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# Determinants of the Adoption of Soil Management Practices among Male Vegetable Farmers in Imo State, Nigeria

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**Keywords:** Soil management practices; Adoption; Agronomic practices; Cultivation practices; Structural and mechanical practices.

**Abstract**

A shift from subsistence production to commercial production has given rise to involvement of more males in the cultivation of vegetables in South Eastern Nigeria. This study investigated the soil management practices adopted by male vegetable farmers and the factors that influence the adoption of these soil management practices. Purposive sampling technique was used to select 64 male vegetable farmers for the study and data were collected by means of questionnaire. Descriptive statistics and Multinomial logit regression were used to analyze data collected. Results showed that the farmers had an average age of 34 years and an average farm size of 0.4 hectares. Majority of the respondents had farming experience of between 1-10 years. Weed management, application of organic fertilizer and mulching were the three most important soil management practices adopted by the farmers. Also, the size of the vegetable farm negatively influenced the adoption of agronomic practices; it however positively influenced cultivation practices among the vegetable farmers. Also, farm income, level of education attained and membership of social group negatively influenced the probability of adoption of cultivation practices and positively influenced the probability of adoption of structural and mechanical practices by vegetable farmers in the area. Household size positively influenced the likelihood of adopting cultivation practices positively by the farmers. The study recommended that vegetable farmers should be encouraged to adopt soil management practices that enhance their production and increase output.

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## Introduction

With over 75% of the world's poor in rural areas and most of them dependent on farming, agriculture must be part of world economic growth, poverty reduction, and environmental sustainability [1]. Agriculture is critical to achieving global poverty reduction targets and it is still the single most important productive sector in most low-income countries, often in terms of its share of Gross Domestic Product and almost always in terms of the number of people it employs [2]. In countries where the share of agriculture in overall employment is large, broad-based growth in agricultural incomes is essential to stimulate growth in the overall economy, including the non-farm sectors selling to rural people. Hence, the ability of agriculture to generate overall GDP growth and its comparative advantage in reducing poverty will vary from country to country [3].

In Nigeria, agriculture is the predominant activity in most of the zones in the Country [4]. Agriculture remains the dominant sector in the rural areas in Nigeria. It provides employment for about 60% of the workforce. The diversity of climate conditions, the richness and the management of soil types and water resources and high population density, provide great potential for crop, animal, fish and tree production. In the 1960's and up to the early 1970's, Nigeria's agriculture flourished.

Horticultural crops especially vegetables are widely cultivated in most parts of Nigeria, as a cheap and reliable source of protein, vitamins, zinc and iron which also constitute between 30% and 50% of iron and vitamins A [5]. The term vegetable is a plant whose stem, leaves, tubers, roots, bulbs or flower is used as food source for people (Enchanted Learning, 2009) but do not fall into the categories of desert fruit, dry pulses, nuts, herbs, species or starchy root crops [6]. Fluted pumpkin (Telferia occidentalis), which is regarded as a vegetable, is a native of West Africa but occurs mostly in its cultivated form in various parts of southern Nigeria. It is widely cultivated for its palatable and nutritious leaves which are used mainly vegetable. The seeds are also nutritious and rich in oil which may be used for cooking and soap manufacture. It grows in many nations of West Africa, but is mainly cultivated in Igboland and Calabarland. The plant is drought-tolerant, dioecious perennial that is usually grown trellised [7].

Waterleaf (Talinum triangullare), is a herbaceous annual and perennial plant that has green leaves that are edible. This vegetable is mostly found in West Africa and Western North Africa. The leaves and stems of this plant are consumed as vegetables. In some parts of the country, it grows as a weed and is usually more abundant in the rainy season. It is considered to be a rich source of vitamins and proteins. The protein content could be likened to that of cashew nuts, millets and cowpeas. The consumption of waterleaf helps diabetic patients as it regulates blood sugar levels in the body. Another health benefit accrued to eating waterleaf is its ability to reduce blood cholesterol levels because of its soluble fiber content. Waterleaf also has antioxidant properties which makes it useful in the treatment of chronic inflammatory disease. Having known all these, it would be awesome to eat these vegetables often in order to stay healthy. The good thing is that they are quite affordable and can be gotten with little or no stress in the market [8,9].

Although males are expected to play dominant roles in farming because of their access to farm resources, production technologies, output and influence on decision making process, women are much more involved in cash crops, arable and vegetable gardening. In some instances, rural women have virtually taken over the production and processing of arable crops being responsible for as much as 80% of the staple food items [5,10]. The cultivation of vegetables is mostly a women venture and women dominate their production especially in Nigeria [5]. In most farming households, vegetables like Fluted pumpkin (Telferia occidentalis) and waterleaf (Talinum triangullare) are considered a woman's crop and is predominantly produced by women at the subsistence level. The crops serve as additions to the main crops like tubers and roots produced for household consumption. This however is changing with the involvement of more men in the cultivation of these crops. According to Ali et al. [11], fruits and vegetables generate more jobs per hectare, on-farm and off-farm, than staple based agricultural enterprises and this benefits farmers and landless laborers in both rural and urban areas. Furthermore, processing and other value addition activities carried out on fruits and vegetables generate further employment in the associated agri-businesses and further down the commodity chain from the producer to the consumer. Fruits and vegetables can generate higher profits than staple crops, especially when land is relatively scarce and labor is abundant [12]. Also, the production of vegetables provides new and profitable sources of income for farmers and this is can be especially important for small-scale farmers since these crops are well suited to smallholdings and family enterprises [12,13]. According to Deji, Koledoye and Owombo [14], vegetable cultivation has become a highly commercialized enterprise, but with a wide gap between current production and potential production. Thus, the crossing of the production threshold from purely subsistent production to commercialization may therefore be responsible for the participation of more males in vegetables production.

Moreover, the main issue with vegetable farming is that of low productivity. Also with population growth, demand for land has increased resulting to intense cultivation with little or no fallow periods and the reliance on continuous cropping rather than conservation cropping systems [15,16]. Hence, under this environmental condition, good soil management practices are essential to maintain sustainable production to meet the current high demand for food and vegetable crops in Nigeria. Several indigenous local technologies in use with organic fertilizers have recorded huge successes especially among peasant farmers [17]. In spite of all these, recent evidences have shown that farmers have not been eager to adopt or invest in soil management practices. Therefore there is a need to identify soil management practices male vegetable farmers have access to and assess them in order to address long term sustainability of Nigeria's soil resources. This is important as the farmers and others seek to sustain yield increases in the major food and vegetable production systems in Nigeria and to increase the efficiency of farmers in the adoption of researched technologies. With the foregoing, this study analyses the socioeconomic characteristics of male vegetable farmers; the soil management practices adopted by the farmers and the determinants of soil management practices in vegetable based production systems by male vegetable farmers in Imo State.

## Methodology

This study was carried out in Imo State, Nigeria. Imo State is located in the humid tropics of south-East, Nigeria. It lies within latitudes 4°45'N and 7°15'N, and longitudes $6^0$ 50'E and 7 $^0$ 25'E. Imo State is bounded on the east by Abia State, on the west by the Rivers and Delta States; on the north by Anambra

State, while River State lies to the south. The State covers a land area of 5,100 km$^2$, with a population of 3,934 899 person (NBS, 2016). Variations occur in rainfall amount from year to year. The State has an average annual rainfall of 1800 to 2500mm [18].

A multistage sample technique was used for the selection of respondents and location for the study. Imo State has three Agricultural Zones which are Okigwe, Owerri and Orlu zone. First, two agricultural zones identified by the State Agricultural Development Programme for high concentrations of vegetable farmers were purposively selected from the three zones in the State. Next, two Local Government Areas (LGAs) were selected from each of the two agricultural zones selected, giving a total of four (4) LGAs for the study.

In the next stage, two communities were selected from each Local Government Area, given a total of eight (8) communities for the study. Next, two villages were selected from each community, giving a total of sixteen (16) villages. Lastly, four male vegetable farmers were selected from each village, giving a total of eighty (64) respondents for the study.

The data for the study were collected from respondents by means of structured questionnaire. The questionnaire was designed to obtain relevant information from the respondents. Information on age, household size, farming experience, level of education, sex of household head, annual income, marital status, soil management practices adopted in the area and the type of vegetables cultivated in the area.

Objectives 1 and 2 which are to describe the socioeconomic characteristics of respondents and to identify the soil management practices available in the area were achieved using descriptive statistics such as means, frequency distributions and percentages.

Objective 3 which is to determine the factors that influence the choice of soil management practices adopted by gender was achieved using multinomial logistic regression as specified by Ben-chendo et al. [19] and Eike.

The model for multinomial logit is given as;

$P(y = j/x) = \exp(x\beta j) / [1+h=1J\exp x\beta h, j = 0,1,2\ldots,J$

Where y denotes a random variable taking on the values (0,1,2…,*j*), for a non-negative integer j;

Where "x" denotes a set of conditioning variables.

In this study, y represents the soil conservation practices which were grouped into three distinct groups of 0,1 and 2.

While x represents farmers' socio-economic characteristics and farm specific constraints. To obtain unbiased and consistent estimates of the MNL specified in the above equation, the study assumed that the independence of irrelevant Alternative (IIA) holds (Deressa et al., 2008).

The IIA assumption requires that the probability of using a single soil management technique by any farmer is independent of the probability of choosing another type of soil management technique (that is the probability of using soil management "A" is ($p_j/p_h$). this is independent of using soil management B and C). This implies that error terms generated in equation (1) should have a zero mean; uncorrelated and have constant variance. The parameter estimates of the MNL model only provide the direction of the effect of the independent variables on the dependent (choice) variable; thus the estimates represents neither the actual magnitude of change nor the probabilities (Green,2000).

Where

$y_i=0.1,\ldots j=d_0+d_1FI+d_2AGE+d_3EDU+d_4HHS=d_5FAS+d_6OFI+d_7EXT+d_8CRE+d_9SGP+d_{10}LOW+d_{11}EXP+d_{12}MAS+\mu_{1.}\ldots(1)$

where

$y_0$ is the choice of using flat or zero tillage soil management technique (y=0)

$y_1$ is the choice of using bedding soil management technology (y=1)

$y_2$ is the choice of using tillage management technology (y=2).

The explanatory variables are:

AGE= age of respondents (years)

EDU= farmers' years of former education (years)

HHS= farmers' household size (number)

FAS= farm size of farmers (ha)

OFI= off-farm income (naira)

FI= farm income (naira)

EXT= contact with extension agents (number of times)

CRE= access to credit facilities (amount of credit received ₦)

SGP= member of a social group (dummy; 1 for member and 0 for otherwise)

LOW= mode of ownership of farm land (dummy; 1 for inherited; 0 for otherwise)

EXP= farming experience (years)

MAS= marital status (dummy variable; 1 for married and 0 for otherwise.

## Results & discussion

The socioeconomic characteristics of the respondents are presented in Tale 1.

**Table 1:** Socioeconomic characteristics of the respondents.

| Socioeconomic Variable | Frequency | Percentage |
|---|---|---|
| **Age (years)** | | |
| 21-30 | 18 | 28.13 |
| 31-40 | 34 | 53.13 |
| 41-50 | 8 | 12.5 |
| 51-60 | 4 | 6.25 |
| Total | 64 | 100 |
| Mean | 34 | |
| **Marital Status** | | |
| Single | 22 | 34.38 |
| Married | 38 | 59.38 |
| Divorced | 2 | 3.13 |

| | | |
|---|---|---|
| Widowed | 2 | 3.13 |
| Total | 64 | 100 |
| **Household Size (Number of persons)** | | |
| 1-2 | 12 | 18.75 |
| 3-4 | 22 | 34.38 |
| 5-6 | 24 | 37.50 |
| 7-8 | 4 | 6.25 |
| 9-10 | 2 | 3.13 |
| Total | 64 | 100 |
| Mean | 4 | |
| **Farm Size (Ha)** | | |
| 0.1-0.5 | 30 | 46.87 |
| 0.6-1.0 | 28 | 43.75 |
| 1.1-1.5 | 6 | 9.38 |
| Total | 64 | 100 |
| Mean | 0.4 | |
| **Years in school** | | |
| 1-6 | 2 | 3.13 |
| 7-12 | 6 | 9.38 |
| 13-18 | 44 | 68.75 |
| 19-24 | 12 | 18.75 |
| Total | 64 | 100 |
| Mean | 17 | |
| **Farming Experience (years)** | | |
| 1-10 | 62 | 96.88 |
| 11-20 | 2 | 3.13 |
| Total | 64 | 100 |
| Mean | 4 | |
| **Membership of social group** | | |
| Non Members | 8 | 12.50 |
| Members | 56 | 89.50 |
| Total | 64 | 100 |
| **Extension Visits** | | |
| 0 | 48 | 75 |
| 1 | 10 | 15.63 |
| 2 | 6 | 9.38 |
| Total | 64 | 100 |
| Mean | 0.25 | |

**Source:** Field survey 2018

The result in Table 1 revealed that the average age of the male vegetable farmers was 34 years. This is an indication that the farmers are relatively young and vibrant. They are also more likely to engage in vegetable production on a commercial scale rather than at a subsistence level. The youthful farmers are also more likely to adopt soil management practices that will enhance production and output on the farms. This result agrees with that of Oloyede et al. [20] who reported the mean age of the vegetable farmers was 39 years.

The result also indicates that majority (59.38%) of the respondents were married. The settled married life may a motivation for the these farmers to engage in vegetable production as a means of livelihood especially as they may more likely have access to labour to for the farm work being provided by their spouses and other household members. This may also enhance their ability and capacity to adopt more soil management practices so as to increase output on the farm. This result also agrees with Olowa and Olowa [5] who reported that majority of vegetable farmers in Lagos State were married.

The result also shows that majority (71.88%) of males, had household sizes of between 3-6 persons. The average household size of the vegetable farmers was 4 persons. The result implies that the respondents had moderate household sizes. Household members are known to provide labour and sometimes capital for use in the farm firm [21]. The support from adult household members would be an added impetus for these vegetable farmers to adopt more soil management practices on their farms. This result agrees with Ben-Chendo et al. [7] who reported an average household size of persons for vegetable farmers in Ahiazu Mbaise Area of Imo State.

The result in Table 1 revealed that majority (about 91%) of the respondents has farm size of mot more than 1 Hectare (1Ha). This implies that the farmers in the study area had small sizes and may therefore be compelled to adopt soil management practices that will enhance yield on the farm. This result agrees with Olowa and Olowa [5] and Deji, Koledoye and Owombo [14] who reported similar farm size for vegetable farmers in Lagos State and Ondo State respectively.

The result further shows that majority (68.75%) of the respondents had between13-18 years of formal education. The implication is that these farmers are highly literate and thus better exposed and more inclined to adopt the best soil management practices on their farms so as to attain maximum yield of crops. The result of this analysis disagrees with the findings of Ben-Chendo et al. [7] who noted that majority of the vegetable farmers in Ahiazu Mbaise had at most 12 years of formal education.

The result in a huge proportion (96.88%) of the vegetable farmers had between 1-10 years of experience in vegetable farming. This may be an indication that the respondents were relatively new entrants into vegetable farming. Thus, they may not therefore have the luxury of depending on past experiences to guide their decisions on the farm. This may however be an advantage because lacking experience; these farmers may be more willing to adopt new soil management practices that could boost their production.

The result in Table 1 also shows that majority (89.50%) of the respondents in the study area belong to one or more social/cooperative groups. This implies that farmers may obtain the benefits of membership of such organizations, such as collective bargaining, improved inputs from government. The analysis disagrees with the findings of Babatunde et al. who noted that majority (93.6%) in Kwara State do not belong to any cooperative group.

The result in Table 1 also shows that majority (75%) of the farmers had no extension visits. The implication of this is that

the dissemination of useful information and technologies including soil conservation practices which could help increase output of the farmers may be greatly impeded. Extension visits are important in ensuring improved agronomic practices and hence higher productivity and output among farmers.

**Adoption of soil management practices**

**Table 2:** Distribution of respondents according to the soil management practices adopted in the study area.

| Soil management practices | Frequency* | Percentage |
|---|---|---|
| Crop rotation | 20 | 31.25 |
| Plant residue | 14 | 21.88 |
| Zero tillage | 10 | 15.63 |
| Green manure | 22 | 34.38 |
| Ridging | 20 | 31.25 |
| Bedding | 34 | 53.13 |
| Inorganic manure | 34 | 53.13 |
| Organic manure | 42 | 65.63 |
| Mulching | 35 | 54.69 |
| Soil biology | 0 | 0 |
| Trap crops | 5 | 7.81 |
| Weed management | 54 | 84.38 |
| Soil liming | 4 | 6.25 |
| Compost manure | 21 | 32.81 |
| Bush fallow | 23 | 35.94 |
| Level terraces | 1 | 1.56 |
| Integrated plant mgt | 4 | 6.25 |
| Buffer strips/contour plough | 2 | 3.13 |
| Double cropping | 32 | 50 |
| Intercropping | 9 | 14.06 |
| irrigation | 15 | 23.44 |
| Manure management | 15 | 23.44 |
| Salinity | 2 | 3.13 |
| Pesticides | 24 | 37.50 |
| Drainage | 16 | 25 |

Source: Field survey 2018. *Multiple responses taken.

Table 2 shows all possible methods of preserving the soil to ensure optimum fertility and minimum degradation such as erosion. It can be deduced from the Table that weed management, application of organic manure and mulching were the three most important soil management practices adopted by the vegetable farmers in the area. Weed management involves the removal of unwanted plants from the farm using cutlass, hoe, or any other farming implement. Weeding minimizes competition for nutrients between the crops grown and the weed. The adoption of weed management may be because the practice is relatively cheap and the materials readily available to the farmers. Also, the use of organic manure is a dominant soil management practice in the study area. This again may be attributed to the resource being relatively cheap and available. Timamiyu et al. and Ojeniyi et al. [22] noted that the use of different organic manures individually are good alternatives of inorganic fertilizer for improved vegetable production in Nigeria, owing to the fact that the use of inorganic fertilizer in Nigeria is limited because fertilizer distribution has become highly political, scarce and unaffordable by resource poor smallholder farmers. Mulching is also widely used as a soil management practice among vegetable farmers in the area. Here, grasses and legumes that are cut off are used to cover-up the top-soil around the crops to reduce transpiration and stop excessive run-off. Mulching and organic manure are predominantly used because of how cheap they are to adopt. The grasses and other crop residues used for mulching, and the animal droppings and farm waste used as organic manure are cheap and easy to acquire [23,24].

**Determinants of adoption of soil management practices by the male vegetable farmers**

Table 3 shows the estimated marginal effects of the multinomial logit for the determinants of the adoption of soil management practices among male farmers in the area. The multinomial logit analysis was done by normalizing structural and mechanical practices as the reference category. In addition, the Ordinary Least Square model was fitted and the model was tested for multi-collinearity using the Variance Inflation Factor (VIF). The VIF for all variables were less than 10, suggesting that multi-collinearity is not a serious problem in this model. The model was tested for validity of the Independence of the Irrelevant Alternatives (IIA) assumption using the Hausman test for IIA. The result consistently proved affirmative, that, the assumption of IIA was not violated. This suggested that, the application of multinomial logit model is appropriate. However, the chi-square value of 42.39 showed that likelihood ratio statistics were highly significant ($P<0.00001$) at one percent. This shows that the model has a strong explanatory power. Results showed that the Pseudo R-square value was 0.6693. This implies that the socioeconomic factors of male farmers explained about 66.93% of the variation in the choice of soil management practices, while the remaining 33.07% was not accounted for due error and omitted variables. The study computed the marginal effects of each socioeconomic factor since the parameter estimates of the model only provide the direction of the effect of the independent variables on the dependent variable; and not the actual magnitude of change and probabilities.

Results in the Table showed that the marginal effects of farm size was significant and negatively influenced the farmers' choice of agronomic practices (-2.7966), but positively influenced their choice of cultivation practices (2.18422) at ten percent and five percent probability levels, respectively. This implies that an increase in farm size by one hectare decreases the likelihood of choosing agronomic practices by 2.8%, and increases the probability of choosing cultivation practices by 2.2%. This could be linked to the fact that as farm size increases, male farmers carry out more of land tilling and making of ridges, and other cultivation practices.

The marginal effect of farm income was significant and negatively influenced the vegetable farmers' choice of cultivation practices (-0.0000045), and positively influenced their choice of structural and mechanical practices (0.0000036) at five percent and one percent probability levels, respectively. This shows that an increase in farm income decreases the likelihood of choosing cultivation practices by 0.00045%, and increases the probability of choosing structural & mechanical practices, such as irrigation. This could be attributed to the fact that farm income increases

the purchasing power of male farmers, and enabled farmers to afford irrigation facilities for all year round production.

Marginal effects of education showed that the variable significantly and negatively influenced male farmers' choice of cultivation practices (-0.3753) at five percent probability level, and positively influenced their choice of structural and mechanical practices (0.0998) at one percent probability level. This implies that an increase in educational attainment of male farmers by one year decreases the probability of choosing cultivation practices by 37.53%, and increases the likelihood of choosing structural and mechanical practices by 9.98%. This could be attributed to the roles education play as it exposes male farmers to improved agricultural technologies such as irrigation, modernized bunds, buffer strips and contour strips that not only control soil erosion, but conserve the soil fertility for all year production.

The marginal effect of household size was significant and positively influenced male farmers' choice of cultivation practices (0.1091) at one percent probability level. This implies that an increase in household size by one person increases the probability of choosing cultivation practices such as land tilling and making of ridges and mounds, by 10.91%. This could be linked to more free hands and free family labour available for agricultural production.

Marginal effect of cooperative membership was significant and negatively influenced male farmers' choice of cultivation practices (-0.5272) at ten percent probability level and positively influenced the choice of structural & mechanical practices (0.6503) at one percent probability level. This implies that increase in membership of cooperative societies by one decrease the likelihood of choosing cultivation practices by 52.72% and increases the likelihood of choosing structural & mechanical practices by 65.03%. This is an indication that cooperative membership increases male farmer's capacity to choose structural & mechanical practices.

**Table 3:** Estimated Marginal Effects of the Multinomial Logit for he Factors Influencing the Choice of Soil Management Practices.

| Socioeconomic Factors | Soil Management Practices | | | | | |
|---|---|---|---|---|---|---|
| | Agronomic Practices | | Cultivation Practices | | Structural & Mechanical Practices | |
| | *dy/dx* | *p-value* | *dy/dx* | *p-value* | *dy/dx* | *p-value* |
| **Farm Size** | -2.796643* | 0.054 | 2.184222** | 0.042 | 0.612421 | 0.455 |
| **Farm Income** | 8.12e-07 | 0.483 | -4.45e-06** | 0.018 | 3.64e-06*** | 0.005 |
| **Level of Education** | 0.1136087 | 0.418 | -0.3753254** | 0.025 | 0.099805*** | 0.001 |
| **Age** | 0.0041862 | 0.483 | -0.0060769 | 0.434 | 0.0018907 | 0.712 |
| **Household Size** | 0.0092502 | 0.817 | 0.1090552** | 0.012 | 0.2617169 | 0.223 |
| **Farming Experience** | 0.0142436 | 0.632 | -0.0523294 | 0.188 | 0.0380858 | 0.104 |
| **Extension Visits** | 0.0328925 | 0.747 | -0.0415897 | 0.583 | 0.0086972 | 0.929 |
| **Membership of Cooperative** | -0.1230575 | 0.475 | -0.5272405* | 0.052 | 0.650298*** | 0.007 |

***significant at 1%, **Significant at 5% probability level; *significant at 10%. LR chi-square 42.39***, Prob>chi-square: 0.0003, Log likelihood: -10.472, Pseudo $R^2$: 0.6693

## Conclusion

The study concludes that the farmers were youthful, highly literate and relatively new entrants into vegetable production. Weed management, application of organic fertilizer and mulching are the three most important soil management practices among male vegetable farmers in the area. Furthermore, the size of the vegetable farm negatively influences the adoption of agronomic practices but positively influences cultivation practices among the vegetable farmers. Also, farm income, level of education attained and membership of social group negatively influence the adoption of cultivation practices but positively influence the adoption of structural and mechanical practices by vegetable farmers in the area. Household size influences the likelihood of adopting cultivation practices positively by the farmers.

### Recommendations

1. There is need to encourage the production of more organic fertilizer as it serves as an important resource for soil management practice among vegetable farmers.
2. Vegetable farmers should be encouraged to adopt soil management practices that enhance their production and increase output.
3. Vegetable farmers should be encouraged to form social groups like cooperatives as membership of these groups will help in giving them access to information and resources that could assist them in their production activities.
4. More young school leavers should be encouraged to venture into vegetable production as it will provide them with a source of income for sustenance.
5. More land could be made available to young and energetic male farmers who are willing and ready to go into vegetable production as a means of livelihood.

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