses of horticultural produces occur due to poor agronomic practices (34.8%), poor handling (22.8%), grading (20.9%), packaging (10.04%), transport (11.2%), and harvesting (0.4%). Males recorded they experienced high crop losses in the study area: amaranthus (*Amaranthus Cruentus*) (36%), avocado (*Persea americana*) (33%), cabbage (*Brassica oleracea*) (29%), carrot (*Daucus carota*) (23%), tomato (*Solanum lycopersicum*) (22%), brassica (*Brassica carinata*) (19.5%), and Chinese mallow (*Malva verticillata*) (16.7%). While female youth high losses experienced in brassica (33.4%); Chinese mallow (32.4%); tomato (30.5%); cabbage (29.5%); avocado (22.7%) and minimum losses experienced in amaranthus (5%). Reasons for high crop losses include lack of readily available markets (31.68), poor handling (31.06), poor storage facilities (15.46%), poor transport facilities (9.18), poor roads (6.96), and poor packaging material (5.66). However, females experienced low crop losses due to the fact that they are more involved in vegetable production and marketing and are able to handle perishable crops with care compared to their male counterparts. This is due to the fact that females play a primary role in postharvest activities such as sorting, cleaning, and drying. Furthermore, the perishable nature of vegetables and fruit causes high losses
during harvesting, packaging, transportation, and marketing through mechanical and physiological damage of horticultural crops. The Kruskal-Wallis equality of population rank test was used to test the hypothesis that male and female youth experience the same level of crop losses in their involvement in horticulture. Results showed that male and female youth experience different crop losses in their involvement in horticulture with statistically significant chi-square (8.7) and p-values (p ≤ 0.01). This was supported by descriptive statistic results as aforementioned that male youth experience more crop losses in their involvement in horticulture agribusiness.

To minimize crop losses, most male and female youth (31.4%) reported that they use cleaning, grading (manual sourcing with hands), and spreading the produce on the ground and spraying with water (31%); all local postharvest management (PHM) methods. However, despite using local PHM, they still experience high PHLs (PHLs). This implies that youth in the study area have limited knowledge and information on improved horticultural PHM. However, there are good methods for minimizing PHLs, which include use of harvesting maturity indices to identify proper harvesting time, Zero Energy Cool Chambers (ZECC), and improved transport facilities equipped with cold storage (Kitinoja 2013). All these have not been used by young farmers in the study area.

Results for innovations used show that most respondents were not aware of innovations used to reduce PHLs (69%) and only (31%) were aware of innovations used to reduce PHLs like grading, harvesting at the coolest time of the day, use of improved storage facilities, and improved packaging materials like plastic crates. These were the only management innovations used to mitigate PHLs in the study area.

The result of findings on profit analyzed by Gross Margin Analysis showed that profit derived from horticultural activities per annum per person per acreage is high. On average, youth earn more profit from horticultural crops such as avocado which yield Tshs 4,895,428.570 (about $2,127.99) per annum per person per acreage compared to non-horticultural crops such as Irish potato Tshs 3,346,971.170 (about $1454.89).

The ordered logit model was used to estimate factors influencing male and female youth involvement in horticulture PHM innovation in Tanzania. Ordered logit results showed factors that positively and significantly influence youth involvement in horticulture postharvest management are primary school education, Form IV and above, Management innovation, access to credit, Good perception of horticulture for agribusiness and improved packaging materials. Factors that negatively and significant influencing youth involvement in horticulture postharvest management are gender
female and farm size. Concerning policy implications for the study, the Government should create a conducive environment for private investors to operate contract farming with male and female youth to ensure a market for their horticultural produce. To facilitate access of youth to farm inputs such as startup capital and PHM innovations, there is a need to promote small and medium financial institutions in Njombe Region that provide credit with minimum interest rates and find modalities, which would not require youth to have collateral like land or a house as a condition to access credit. An alternative would be to promote the formation of youth groups so the youth can refer one another to access credit. The report presents specific recommendations for policy practice to attract youth to horticulture agribusiness.

Through public-private partnerships, the Government and private sector should develop infrastructure like packhouses, cold rooms, and environment-friendly technologies to control pests and diseases to improve storage systems for horticultural produce. This can be worked out through linking youth with organizations or companies which purchase horticultural produce to small-scale farmers including youth. Also, the formation of youth Agricultural Marketing Cooperative Societies (AMCOS) could help youth among themselves to pay rent for a packhouse as it is expensive for individual youth to operate; the cost per season is about Tshs 1million ($434.69) and the storage capacity ranges from 20 to 80 tons. Youth also need enhanced skills in PHM. The Government and private sector should also help to provide training to youth through their extension officers to transfer knowledge to male and female youth on PHM innovation. This will go a long way to increase the productivity and income of the youth and ultimately reduce PHLs and the unemployment problem among the youth. With the above measures in place, an enabling environment for male and female youth to participate in horticultural agribusinesses will be created.
Assessment of youth involvement in agriculture: The case of horticulture postharvest management in Tanzania IITA monograph 2.
1. Introduction

Background

Africa has the youngest population in the world, with almost 200 million people, accounting for 19 percent of the global youth population between the ages of 15 to 24 years, a number that is expected to double by 2045 (Allen et al. 2016; Yami et al. 2019). There are various youth definitions, the United Nations (UN) defines youth as all people between the ages of 15 to 24 while the African Union (AU) adopts the ages between 15 and 35. Tanzania defines a youth as a person ages between 15 to 35 (URT 2016). In Tanzania, the youth provide an opportunity for increased economic development through their involvement in agriculture, which is the main activity in rural areas. The Tanzanian population and housing census (PHC, 2012) shows that about 67 percent of the labor force comprises of the youth aged between 15 and 35 years and mostly unemployed. Also, International Labour Organization (ILO) indicated that there were over 1 million unemployed youth between the ages of 15 to 24 years in 2014 in Tanzania. Almost a fifth of all female youth (769,800) and over a tenth of male youth (409,200) were not in employment, education or training (ILOSTAT 2014). In this regard there is a need to support youth reside in rural areas to identify business opportunities available in agriculture including horticulture along value chain such as production, grading, storage, processing, transportation and marketing which in turn reducing the unemployment rate, rural urban migration as well as poverty reduction. Accordingly, there is a significant relationship in terms of the economy, employment, investment growth rates and poverty. The youth have the potential to make significant contributions to agricultural development at different levels and can provide a tremendous opportunity for developing an agricultural-based rural economy if properly harnessed. Furthermore, the growing economy can produce many employment opportunities, only if the available youth’s labor force is fully utilized, leading to an increase in income per capita with a significant contribution to poverty reduction.

The agriculture sector is the key economic activity in rural areas accounting for about 65.5 percent of Tanzania employment, about 29 percent of Gross Domestic Product, 30 percent of export earnings and 65 percent contributing to industrial raw material (URT 2019). Therefore, the agriculture sector has the potential to provide solutions to the challenges of youth unemployment in Tanzania. This is because the majority
of people (about 65.5 percent) in Tanzania are employed in the agriculture sector (Tanzania 2018). However, some challenges make the sector unattractive to youth. These challenges include economic factors like no access to land, no credit facility, low-profit margin and accessibility of market; social factors such as low level of education, less contact with extension officers, negative attitude towards agriculture and parental influence; environmental factors such as increased temperature, pest and disease attack and poor roads (Akpan et al. 2015). However, these challenges can be adequately addressed through evidence-based policy measures to produce positive results.

In fact, youth involvement in agriculture is a recent phenomenon that the government in Africa including Tanzania made commitments to engage youth in Agribusiness as a solution towards youth unemployment. Moreover, youth are energetic, innovative, grown-up, and risk-takers and could take the lead in agriculture production to feed the world as the majority of the farmer in Africa are older people average of 60 to 70 years old (Yami et al. 2019). In this ground, African leaders made commitments reflecting in several initiatives such as adoption of the Youth Charter (AYC) by African Union in 2006, the declaration of the Youth Decade Plan African of Action (2009 to 2018), the establishment of Youth Desk in the New Partnership for Africa’s Development (NEPAD) and the Comprehensive African Agriculture Development Program (CAADP). All these commitments made by African leader Tanzania inclusive in exploring potential solutions to solve or reduce the increasing youth unemployment problem.

In this view, the Tanzanian Government has developed various development programs envisaged to promote employment growth amongst the youth and youth involvement in the agriculture sector. These include; Tanzania Development Vision 2025, The second National Strategy for Growth and Reduction of Poverty II (NSGRPII) in its Kiswahili acronym (MKUKUTA II) Currently, the Government of Tanzania through the Ministry of Agriculture has developed National Strategy for Youth Involvement in Agriculture (NSYIA) for 2016-2021 with a vision of empowering youth to participate fully in agricultural development and contributing to the national economic growth. Also, the government has developed\textsuperscript{1234} all are envisaged to promote employment growth amongst the youth and increasing agricultural productivity for food and nutrition security as well as increasing income. The Government policy such as National Youth Development Policy 2007 its overall objective is to empower, facilitate and guide youth and other stakeholders in the implementation of youth development issues; National

\textsuperscript{1} Agricultural Sector Development programme (ASDP II, 2017)
\textsuperscript{2} Tanzania Agriculture and Food Security Investment Plan (TAFSIP) for 2011/2012 to 2020/2021)
\textsuperscript{3} Southern Agriculture Growth Corridor of Tanzania (SAGCOT 2011)
\textsuperscript{4} Five-year development Plan 2016/2017-2020/2021
Agricultural Policy 2013 seeks to involve youth in agriculture through provides an opportunity for increased economic development particularly in agriculture the main economic activity in rural areas.

Despite the government initiatives towards youth involvement in agriculture as a solution to youth unemployment, the response towards youth is still limited. Hence this study opts to take the case of horticulture postharvest management (PHM) to assess and understand factors that influencing youth involvement in horticulture agribusiness in Tanzania is a motivation for this study. In addition, PHLs for horticultural products could be viewed as an opportunity for youth to be involved in PHM with innovations along the value chain of horticultural products such as processing, drying, storage, packaging and trade.

Horticulture is one of sub-sectors in agriculture that could attract youth to participate in agricultural agribusinesses due to the fact that the sub-sector provides quick yield and return on investment (short growing season average of three months) and requires limited land (0.1 to 2.0 hectares) (HODECT 2010). Also, horticulture is more labor-intensive and generates employment throughout the short crop cycle (planting, weeding and harvesting) compared to staple crops (TAHA 2017). But horticulture is having a high degree of PHLs because it produce are highly perishable (ILO 2012; Giuliani et al. 2017). Tanzania is among countries in sub-Saharan Africa (SSA) faced with high PHLs in horticulture that impact negatively not only food and nutrition security, but also monetary loss and waste of human efforts. About 50 to 70 percent of horticultural products are lost during harvesting, handling, packaging, transporting, and marketing (Kitinoja 2013; Ezekiel and Mtunguja 2014; Addo et al. 2015). Reducing PHLs for fresh produce has been demonstrated to be an important part of sustainable agricultural development efforts meant to increase food and nutritional security, income stability, efficient use of resource and employment creation.

Research questions and research hypotheses

Research questions
1. How much yield is lost on a horticultural farm managed by male youth compared to female youth in the study area?
2. What is the percentage of male and female youth involvement in horticulture?
3. What are the factors which influence the decision of the male and female youth to be involved in horticulture postharvest management innovations in Tanzania?
4. How access to innovations used to mitigate horticulture PHL influence youth decision to be involved in agribusiness?

Research hypothesis
1. Male and female youth experience the same yield losses in their involvement in horticulture
2. There is no difference in percentage between male and female youth involvement in horticulture
3. Innovations used to mitigate horticulture PHL could not influence male and female youth decision to be involved in agribusiness

Objectives
We conducted this study to assess how innovations in PHM influence youth involvement in horticulture agribusinesses in Tanzania.

More specifically, the study aimed at:
1. Quantifying PHLs in horticulture farms managed by male and female youth in the study area
2. Determining the level of involvement in the horticultural sub-sector for male and female youth
3. Identifying factors contributing to male and female youth involvement in horticulture PHM innovation in Tanzania
4. Identifying innovations used to mitigate horticulture PHL as an incentive to influence male and female youth decision to be involved in agribusiness

The rest of the paper is organized as follows. The next section presents the literature review. Section 3 presents methods, section 4 presents results and discussions, followed by section 5 highlighting the conclusion and policy implications.
2. Literature Review

Conceptual framework

Empirical studies show that the population engaging in agriculture is aging and youth are reluctant to join in the farming activities (Yami et al. 2019). This is attributed to many factors that can be categorized into three categories: economic factors, social factors, and environmental factors (Fig. 1). However, these factors can be intervened through policy measures and produce positive results. Moreover, those policy measures need evidence-based information to be effective in addressing the challenge. Thus, this study attempts to use the case of PHL to study how postharvest management innovations influence youth involvement in horticulture activities in Tanzania. This study will contribute to addressing the challenge by informing policy on the possible policy measures to undertake with regards to PHL and thus increase young men’s and women’s participation in the horticulture sub-sector.

Figure 1. Conceptual Framework.
Empirical review
Youth involvement in agriculture is a recent phenomenon that the government in Africa is exploring to solve or reduce the increasing youth unemployment problem. In this ground, several studies have been carried out on youth involvement in agriculture for instance, Yami et al. (2019) in the study for African rural youth engagement in Agribusiness used deductive coding approach results found that interventions that integrate capacity development, financial support for startup and continuous mentorship on the technical and financial aspects proved successful in enhancing youth engagement in agribusiness a study carried out by (Nnadi and Akwiwu 2008) Nnadi and Akwiwu (2008) on the “Determinants of youth” participation in Rural Agriculture in Imo State, Nigeria used logistic regression model. The empirical results revealed that age, marital status, education, Household size, Parents’ Occupation, parents’ farm income and dependence status were significant factors influencing youth participation in agricultural activities. The empirical results revealed that age, marital status, education, Household size, Parents’ Occupation, parents’ farm income and dependence status were significant factors influencing youth participation in agricultural activities. Similarly, Akpan et al. (2015) on the determinants of decision and participation of rural youth in agricultural production in Nigeria used the logistic model. The empirical results revealed that years of youth in social organization, access to ICT, nature of land ownership, and access to state-owned agricultural program were a positive determined decision of youth to engage in agricultural activities in the study area. Adekunle et al. (2009) examine the constraints to rural youth involvement in agricultural production in Kwara State, Nigeria results found that lack of agricultural insurance, poor returns to agricultural investments, lack of basic farming knowledge and lack of access to farm inputs were the major constrains limiting youth involvement in agricultural production.

Also, a study carried out by Addo et al., (2015) assessed and quantify losses along the tomato postharvest Value Chain. Results found that losses during harvest across the region ranged between 4.6 percent and 10.85 percent with the highest in the Upper Eastern region of Ghana. During grading and packing between 3.6 percent and 13.75 percent of fruits were lost, 2.3 percent to 7.4 percent and 2.6 percent to 3.3 percent during transporting and marketing respectively. Also, Ezekiel and Mtunguja (2014) found that huge loss of orange fruits about 56 percent occurs at farm level due to farmers and harvester poor practice and facilities during harvesting, handling and storage in coast belt of Tanzania. (Kasso and Bekele 2018) on his assessment for postharvest loss and quality deterioration of horticultural crops in the Dire Dawa Region, Ethiopia used descriptive statistics to estimate PHLs. Results revealed that climate and weather
conditions, harvesting and handling techniques, packaging, storage and transportation facilities, market situation, and diseases and pests were recorded as major causes for PHLs. The study further found that severe postharvest loss and quality deterioration of horticultural crops mainly occurred during harvesting followed by marketing, transporting, and storage. The highest postharvest loss was recorded for tomato (45.32%) followed by mango (43.53%) whereas the least postharvest loss was recorded for coffee (15.75%). From the reviewed literature, there is no assessment of factors that influence youth participation in horticulture PHM innovations as a means towards reducing the unemployment rate among male and female youth in Tanzania along the value chain such as processing, drying, storage, packaging and trade. This study will fill the existing knowledge gap in Tanzania particularly in Njombe Region.
3. Methodology

Description of the study area

The study was conducted in Njombe Region, which is located in the southern highland of Tanzania from November to December 2018. Administratively Njombe Region is divided into six districts, Namely, Ludewa, Makambako Town Council, Makete, Njombe Town Council, Njombe district Council and Wanging’ombe. This study focused on 3 districts namely, Njombe District council, Njombe Town council and Makambako Town council (Fig.2).

![Map of Tanzania showing study location.](image)

**Figure 2.** Map of Tanzania showing study location.
These districts were selected because of high potential in horticultural farming within Ihemi Cluster under Southern Agricultural Growth Corridor of Tanzania (SAGCOT) initiative, where the government initiatives to pioneer public-private partnership necessary for agricultural sector development through agribusiness investment is implemented. Among the horticultural crops selected are tomato (*Solanum lycopersicum*), carrot (*Daucus carota*), cabbage (*Brassica oleracea*), amaranthus (*Amaranthus cruentus*), avocado (*Persea amewricana*), Brassica (*Brassica carinata*), and Chinese mallow (*Malva verticillata*). This is due to their economic importance in the study area.

**Research design and Sampling procedure**

A cross-sectional survey was used to collect data from the three target districts of Njombe Region, whereby youth were the targeted respondents. Pre-tested questionnaires with open and closed-ended questions were used for the interview. Tablet with Survey CTO application was used for data capturing. The Survey CTO is a software that helps to collect high-quality data using Android phones, tablets or web. A total of 576 respondents were interviewed whereby male youth were 343 and female youth were 233. Among the 576 respondents, 219 respondents were used as a reference group; that is, male and female youth who are not involving in horticulture activities.

A multistage sampling procedure was employed to select respondents. First, 3 out of 6 district council of Njombe Region were purposively selected based on horticultural potential. The second stage sampling involved the selection of 16 villages. At least 10 villages were close to the region headquarters and 6 villages were far away to cater for any possible difference in views of experience with horticulture agribusiness. In the third stage, a list of youth was prepared in each ward and a random selection was employed to select 214 male youth and 143 female youth who make a total of 357 youth involved in horticulture activities. Likewise, 129 male youth and 90 female youth who make a total of 219 youth who are not involved in horticultural activities. Similarly, 357 youth involved in horticulture and 219 youth who are not involved in horticulture were randomly selected from 3 districts, making a total of 576 youth as shown in Tables 1 and 2, respectively.
Data collection methods

Primary data collection
Primary data related to horticulture production such as access to land, farm size, market, credit availability, farming experience, and postharvest management innovation like postharvest handling, packaging material and storage facility, and socioeconomic characteristics of respondents such as sex, age, marital status, education, household size, and contact with extension services were collected from youth involving in horticulture agribusiness through interviews by using pre-tested questionnaires. The individual youth interviews were complemented with 16 focus groups discussion (FGDs) one in each village, to validate information on losses, rate of youth involvement in horticulture and other questionnaire survey information. In total, 80 farmers made up of male and female youth, elders extension officers, District Agricultural Irrigation and Cooperative Officers (DAICO’s), and village executive officers took part in the FGDs.

Secondary data collection
Secondary data on horticulture production, marketing, and postharvest management innovation were extracted from the Ministry of Agriculture, budget speeches, Njombe Region and District Social Economic profile, District council reports. Secondary data were reviewed to verify and validate the accuracy of information supplied by farmers.

Table 1. Sampling distribution of male and female youth involved in horticulture and not-involved by gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Non-Horticulture</th>
<th>Horticulture</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>N 129</td>
<td>214</td>
<td>343</td>
</tr>
<tr>
<td></td>
<td>% 37.61</td>
<td>62.39</td>
<td>100</td>
</tr>
<tr>
<td>Female</td>
<td>N 90</td>
<td>143</td>
<td>233</td>
</tr>
<tr>
<td></td>
<td>% 38.63</td>
<td>61.37</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>N 219</td>
<td>357</td>
<td>576</td>
</tr>
<tr>
<td></td>
<td>% 38.02</td>
<td>61.98</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 2. Sampling distribution of youth involved in horticulture and non-involved by district.

<table>
<thead>
<tr>
<th>District</th>
<th>Non-Horticulture</th>
<th>Horticulture</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Njombe District Council</td>
<td>121</td>
<td>32.97</td>
<td>246</td>
</tr>
<tr>
<td>Njombe Town Council</td>
<td>95</td>
<td>62.91</td>
<td>56</td>
</tr>
<tr>
<td>Makambako Town Council</td>
<td>3</td>
<td>5.17</td>
<td>55</td>
</tr>
<tr>
<td>Total</td>
<td>219</td>
<td>38.02</td>
<td>357</td>
</tr>
</tbody>
</table>

Data analysis

Estimation procedure
The data collected were analyzed with descriptive statistics (percentage, frequency, mean and standard deviation) to examine the socioeconomic characteristics of male and female youth, determine level of involvement in horticultural sub-sector for male and female youth and identify innovations used to mitigate horticulture PHLs (objectives 2 and 4).

Shapiro Wilk test
Shapiro-Wilk test was used to test data for the quantity of crop loss among male and female youth if are normally distributed. Thus, on one hand, if p-value is less than the chosen alpha level, the null hypothesis is rejected, and there is evidence that the data tested are not normally distributed. On the other hand, if p-value is higher than the chosen alpha, the null hypothesis cannot be rejected, and there is evidence that the data tested are normally distributed. In this study, data were tested and found that the data for the quantity of crop losses among male and female youth (Objective 1) are not normally distributed. This proved by the existence of small p-value (p ≤ 0.0000), hence a non-parametric test (Kruskal-Wallis rank test) was chosen.

Kruskal Wallis equality test
Kruskal Wallis rank test was used to test hypotheses that male and female youth experience the same crop losses in their involvement in horticulture. The Kruskal-Wallis is used for comparing two or more independent samples of equal or different sample.
Since it is a non-parametric method the Kruskal-Wallis test does not assume a normal distribution of the residuals unlike one-way Analysis of Variance (ANOVA) (Kruskal and Wallis 1952). The formula for computing Kruskal-Wallis rank test is:

\[
H = \frac{12}{N(N+1)} \sum_{i=1}^{c} \frac{R_i^2}{n_i} - 3(n + 1)
\]

(1)

Where, \(N\) = Total number of observations over all samples, \(R_i^2\) = Square of the sum of rank for samples \(i\); \(c\) = number of samples; \(n_i\) = sample size of sample \(i\); \(\sum\) = Summation sign

Decision rule. The rejection for the \(H\) test is \(H > X^2\) where \(X^2\) is based on \((c-1)\) degree of freedom \((P \leq 0.05)\).

\[
X^2 = \frac{\sum(f_n-f_e)^2}{f_e}
\]

Where \(f_n\) = observed frequencies in each cell; \(f_e\) can be computed as:

\[
f_e = \frac{R \times C}{N}
\]

Where \(R\) = Row total, \(C\) = Column total, and \(N\) = Number of cases.

Decision rule:

If \(X^2\) calculated is greater than \(X^2\) tabulated the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted and vice versa. The degree of freedom is \((C-1)(R-1)\) and \(p \leq 0.05\).

Gross margin analysis

The study further compared profitability received by youth in horticulture agribusiness and non-horticulture agribusiness by using Gross margin (GM) analysis. This was done by calculating Total revenue from the sales of the produces per acre minus Total variable cost spent in one acre due to the \(i\)th marketing function. The formula for calculating GM is shown below:

\[
GM_j = \Sigma TR_i - \Sigma TVC_i
\]

(3)

Where; \(GM_j\) = Gross margin per acre of youth farmers
\(\Sigma TR_i\) = Total revenue from sales of crops per acre
\(\Sigma TVC_i\) = Total variable cost spent in one acre of \(i\)th marketing function
Econometric analysis

Ordered logit models (OLM) conducted to assess factors contributing to male and female youth involvement in horticulture PHM innovation (objective 3). Ordered logit models are appropriate for ordered, categorical variables such as not involved, time and full time involved. One interpretation of the ordinal model is that the probability of selecting a particular number of practices is a function of the underlying latent variable that measures a youth utility for involvement in horticulture PHM innovation. OLM is a regression model for an ordinal response variable, which is based on the cumulative probabilities of the response variable. The logit of each cumulative probability is assumed to be a linear function of the covariates, with regression coefficients constant across response categories (Agresti 2010).

In comparison with Multinomial logit and ordinary least squares (OLS) regression models, OLMs are good for quantifying the effects of the contributing factors on the ordinal response variable while avoiding losing valuable information about the ordering. This is because despite being ordered, the scores are not continuous outcomes or normally distributed (Chang and Wang 2006). The ordered logit model is given by

\[ Y^* = X^T \beta_i + \varepsilon \]

(4)

The latent variable (level of involvement) in this study exhibits itself in ordinal categories which was coded as 0, 1, 2...j. The response category j is thus observed when the underlying continuous response falls in the j-th interval as:

\[ Y^* = \begin{cases} 
0, & \text{if } Y^* \leq \delta \\
1, & \text{if } \delta \leq Y^* \leq \delta_1 \\
2, & \text{if } \delta_1 \leq Y^* \leq \delta_2 \\
\vdots & \vdots \\
N & \text{if } \delta_N \leq Y^* 
\end{cases} \]

Where, \( Y^* \) ( \( i = 0, 1, 2...j \)) are the unobservable threshold parameters that were estimated together with other parameters in the model. Greene (2003) noted that when an intercept coefficient is included in the model, \( Y^*_0 \) is normalized to zero value and hence only N-1 additional parameters are estimated with X’s. Like the model for binary data, the probabilities for each of the observed ordinal response (level of youth involvement in horticulture postharvest management innovation in this study)

The specification of the ordered logit model in this study is as follows. Let \( Y \) denote the
level involvement: Not involving (0 = Y_i), Part-time (1 = Y_i), Full time (2 = Y_i) in horticulture PHM activities. The Odds ratio is proportional odds ratios for the ordered logit model. They can be obtained by exponentiating the ordered logit coefficients, \( e^{\text{coef}} \), or by specifying the or option in stata.

**Multicollinearity test**

Multicollinearity test was performed to check for collinearity among the independent variables using the Variance Inflation Factor (VIF). The decision criteria are that there is a multicollinearity problem when a VIF statistic exceeds 10.

The findings from Table 3 reveal that there is no severe multicollinearity problem in this study since the mean VIF obtained is 1.4, which is less than the usual threshold of 10. Therefore, there is no severe multicollinearity problem and ensures that the independent variables are unbiased and can be used for estimation.

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>1/VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education: Primary education</td>
<td>2.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Education: Form IV and above</td>
<td>2.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Improved transport facility</td>
<td>1.4</td>
<td>0.7</td>
</tr>
<tr>
<td>Household income form horticulture</td>
<td>1.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Farm size</td>
<td>1.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Improved packaging</td>
<td>1.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Gender female</td>
<td>1.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Perception of horticulture for agribusiness</td>
<td>1.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Management innovation</td>
<td>1.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Marital status</td>
<td>1.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Equal access to credit</td>
<td>1.2</td>
<td>0.9</td>
</tr>
<tr>
<td>Extension services</td>
<td>1.1</td>
<td>0.9</td>
</tr>
<tr>
<td>improved storage facilities</td>
<td>1.1</td>
<td>0.9</td>
</tr>
<tr>
<td>household size</td>
<td>1.1</td>
<td>0.9</td>
</tr>
<tr>
<td>Experience</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Mean VIF</td>
<td>1.4</td>
<td></td>
</tr>
</tbody>
</table>
Description of socioeconomic variables

Gender. A dummy variable (male = 0, female = 1). The female variable is expected to have a negative relationship with involvement in horticulture agribusiness as they regard horticulture as a tedious job, which involves labor and is capital intensive, so limiting females from practicing compared with their male counterparts. Marital status. A dummy variable (unmarried = 0, married = 1). Married variable is expected to have positive influence on the dependent variable compared to unmarried youth. This is due to the family and domestic responsibilities they have such as taking care of children in terms of food, health, shelter, and education. Household size (Number of members) is expected to have a positive relationship with youth involvement in horticulture agribusiness. This means that youth who have more people in a family will use family labor in production, which in turn reduces the cost of production compared with those with few people.

Land size (acres) is expected to have positive relationship with dependent variable. This means that as youth access to land increase motivate them to involve in horticulture agribusiness with expectation of increasing production and income. Education: Primary education. A dummy variables (yes = 1, no = 0). The expected relationship is negative with the dependent variable. Education: Form IV and above. A dummy variable (yes = 1, no = 0). In fact, level of education plays a great role in youth decisions to involve and adopt a technology in horticulture postharvest management. The expected relationship is positive with the dependent variable. Access to extension services. A dummy variable (yes = 1, no = 0). Empirical evidence shows that youth who receive extension services acquire information and technology for horticulture postharvest management. The expected relationship with the dependent variable of the estimated coefficient is positive. Experience in horticulture agribusiness (Number of years) is expected to have a positive relationship with the dependent variable for youth who are engaged in horticulture agribusiness. This means that youth with more experience will be involved more in horticulture agribusiness as they have been practicing in the sub-sector for several years and they become aware of the risk associated with and ways used to eliminate those risks. Household income from horticulture. Sales (Tshs) are expected to have positive impact with dependent variable. This means that increase in income provides an opportunity for youth to access more farm inputs like increased land size, fertilizer, and use of improved horticulture management innovation such as packhouses, refrigerated transport facilities, and packaging material. Management innovation. A dummy variable (yes = 1, no = 0) is expected to have a positive relationship with the dependent variable. This means that youth are attracted to the availability of
management innovations necessary for a reduction of horticulture postharvest losses, which ultimately boosts the income for the youth in horticulture agribusiness. Access to credit. A dummy variable (yes = 1, no = 0) is expected to have a positive relationship with the dependent variable. This implies that youth access to credit will enable them to access important farm inputs like fertilizer, improved seeds, herbicides, pesticides and accessibility of improved storage facilities, improving packaging material and transport facility that would enhance productivity as well as income. Good perception on horticulture for agribusiness. Dummy variables are introduced to capture level of perception; good perception of horticulture for agribusiness (yes = 1, no = 0). For youth who have a good perception, the expected relationship with the dependent variable is positive. For those who have a poor perception, the expected sign of the coefficient is negative. Improved packaging material. A dummy variable (yes = 1, no = 0) is expected to have a positive relationship with dependent variables. This means that youth who have access to improved packaging material like plastic crates will be attracted to horticulture postharvest management due to the possibility of reducing postharvest losses. Improved transport facility. A dummy variable (yes = 1, no = 0) is expected to have a positive relationship with dependent variables. This means that youth are attracted to horticulture agribusiness due to the existence of improved transport facilities equipped with cold storage, which make the produce fresh throughout transportation and reduces crop losses which might occur during transportation. Improved storage facility. A dummy variable (yes = 1, no = 0) is expected to have a positive relationship with dependent variables. Improved storage facilities such as packhouses. A dummy variable (yes=1, no=0) are expected to have a positive impact for youth involvement in horticulture agribusiness. This means that the availability of storage facilities would reduce crop losses as well as increase income and food security.
### Table 4. Descriptive statistics of variable.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observation</th>
<th>Expected sign</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (male = 0, female = 1)</td>
<td>576</td>
<td>–</td>
<td>0.405</td>
<td>0.491</td>
</tr>
<tr>
<td>Marital status (married = 1, unmarried = 0)</td>
<td>576</td>
<td>+</td>
<td>0.746</td>
<td>0.435</td>
</tr>
<tr>
<td>Education: Primary education (yes = 1, no = 0)</td>
<td>576</td>
<td>–</td>
<td>0.635</td>
<td>0.482</td>
</tr>
<tr>
<td>Education: Form IV and above (yes = 1, no = 0)</td>
<td>576</td>
<td>+</td>
<td>0.215</td>
<td>0.41</td>
</tr>
<tr>
<td>Household size (number of members)</td>
<td>576</td>
<td>+</td>
<td>4.66</td>
<td>1.64</td>
</tr>
<tr>
<td>Access to extension services (yes = 1, no = 0)</td>
<td>576</td>
<td>+</td>
<td>0.22</td>
<td>0.411</td>
</tr>
<tr>
<td>Experience in horticulture agribusiness (years)</td>
<td>576</td>
<td>+</td>
<td>0.741</td>
<td>0.438</td>
</tr>
<tr>
<td>Land size (acres)</td>
<td>572</td>
<td>–</td>
<td>1.089</td>
<td>1.050</td>
</tr>
<tr>
<td>Household income from horticulture (Tshs)</td>
<td>388</td>
<td>+</td>
<td>1801268</td>
<td>3292559</td>
</tr>
<tr>
<td>Management innovation (yes = 1, no = 0)</td>
<td>576</td>
<td>+</td>
<td>0.314</td>
<td>0.465</td>
</tr>
<tr>
<td>Access to credit (yes = 1, no = 0)</td>
<td>576</td>
<td>+</td>
<td>0.357</td>
<td>0.479</td>
</tr>
<tr>
<td>Good perception of horticulture for agribusiness (1 = yes, 0 = poor)</td>
<td>576</td>
<td>+</td>
<td>0.747</td>
<td>0.434</td>
</tr>
<tr>
<td>Improved packaging (yes = 1, no = 0)</td>
<td>576</td>
<td>+</td>
<td>0.212</td>
<td>0.409</td>
</tr>
<tr>
<td>Improved storage facilities (yes = 1, no = 0 )</td>
<td>576</td>
<td>+</td>
<td>0.227</td>
<td>0.4353</td>
</tr>
<tr>
<td>Improved transport facility (yes = 1, no = 0)</td>
<td>576</td>
<td>+</td>
<td>0.272</td>
<td>0.445</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2018 and Authors’ estimation.
4. Results and Discussion

Socioeconomic characteristics

The results in Table 5 show that 75% of respondents were married. This finding clearly indicates that rural youth who are married are more involved in horticultural activities than unmarried ones. This is because married youth have more family responsibilities than unmarried youth in terms of food provision to the family, health services, shelter, and education. Hence married youth involvement in horticulture is inevitable due to the domestic and family responsibilities they have. This study is in conjunction with findings by Kimaro and Towo (2015) who found that married youth are more likely to participate in agricultural activities than unmarried youth due to their daily socioeconomic needs. Concerning the gender of the respondents, the result shows that males dominated (59%). Male youth are more engaged in horticultural activities due to their ability to own land and doing a tedious job like horticultural activities, which require close supervision such as irrigation, application of fertilizer, herbicides pesticides, among others, all of which are capital intensive. In the side of female youth, most of them are constraint with African culture which limit female to own major means of production such as land resources and disability of working in a tedious job. This finding is similar to an earlier empirical study by (Falola et al. 2013) who found that majority of youth farmers were male in rice farming as rice farming like any crop production such as horticulture production, is energy consuming and males are capable of doing more tedious work than females. Similarly, Cheteni (2016) who studied youth participation in agriculture in the Nkonkobe District Municipality, South Africa noted that males dominate in rural areas because of farming occupations.

The majority of the respondents had primary school education (63.5%) while secondary and high education levels were 21.5%. This means that youth who have acquired some basic education are in a good position to be involved in horticulture agribusiness and adopt PHM innovation compared with uneducated ones. This is because the majority of youth were literate, and literacy is expected to influence youth involvement and adoption of new horticulture PHM. This result is in conjunction with earlier empirical studies of Etim and Udoh (2018) who found that youth who have acquired some form of education are more likely to adopt and participate in new farming activities like horticulture activities.
earlier and faster than uneducated ones. Similarly, Cheteni (2016) noted that educated people are expected to accept a moderate degree of awareness about agricultural activities including horticulture. Results also show that youth with more experience in farming 74% constitute most respondents. This indicates that experience is an important determinant for youth involvement in horticulture PHM innovation. The more they have experience in horticulture agribusiness the more they could adopt new ideas, innovation and participate in new agricultural activities faster than youth with less experience in farming (26%). This is because youth with more experience of horticultural agriculture have some technicality associated with risks of PHLs and ways to reduce them compared to youth with little or no experience. This finding is similar to the study of Muhammad-Lawal et al. (2009) who noted that farming experience correlates with the acquisition of improved skills in agricultural production such as horticultural production.

The result finds that youth with a household size of 5 (74%) people were predominant as they are more involved in horticulture activities, followed by youth with a family size of 6 to 10 people (25%) and youth with a family size of 11 to 13 people (0.5%). This shows that youth with more family members (above five people) reduce their involvement in horticultural activities. This indicates that as family size increase, farm size remains the same and do not increase in the same way as family size. Thus, the limited land (small farm size) has to be shared among the family members as a result of youth participation in horticulture decreasing and a shift to non-farming activities such as carpentry, tailoring, and trading to increase their income and meet their domestic and family responsibilities. This result aligns with findings of Etim and Udoh (2018) who found that youth with large sized families are less likely to adopt new ideas and participate in new agricultural activities such as horticulture activities.

Table 5 shows that the majority of youth involved in horticulture cultivated small farms with an average of 1.1 acres. Since the majority of youth inherit land from their parents or relatives, male youth in particular are allowed to inherit land when they are old enough and married. So the only option for youth to own land is through purchasing or renting small land sizes and becoming involved in horticulture activities. This is because horticulture activities can be practiced on a small piece of land and produce good outputs and generate more profit as shown in Tables 5 and 6; this is attractive to the youth as they are able to take care of their domestic and family responsibilities. Also, the study reveals that youth in the study area are small-scale farmers due to the small land area they occupy. This result disagrees with findings by Demie and Zeray (2016) who found that households in Eastern Ethiopia with limited or no access to land have to work in non-farm activities to earn their living.
Our results show that the primary occupation is farming (98.4%) with employees (0.7%) and traders (0.9%). This indicates that farming is the major income generating activity in rural areas as when youth grow up, they find their parents or guardians involved in farming activities. Hence youth imitate their elders. Therefore, one can conclude that youth who have been raised in a farming family tend to be more involved in horticulture activities compared with those who depend on their earnings from non-farming activities. This study is in conjunction with findings by Kimaro and Towo (2015) who found that youth who belong to farmers’ families participate more in agriculture like horticulture activities compared with those who did not belong to farmer families.

Table 5. Distribution of socioeconomics of male and female youth in Njombe District (N=>576)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percent</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15–24</td>
<td>129</td>
<td>22.4</td>
<td></td>
</tr>
<tr>
<td>25–29</td>
<td>129</td>
<td>22.4</td>
<td>29.3</td>
</tr>
<tr>
<td>30–35</td>
<td>318</td>
<td>55.21</td>
<td></td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not married</td>
<td>146</td>
<td>25.35</td>
<td></td>
</tr>
<tr>
<td>Married Marital Status</td>
<td>430</td>
<td>74.65</td>
<td></td>
</tr>
<tr>
<td><strong>Household size</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–5</td>
<td>428</td>
<td>74.31</td>
<td></td>
</tr>
<tr>
<td>6–10</td>
<td>145</td>
<td>25.17</td>
<td>4.7</td>
</tr>
<tr>
<td>11–13</td>
<td>3</td>
<td>0.52</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>343</td>
<td>59.55</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>233</td>
<td>40.45</td>
<td></td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below STD 7</td>
<td>46</td>
<td>7.99</td>
<td></td>
</tr>
<tr>
<td>STD 7</td>
<td>406</td>
<td>63.5</td>
<td></td>
</tr>
<tr>
<td>FORM IV ++</td>
<td>124</td>
<td>21.53</td>
<td></td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmer</td>
<td>567</td>
<td>98.44</td>
<td></td>
</tr>
<tr>
<td>Employee</td>
<td>4</td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td>Traders_ Other</td>
<td>5</td>
<td>0.87</td>
<td></td>
</tr>
<tr>
<td><strong>Farm Experience (years)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–5 years</td>
<td>75</td>
<td>13.02</td>
<td></td>
</tr>
<tr>
<td>6–10 years</td>
<td>74</td>
<td>12.85</td>
<td>5.4</td>
</tr>
<tr>
<td>11 ++ years</td>
<td>427</td>
<td>74.13</td>
<td></td>
</tr>
<tr>
<td><strong>Farm size (acre)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.125– 1.5</td>
<td>442</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>1.6 – 3.6</td>
<td>108</td>
<td>18.75</td>
<td>1.1</td>
</tr>
<tr>
<td>3.7 – 6.7</td>
<td>24</td>
<td>4.17</td>
<td></td>
</tr>
<tr>
<td>6.8 ++</td>
<td>2</td>
<td>0.35</td>
<td></td>
</tr>
</tbody>
</table>
The result in Figure 3 shows that about equal numbers of youth in our sample (58%) receive extension services compared to those who do not (42%). Also, results show that the frequency of extension contact with the youth is poor. About 41.67% responded that they were not received extension services frequently as shown in Figure 4. Only 35.42% of respondents have access to extension officers more often, 17.7% rarely, and 5.2% sometimes. This implies that the majority of the respondents do not access extension services timely, hence youth lack essential knowledge and skills on horticulture PHM, which is vital for reducing horticulture PHLs, which in turn influences youth involvement in horticulture agribusiness as well as the reduction of the youth unemployment rate.

This result is aligned with the findings of Trevor and Kwenye (2018) who found that among the factors, which constrain youth involvement in agriculture such as horticulture, was inadequate provision of agricultural extension services for the rural youth.

The study shows that youth perception of horticulture agribusiness is good (56%), satisfactory (31%), and poor (13%) (Fig. 5). This implies that the majority of youth in the study area are aware of the importance of the horticulture sub-sector in the economy. Almost more than half of the respondents think that the horticulture sub-sector is vital for the economy and the solution to their unemployment. Likewise, profits generated from horticultural activities attract them to participate in the sector for their livelihood and employment as shown in Tables 6 and 7. Youth who participate in horticulture earn more profit compared to those engaging in non-horticulture (Tables 6 and 7). This study is in line with the finding of Giuliani et al. (2017) who found that youth frequently mentioned that agriculture such as horticulture provides their source of income.
Figure 3. Access to extension services.

Figure 4. Frequency of extension officers.
Horticultural and non-horticultural average profit against farm size

Respondents were asked to provide their estimated annual income at the time of the study which helps us to calculate the average profit by using GM analysis. Results in Tables 6 and 7 show that horticulture (vegetable and fruit) agribusiness is a lucrative enterprise for the youth. On average, youth earn more profit from fruit production such as avocado (*Persea americana*), which yields Tshs 4,895,428.570 (about $2,127.99) per annum per person per acreage compared to non-horticultural crops (Table7) such as Irish potato (Tshs 3,346,971.170 about $1,454.89). Among the horticultural crops, avocado (*Persea americana*) and tomato (*Solanum lycopersicum*) generated the highest income, followed by carrot (*Daucus carota*), cabbage (*Brassica oleracea*), amaranthus (*Amaranthus cruentus*), brassica (*Brassica carinata*), and Chinese mallow (*Malva verticillata*). Among the non-horticultural crops, Irish potato (*Solanum tuberosum*) ranks first followed by maize (*Zea mays*) and beans (*Phaseolus vulgaris*). In fact, the horticulture agribusiness yields high returns compared to non-horticulture due to its importance to food and nutrition security and its market is readily available within and outside the country. Similarly, a small plot of about one acre can provide high returns that can attract the youth to become involved in the sub-sector as opposed to non-horticulture agribusiness. Moreover, horticulture agribusiness provides employment opportunities due to its labor-intensive nature as it requires more labor from production, harvesting, storage, and packaging along the value chain. Also, access to land for the youth is very difficult in Tanzania and especially women due to customary norms. Hence, a small portion of land can be used efficiently for horticultural agribusiness and yield more income, which attracts youth involvement in the sub-sector. Similar results were found by Juma et al. (2018) who recommended that youth should engage in vegetable farming since its returns are higher and a market is readily available.
### Table 6. Vegetable average profit (Tshs) and farm size (acre) per youth.

<table>
<thead>
<tr>
<th>Crops</th>
<th>TR</th>
<th>TVC</th>
<th>Profit (Tshs)</th>
<th>Profit (USD)</th>
<th>Farm size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amaranthus(Amaranthus cruentus)</td>
<td>535,325.000</td>
<td>97,600</td>
<td>437,725.000</td>
<td>190.27</td>
<td>0.230</td>
</tr>
<tr>
<td>Brassica (Brassica carinata)</td>
<td>268,200.000</td>
<td>110,139.74</td>
<td>158,060.260</td>
<td>68.71</td>
<td>0.263</td>
</tr>
<tr>
<td>Cabbage (Brassica oleracea)</td>
<td>750,588.240</td>
<td>215,666.67</td>
<td>534,921.570</td>
<td>232.53</td>
<td>0.430</td>
</tr>
<tr>
<td>Carrot (Daucus carota)</td>
<td>567,777.780</td>
<td>94,470.588</td>
<td>473,307.192</td>
<td>205.74</td>
<td>0.324</td>
</tr>
<tr>
<td>Chinese mallow (Malva verticillata)</td>
<td>182,406.250</td>
<td>78,640</td>
<td>103,766.250</td>
<td>45.11</td>
<td>0.261</td>
</tr>
<tr>
<td>Tomato (Solanum lycopersicum)</td>
<td>2,151,990.900</td>
<td>339,966.18</td>
<td>1,812,024.720</td>
<td>787.67</td>
<td>0.689</td>
</tr>
<tr>
<td>Total</td>
<td>4,456,288.170</td>
<td>936,483.178</td>
<td>3,519,804.992</td>
<td>1,530.024</td>
<td>2.197</td>
</tr>
</tbody>
</table>

### Table 7. Fruit tree (Avocado) average profit (Tshs/USD) and farm size (acre) per youth.

<table>
<thead>
<tr>
<th>Crops</th>
<th>TR</th>
<th>TVC</th>
<th>Profit (Tshs)</th>
<th>Profit (USD)</th>
<th>Farm size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avocado (Persea Americana)</td>
<td>5,320,147.100</td>
<td>424,718.53</td>
<td>4,895,428.570</td>
<td>2,127.99</td>
<td>1.12</td>
</tr>
<tr>
<td>Total</td>
<td>5,320,147.100</td>
<td>424,718.53</td>
<td>4,895,428.570</td>
<td>2,127.99</td>
<td>1.12</td>
</tr>
</tbody>
</table>

### Table 8. Non-horticulture average profit (Tshs) and farm size (acre) per youth

<table>
<thead>
<tr>
<th>Crops</th>
<th>TR</th>
<th>TVC</th>
<th>Profit (Tshs)</th>
<th>Profit (USD)</th>
<th>Farm size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beans (Phaseolus vulgaris)</td>
<td>838,350.880</td>
<td>500,442.42</td>
<td>337,908.460</td>
<td>146.885</td>
<td>1.92</td>
</tr>
<tr>
<td>Irish potato (Solanum tuberosum)</td>
<td>3,936,574.100</td>
<td>589,602.93</td>
<td>3,346,971.170</td>
<td>1,454.89</td>
<td>1.83</td>
</tr>
<tr>
<td>Maize (Zea mays)</td>
<td>1,098,448.300</td>
<td>305,963.77</td>
<td>792,484.530</td>
<td>344.49</td>
<td>1.93</td>
</tr>
<tr>
<td>Total</td>
<td>5,873,373.280</td>
<td>1,396,009.12</td>
<td>4,477,364.160</td>
<td>1,946.27</td>
<td>5.67</td>
</tr>
</tbody>
</table>

Postharvest losses in horticulture farms managed by male and female youth

The Kruskal-Wallis equality of populations rank test was used to test the hypotheses that male and female youth experience the same crop losses in their involvement in horticulture (equation 1). Results in Table 9 show that male and female youth experience different crop losses in their involvement in horticulture with statistically significant chi-square (8.7) and p-values (p ≤ 0.01). Hence, we reject the null hypothesis which states...
that male and female youth experience the same crop losses in their involvement in horticulture agribusiness. This finding supported by descriptive statistics in section 4.6, shows that male youth experience higher crop losses compared with female youth. This study is in agreement with findings of (Adebisi-Adelani et al. 2011; Issa et al. 2015) in their study in Oyo State, Nigeria who reported that there is a significant difference between roles performed by male and female farmers in watermelon production.

The extent of male and female youth involvement in horticulture

Results in Figure 6 show that male youth dominate in horticultural agribusiness (59%) compared to female youth. This might be due to the labor-intensive nature of the subsector which could be very tedious and time consuming for female youth who may have to integrate this activity with family and domestic responsibilities. Also, access to land and capital could be a limiting factor for female youth to be more involved in the horticulture subsector since most African societies do not allow women to inherit family land. Also, results in Figure 7 show that male youth participate more in the production and marketing of tomato (\textit{Solanum lycopersicum}) (25%), avocado (\textit{Persea americana}) (18%), and cabbage (\textit{Brassica oleracea}) (9.3%). Moreover, female youth participate more in the production and marketing of leafy vegetables such as Brassica (\textit{Brassica carinata}) (12.9%), Chinese mallow (\textit{Malva verticillata}) (11.6%), tomato (\textit{Solanum lycopersicum}) (7.6%), cabbage (\textit{Brassica oleracea}) (6.9%), amaranthus (\textit{Amaranthus cruentus}) (6.4%), and carrot (\textit{Daucus carota}) (4%). This indicates that female youth are more experienced in the marketing of vegetables such as amaranthus, the market for which is readily available as they can sell the produce in the street directly after harvest. This study agrees with the findings of Fakayode et al. (2012) who found that males are more into fruit and vegetable farming than females due to the labor-intensive nature of enterprise.

### Table 9. Kruskal-Wallis equality of populations rank test.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Observation</th>
<th>Rank Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>207</td>
<td>41,422.5</td>
</tr>
<tr>
<td>Female</td>
<td>163</td>
<td>27,212.5</td>
</tr>
</tbody>
</table>

Chi-squared = 8.766 (1 d.f)
Probability = 0.0031*
Chi-square with ties = 8.7 (1 d.f)
Probability = 0.0031*

Statistically significant at 1%
The extent of male and female youth involvement in horticulture.

Male and female youth in horticulture agribusiness.

Innovations used to mitigate horticulture PHLs
The innovations youth bring to their horticultural businesses were investigated. The results in Figures 8 and 9 show that most respondents are not aware of the types of innovation needed to reduce PHLs as the majority (68.77%) were not aware of them and only (31.23%) were aware (Fig. 8). The most common innovations used to manage PHLs are grading (48.7%) and harvesting at the coolest time (39.3%) of the day (Fig. 9), all of which are manual sourcing with hands, the use of improved storage facilities such as packhouses (4.55%) followed by improved packaging materials such as plastic crates (3.25%), and improved transport facilities such as a motor van equipped with cold-store facilities (2.92%). Other innovations required to reduce PHLs were not mentioned by respondents such as cooling systems like Zero Energy chambers, charcoal room, maturity
index, use of mulch for controlling weed growth and loss of moisture content, and the use of greenhouses to control the temperature, which may cause the crop to deteriorate and become susceptible to diseases. This implies that the majority of youth in the study area have little knowledge about innovations to reduce PHLs. This study aligned with the findings of Kitinoja (2013) who found that the majority of respondents used shade cover and plastic crates and cool chambers to minimize losses of horticultural crops. Similarly, Kasso and Bekele (2018) reported that different traditional methods were practiced by the local community to reduce losses for horticultural crops.

![Figure 8. Use of innovations to manage PHLs.](image)

![Figure 9. Type of innovation used to reduce PHLs.](image)
Percent of crop losses in the study area by gender

It was shown previously that only a small proportion of respondents use innovations to manage PHLs (Fig. 8) and only a limited number of innovations are known to them (Fig. 9); it is therefore not a surprise that crop losses can be very high. Results in Figure 10 show the percentage of crop losses in the study area, whereby male youth experience the highest crop losses in their involvement in horticulture. The highest losses were recorded in amaranthus \((\text{amaranthus cruentus})\) (44.5%); avocado \((\text{Persea americana})\) (41.0%) cabbage \((\text{Brassica oleracea})\) (27.6%); carrot \((\text{Daucus carota})\) (25.1%); tomato \((\text{Solanum lycopersicum})\) (22.7%); brassica \((\text{Brassica carinata})\) (14.5%), and Chinese mallow \((\text{Malva verticillata})\) (10.0%). While the highest losses of female youth were experienced in tomato (32.1%) Chinese mallow \((\text{Malva verticillata})\) (28.6 %), Brassica \((\text{Brassica carinata})\) (27.4), avocado \((\text{Persea americana})\) (20.4%); and cabbage \((\text{Brassica oleracea})\) (19.1%) with minimum losses experienced in amaranthus \((\text{amaranthus cruentus})\) (2.5%). Low losses for female youth might be attributed to females being more involved in vegetable production and marketing and the ability to handle perishable crops with care compared with their male counterparts. This study is in agreement with the findings of (Adebisi-Adelani et al. 2011; Issa et al. 2015) in their research on Analysis production constraints facing fadama vegetable farmers in Oyo State, Nigeria who reported that there is a significant difference between roles performed by male and female farmers in watermelon production. However, the total percent for crop losses among male and female youth is observed to be above 100 percent because the analysis was based on specific crops. For instance, in amaranthus, males experienced the highest losses of 44.5% of the total quantity harvested of amaranthus by males. This might be attributed to the fact that males have little experience in selling amaranthus on the street; instead, they sell directly from the farm compared to female youth who sell vegetables on the street. With regards to females, the highest crop losses of 32.1% were recorded for tomato out of total tomato production by females. This might be attributed to the tedious and capital-intensive nature of the crop such as the application of fertilizer, and frequently spraying pesticides and herbicides which limit females from being efficiently involved in the sub-sector.
Figure 10. The extent of crop losses in horticultural crops produced by gender

Percentage of crop losses by district

Both Njombe Town Council (39%) and Njombe District Council (37%) show an equal percentage of crop losses as shown in Figure 11, while Makambako Town Council seems to have a low percentage (24%) of crop losses. This implies that the location of Njombe Town Council favors low crop losses compared to other districts. Makambako is at the junction between Mbeya Region, Iringa Region, and Njombe Town Council, hence the assurance of a market to sell the crops produced at Makambako is high as more customers are available. Also, the road network to Makambako is good and attracts traders easily, which in turn minimizes crop losses compared to other districts.

Figure 11. Percent of crop losses by district.
Proportion of crop losses

Figure 12 shows the proportion of losses of horticultural crops at different stages of management. Results indicate that a high level of losses of horticultural crops occur due to poor agronomic practices with 34.8% losses, handling 22.8%, grading 20.9%, transport 11.2%, packaging 10.04%, and during harvest 0.4%. This implies that horticultural crops are highly perishable due to their high moisture content that causes them to deteriorate or be injured during harvesting, grading, transporting, and marketing when not appropriately handled. For example, the bamboo basket (“Tenga”) used to carry tomato during transportation are big and rough inside, causing fruit to become injured and the crop to become unfit for sale. The results from this study are close to those of Ezekiel and Mtunguja (2014) who found that 15% of orange fruit were wasted during the harvesting process; 18% during the handling process; 50% during the storage; and 17% during transportation. Similarly, this study agrees with Kasso and Bekele (2018) who reported that severe postharvest losses and quality deterioration of horticultural crops occurred during harvesting, marketing, transportation, and storage.

Causes of crop losses

Figure 13 shows that the major causes of crop loss are lack of readily available markets (31.7%) for youth to sell perishable products, poor handling (31.1%), poor storage facilities (15.5%), poor transport facilities (9.2%), poor quality roads (7%), and poor packaging materials (6%). This implies that the market place is a critical problem in the study area as the majority of the respondents claimed that the absence of a market in their localities caused them to waste the produce once harvested the crops.
or the absence of customers after harvesting may pose losses of their produce. Low skills on how to handle horticultural produce during harvesting poses losses, as well as inadequate storage facilities like cold rooms and packhouses. In the study area there is only one packhouse for horticultural produce, which was constructed in a partnership between the Government of Tanzania and the Tanzania Horticulture Association. Also, poor roads and poor packaging material like bamboo baskets, sacs, and boxes were mentioned as the major causes for horticultural crop losses in the study area. These losses are among the discouraging factors for youth to be involved in horticulture agribusiness. This study aligns with the findings of (Kasso and Bekele 2018) who found that inappropriate harvesting techniques, packaging, storage, transportation facilities, market situation, and disease and pests were recorded as major causes for horticultural PHLs.

![Figure 13. Causes of crop losses](image)

**Measures to minimize PHLs in horticultural crop produce**

Results in Figure 14 show that cleaning and grading (31.4%) and local methods (like spreading the produce on the floor and spraying water) (30.8%) are the major strategies used to minimize horticultural PHLs by male and female youth in the study area. About 20% also use fumigation with chemicals such as Blue copper and Diathane for tomato affected by fungi. It is obvious that the majority of the respondents in the study area do not use improved management innovations. This is due to limited capital and limited information on the availability of improved management innovations like cold rooms such as zero-energy cool chambers, packhouses, transport facilities equipped with cold storage, maturity index, and the use of shade cloths. Also youth need to link themselves
with the private sector investing in their localities for contracts to supply produce like ones done for avocado by Tanzanie, Lima kwanza, OlivadoTZ, Kuza Africa, and Gibbry. This could help to reduce PHLs for horticultural crop produce as well as increase crop productivity, income, and employment opportunities among the youth. This study is close to the finding of Kitinoja (2013) who found that the use of improved containers, field packaging systems (packhouse), zero-energy cool chambers, and CoolBot™ equipped with small, cold rooms help to minimize PHLs for horticultural crop produce.

![Coping strategies used to minimize postharvest losses in horticultural crop produce](image)

**Constraints facing youth in horticulture agribusiness**

The major constraints encountered by male and female youth in horticulture agribusiness were fluctuation of prices (42.9%). Prices of horticultural produce are not stable, leading to monetary loss due to changing prices in the markets, making the cost of operations high compared to income received. During the field survey, respondents reported that prices for one box of tomato range from Tshs 15,000 to Tshs 35,000 per season; leafy vegetables might fluctuate from 100 to 500 per season, while the rate for avocado ranges from 500 to 1500 per season. Other factors that were reported to discourage youth involvement in horticulture agribusiness are inadequate storage and transport facilities (25.5%), followed by high PHLs (22.35%) due to poor handling of the produce, poor quality roads, and inferior packaging materials that increase abrasion of horticultural crops during transportation; and last but not least, the lack of market and startup capital (5.3%) as shown in Figure 15. This implies that the absence of a ready market increases PHLs if there is no available customer for the produce as the crops
are perishable in nature and lack of storage facilities makes the produce deteriorate. Also, inadequate capital for the youth is another constraint that limits them from being involved in horticulture postharvest management as it hinders access to important farm inputs and postharvest management innovations vital for the development of the horticultural sub sector. The results from this study are in line with findings of Kereth et al. (2013) who found that poor infrastructure such as rough roads, inferior packaging materials and hygiene conditions were the major problem affecting many smallholder farmers including youth in Tanzania.

![Figure 15. Constrains for youth in horticulture agribusiness](image)

Factors influencing male and female youth involvement in horticulture postharvest management innovation in Tanzania

Table 10 presents an ordered logit model analysis used to estimate factors influencing male and female youth involvement in horticulture postharvest management (PHM) innovation in Tanzania particularly for Njombe Region. The three categories of level of involvement were specified as follows: Not involved, part-time, and full-time; these formed the dependent variables as ordered 0, 1, and 2, respectively. The model revealed that the log likelihood ratio of 243.6 is highly significant ($p \leq 0.000$). The explanatory power of the model is good and that variability of the dependent variables or the decision to be involved in horticulture agribusiness is associated with the specified independent variables.
The variable Primary education is positive and significant at 1% influencing male and female youth involvement in horticulture PHM innovation. This implies that youth who completed primary school education are more likely to be involved in horticulture PHM innovation by about 9.7 times (odds = 9.7) compared with youth who have a high level of education. The variable high level education is also positive and significant at 10%. This implies that youth who attained high level education are more likely to involve in horticulture PHM innovation in small proportional of 2.0 times (odds = 2.0) compared to primary school education. This implies that youth who completed primary school education see horticulture as a major income generating activity in rural areas since they have limited options for jobs compared with youth who acquire higher level education. Youth who have more education have more choices and they opt to work in non-farming activities or in urban areas and they regard horticulture as labor intensive and a job for uneducated people. Hence very few educated youth can be found in horticulture PHM. Therefore, there is a need to increase awareness among youth who have better education to remain in their respective localities and utilize the knowledge received in horticulture PHM, which in turn could reduce horticulture PHLs as well as increase productivity and income among the youth, leading to a reduction of youth unemployment. This recommendation is in conjunction with earlier empirical studies by (Diao et al. 2018; Etim and Udoh 2018) who found that youth who have acquired some form of education are more likely to adopt and participate in new farming activities like horticulture postharvest management. These similarities imply that formal education plays a significant role in the enlightenment of youth toward identifying economic opportunities like involvement in horticulture PHM. The results further reveal that the variable “Gender female” is negative and significant at 5%. This indicates that female youth are less likely to be involved in horticulture PHM innovation by 0.52 times (odds = 0.52) compared with their male counterparts. This implies that female youth involvement in horticulture agribusiness is a challenge because females have to integrate it with their domestic responsibilities of taking care of the family, cooking, and other household chores. Similarly, horticulture activities are more labor-intensive, time consuming, and capital-intensive and may contribute to the low participation of female youth in horticulture agribusiness. This result disagrees with that of Adejo et al. (2015) in their study on the Assessment of Postharvest Management Information Needs of Yam Farmers in Kogi State, Nigeria. Their results found that gender has no significant effect on improved postharvest management technologies, probably because they have no access to information on those technologies. The difference between these findings denote that gender issues vary from one society to another due to historical factors,
environmental factors, and culture of a particular society. Taking the case of “Developing countries, women’s insecure rights to land exclude them from participation in decision making overland and natural resource use in many parts of the World as a result of colonial ideals. Example, Men play the main role in economic development, therefore be the beneficiaries of education, training and technology compared to Women (Boserup et al. 2013). Also Dolan and Sutherland (2002) in their study for Gender and Employment in Kenya horticulture Value Chain found that entitlements to land are not uniform among male and female due to Kinship norms that provide women with land rights through marriage and again they had no choice of what to produce. Moreover, in Tanzania Men are primary decision makers about what to plant since they are often owner of the plots due to customary patrilineal land practices and gender norms regarding farm activities (Bullock et al. 2018).

Land size is negative and significant at 10%. This implies that a unit increase in land size reduces the probability of youth involvement in horticulture PHM innovation by 0.78 times (odds = 0.78). This means that as land size increases, youth may reduce their involvement in horticulture agribusiness and shift to non-horticultural crops such as potato, maize. and beans. This is because horticultural crops are often grown in small plots because is more labor- and capital-intensive. Hence, the increase in land size may increase the costs of operation and management, which could be difficult for the youth to sustain due to financial constraints, which most youth face. Moreover, Prices of horticultural produce are not stable, leading to monetary loss due to changing prices in the markets, making the cost of operations high compared to income received. During the field survey, respondents reported that prices for one box of tomato range from Tshs 15,000 to Tshs 35,000 per season, while the rate for avocado ranges from 500 to 1500 per season and leafy vegetables might fluctuate from 100 to 500 per season. Other factors that were reported to discourage youth involvement in horticulture agribusiness are inadequate storage and transport facilities, followed by high PHLs due to poor handling of the produce, poor quality roads, and inferior packaging materials that increase abrasion of horticultural crops during transportation to big markets such as Dar es Salaam (Kariakoo market) and Zanzibar market. Also absence of processing plants to add value of horticultural produce in order to reduce PHLs limit youth increase their involvement in horticulture agribusiness. Therefore with improvement of the stated problems will increase youth involvement in horticulture agribusiness.

Management innovation is positively and significantly associated with the dependent variable at 1%. This shows that youth with management innovations are more likely to
be involved in horticulture PHM innovation by 8.9 times (odds = 8.9) compared with youth with no management innovation. This implies that youth who have knowledge and techniques on how to reduce PHLs are more likely to be involved in horticulture PHM innovation due to awareness and knowledge they have on how to tackle PHLs as a result increasing productivity and income due to saved produces from PHLs.

Access to credit has a positive significant association at 10%. Youth with access to credit are more likely to be involved in horticulture PHM by 1.6 times (odds = 1.6) compared with youth who have no access to credit. Access to credit can help youth acquire farm inputs such as fertilizer, pesticides, land, seed, farm machinery, and other PHM innovations like packhouses, transport equipped with cold store facilities, use of shade, and processing plants, among others, which are vital in horticulture sub-sector development. Furthermore, good perception as horticulture is good business is positive and significant at 1%. This implies that male and female youth who perceive horticulture as good business are more likely to be involved in horticulture agribusiness by 5.3 times (odds = 5.3). This is motivated by highest expected returns from horticulture agribusiness. This result is in line with earlier empirical results of Magagula and Tsvakirai (2019) in their study found that youth have positive perception of agriprenuership. This results show that youth have positive perception in agriculture sector are more likely to involve in horticulture agribusiness compared to youth who have negative perception. Moreover, improved packaging material positively and significantly influences the dependent variable at 1%. Youth with access to improved packaging material such as plastic crates are more likely to be involved in horticulture PHM by 2.7 times (odds = 2.7) than those with no access to improved packaging material. This implies that youth who use improved packaging material could incur low crop losses compared to those who use local packaging material like baskets.

Generally, the framework guiding this study was useful in describing factors influencing youth involvement in horticulture postharvest management in Njombe Region as indicated above. However, the conceptual framework could be improved to capture more variables like agro-processing, improved rural roads, access to ICT, improved irrigation infrastructure, access to electricity, more investment on cold chain public logistic facilities (e.g., Cold chain warehouses at airports like Songwe International airport) and Research and Development, all important factors in reducing horticulture postharvest losses, which in turn increase productivity of produce as well as income which could attract youth to be involved in horticulture agribusiness.
### Table 10. Ordered logit model used to estimate factors influencing male and female youth involvement in horticulture postharvest management

| Variables                                           | Coefficient | Odds Ratio | Std. Err. | z     | P>|z| |
|-----------------------------------------------------|-------------|------------|-----------|-------|-----|
| Education: Primary education***                     | 2.273       | 9.712      | 3.601     | 6.130 | 0.000 |
| Education: Form IV and above**                      | 0.704       | 2.022      | 0.791     | 1.800 | 0.072 |
| Marital status (married)                            | –0.069      | 0.933      | 0.274     | –0.240| 0.814 |
| Gender female **                                    | –0.648      | 0.523      | 0.138     | –2.460| 0.014 |
| Land size*                                          | –0.241      | 0.786      | 0.099     | –1.910| 0.057 |
| Access to extension services                        | –0.060      | 0.942      | 0.302     | –0.190| 0.852 |
| Experience in horticulture agribusiness             | –0.003      | 0.997      | 0.280     | –0.010| 0.991 |
| Household size                                      | 0.067       | 1.069      | 0.083     | 0.860 | 0.392 |
| Management innovation***                            | 2.184       | 8.883      | 3.225     | 6.020 | 0.000 |
| Access to credit*                                   | 0.481       | 1.617      | 0.449     | 1.730 | 0.083 |
| Good perception of horticulture for agribusiness*** | 1.666       | 5.289      | 1.674     | 5.260 | 0.000 |
| Household income form horticulture                  | 0.098       | 1.103      | 0.111     | 0.980 | 0.330 |
| Improved packaging***                               | 0.994       | 2.701      | 0.985     | 2.730 | 0.006 |
| Improved storage facility                           | –0.131      | 0.877      | 0.266     | –0.430| 0.666 |
| Improved transport facility                         | 0.414       | 1.514      | 0.550     | 1.140 | 0.254 |

Observation = 385

log likelihood = –243.6

Pseudo R² = 0.3186

Chi-square = 227.89

Source: computed by authors using stata software, data from field survey 2018. Asterisks represent statistically significant at *** 1%, ** 5%, and * 10%, respectively.
5. Conclusion

The results show that male youth dominate the horticulture agribusiness in Njombe District Council, Njombe Town Council, and Makambako Town Council. However, more female youth are involved in the production and marketing of specific types of vegetables like amaranth (Amaranthus cruentus), brassica (Brassica carinata), carrot (Daucus carota), and Chinese mallow (Malva verticillata). Most females do not have financial capital and do not own land necessary for the cultivation of fruit and vegetables like tomato (Solanum lycopersicum) and avocado (Persea americana). This implies that operational costs like the price for farm inputs and the cost of postharvest management innovations are high and limit female youth involvement in horticulture agribusiness. The active participation of youth in horticulture agribusiness indicates that horticulture still serves as one of the major means of employment as it can be practiced with limited land resources (average of 1–acre), minimum capital, a short growing season averaging two months for vegetable production and two years for avocado production under good agricultural practices, and has high returns as shown in the previous section. Therefore, unemployed youth (both male and female) could take advantage of vegetable and fruit cultivation, particularly avocado (Persea Americana), tomato (Solanum lycopersicum), carrot (Daucus carota), and cabbage (Brassica oleracea) as these crops provide high returns to investments. Significant constraints facing youth that engage in the horticultural agribusiness are fluctuation of prices, inadequate infrastructure, such as storage facilities and lack of improved transport system, high PHLs, lack of market and capital, and the high cost of packaging materials. Also, the study found that high PHLs experienced in Njombe Town Council and Njombe District Council while Makambako Town Council experiences low PHLs. This is due to the geographical location of Makambako Town Council; it can easily be accessed through a good road network, being central for Mbeya, Iringa, Njombe, and Songea regions, so enhancing the availability of markets. To minimize horticultural PHLs, youth used local methods such as handpicking of fruit and vegetables, spreading the produce on the floor, and spraying with water. This implies that youth in Tanzania particularly in Njombe Region have limited knowledge and information on improved horticultural PHM innovations, which are vital for the development of the sub-sector and encouragement for youth involvement as well as a reduction of unemployment rate among the youth. The above constraints are non–gender–based problems preventing both male and female youth involvement in horticulture agribusiness. Also, this study found that Ordered logit
results showed that factors that positively and significantly influence youth involvement in horticulture postharvest management are primary school education, Form IV and above, Management innovation, access to credit, Good perception of horticulture for agribusiness and improved packaging materials. Factors that negatively and significant influencing youth involvement in horticulture postharvest management are gender female and farm size all are significant influencing male and female youth involvement in horticulture PHM innovation in Tanzania, particularly in Njombe Region.

Policy implications
The following options can enhance opportunities for engagement for male and female youth in horticulture agribusiness.

- The government should create a conducive environment for private investors (such as improved rural roads, power supply, and lowering tax in improved horticultural PHM facilities) to have contract farming arrangements with male and female youth in Njombe Region. For example, many investors are investing in the production value chain for tomato, avocado, Irish potato, and tea, among others, in the Southern Highlands of Tanzania (Njombe Region inclusive). Therefore, those investors should be linked with male and female youth to ensure markets for produce and their access to inputs of good quality.

- Infrastructure development: Youth would benefit from investments made in the construction of many packhouses. Currently, there is one packhouse in Njombe Region centered in Njombe Town Council, which was developed through a public–private partnership between the Government and the private sector (TAHA). This can be worked out through linking youth with organizations or companies that purchase horticultural produce from small–scale farmers including youth, also the formation of youth Agricultural Marketing Cooperative Societies (AMCOS) could help youth to pay rent for a packhouse as this seems to be expensive for individual youth to operate since cost per season is about Tshs 1million (USD 434.69) and has a storage capacity of 20 to 80 tons.

- There is a need for the development of processing plants; this is important for reducing horticultural PHLs to enhance youth participation in horticulture agribusiness as well as to trigger employment creation along the value chains.

- Alleviating financial constraints: Youth lack the financial resources to start and develop horticultural businesses. There is need to create incentives for small and medium financial institutions or micro–credit financial institutions to open sub–offices in Njombe to provide credit with an affordable interest rate for youth. Such
as youth-friendly credit schemes will help them to access farm inputs and PHM innovations.

- Training of youth in horticulture PHM. The Government and private sector through contract farming with youth should provide quality training in horticulture management innovation to enhance the skills of male and female youth in horticulture agribusiness and attract youth to remain in the sub-sector.

- The Ministry of Agriculture, Ministry of Health, Community Development, Gender, Elderly and Children, and Tanzania Horticulture Association should link with development partners to develop a project for raising awareness on the available opportunities in the horticulture sub-sector, which could attract female youth to be more involved in the horticulture subsector.
6. References


