



Dynamics of Trifoliolate Yam (*Dioscorea dumentorum*) Production in Enugu State, Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author JCI designed the study, wrote the protocol and wrote the first draft of the manuscript. Author KCO managed the literature searches, data collection and analyses of the study. Author JCI read and approved the final manuscript on behalf of the two authors.

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ABSTRACT

Trifoliolate yam (*Dioscorea dumentorum*) is one of the under-utilized species of yam with little or no research and industrial application in spite of its enormous potentials. In view of the possibility of losing the crop in the universe especially in the study area, if the current production and utilisation conditions are not reversed, the study was carried out to assess dynamics of trifoliolate yam production in Enugu State, Nigeria. Data were collected from 108 trifoliolate yam farmers that constituted sample for the study. Mean score, standard deviation, Pearson correlation and factor analysis were used in analysing the data. Results on dynamics of production show that mean size of land allocated to trifoliolate yam production was relatively steady, mean cost of input and income were increasing while mean output was decreasing within the years under consideration (before 2001 to 2014). Years of experience in trifoliolate yam production (0.254; $p \leq 0.008$), farm size (0.364; $p \leq 0.000$) and portion of farmland cultivated with trifoliolate yam (50.421; $p \leq 0.000$) were determinants of trifoliolate yam production. Serving as a staple food (M=2.29) and promotion of good health were perceived as importance of trifoliolate yam while, technical/land, institutional/infrastructural and economic/physical problems were extracted as causes of decline in trifoliolate yam production in the area. The study therefore recommends that favourable land ownership policy/law that will allow

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farmers to acquire land for agricultural purpose should be enacted and implemented by government while awareness campaign on the potentials of trifoliolate yam should be carried out by extension agencies in order to boost the interest of the masses in production, consumption and industrial utilisation of the crop.

Keywords: Dynamics; trifoliolate yam; production; Enugu state; Nigeria.

1. INTRODUCTION

Yam (*Dioscorea Spp*) is an important agricultural crop in Nigeria, though its importance in the diets of the various tribes in the country varies [1]. Nigeria is by far the world's largest producer of yams, accounting for over 70% of the world production [2]. There are over 600 species of yam worldwide but six species can be considered as the edible ones in the tropics. These are white yam (*Dioscorea rotundata*) yellow yam (*D. cayenensis*), water yam (*D. alata*), trifoliolate yam (*D. dumetorum*), arial yam (*D. bulbifera*) and Chinese yam (*D. esculenta*) [3].

Trifoliolate yam (*Dioscorea dumetorum*) as one of the species in the genus *Dioscorea* has other common names as African bitter yam, wild yellow yam, trifoliolate (three-leaved) yam and cluster yam. Bitter (trifoliolate) yam is known as 'ji una' or 'ji ona' in Ojoto and many Igbo speaking area in the south-eastern Nigeria, where it is regarded as food for the adult [4]. It can also be used as a vegetable, but not pounded into 'fufu'. Owing to its soft texture, it is favoured by old people with poor teeth. The wild forms are regarded as famine food.

Being a high yielding and cheaper crop, it could serve as raw materials for food formulation. The dried tubers can be used in breweries as a base for the preparation of beer. The tubers of trifoliolate yam, when properly processed like some other yams, can be used in the production of yam flakes; instant flour for the bakery sector or starch in diverse pharmaceutical preparations [5]. Bitter yam serves as food of choice for the diabetic patients and as herb for the treatment of various ailments. In the South-western Nigeria, bitter yam is utilized in the treatment of malaria [6], suggesting a widespread ethno-medicinal importance of bitter yam. Yet it remains an underutilized tropical tuber [7] that may be driven into extinction in no distant future.

A research in Enugu North agricultural zone of Enugu state by [8] shows that average yield (kg/ha) of *D. dumetorum* for 2006, 2007 and

2008 were 22,337 kg/ha; 19,563 kg/ha and 17,800 kg/ha respectively. These data obviously suggests decrease in *D. dumetorum* production in the area. Certain factors like high costs of planting material and labour, decreasing soil fertility, inadequate yield potential of varieties, as well as increasing levels of field and storage pests and diseases associated with intensification of cultivation [9], might be responsible for the decline. Personal, social, economic, institutional factors such as age, educational level, sex, ownership of farmland, farming experience, farm input, extension contacts etc may also have direct or indirect relationship with this decline.

There is also limited information on the use of flours from trifoliolate yam in food industries and at household levels in Nigeria. This could probably be due to lack of information on the usefulness and importance of the flours for functional food products [1]. In line with this fact [10] reported that so far the yam has found no industrial application. Worst also, the crop is yet to attract adequate research interest in its production, consumption and in tapping the potentials of this crop.

Hence, there is need to investigate on this under-utilized species of yam. This will be useful in boosting the potential uses of the tuber in the food, animal feed and cosmetic or pharmaceutical industries. Additionally, increased study on *Dioscorea dumetorum* could add to the likelihood of exploitation of the specie as an economic plant and bring about further work on its cultivation [11] in order to reap the benefits of this crop and retain it in the universe. In view of the afore mentioned facts, the study examined dynamics of trifoliolate yam production in Enugu State, Nigeria. Specifically, the study:

- i. Described socio-economic characteristics of trifoliolate yam farmers in the study area;
- ii. Described trifoliolate yam farmers production trend in the study area ;
- iii. Ascertained determinants of output of these farmers;
- iv. Ascertained potentials/uses of trifoliolate yam and

- v. Ascertained causes of decline in trifoliate yam production in the area.

2. METHODOLOGY

The study was carried out in Enugu State, Nigeria. Enugu State is one of the states in the Eastern part of Nigeria. The state shares borders with Abia State and Imo State in the south, Ebonyi State in the east, Benue State in the northeast, Kogi State in the northwest and Anambra State in the west. The state is made up of seventeen (17) Local Government Areas and six agricultural zones.

Enugu is located in a tropical rain forest zone with two distinct seasons of rainy and dry seasons. The average annual rainfall is about 2,000 mm. The State had a population of 3,267,837 people at the Census held in 2006. Economically, the state is predominantly rural and agrarian. Major crops grown include, cassava, yam, cocoyam, vegetables etc. while poultry, sheep and goat are major animals reared in the area.

2.1 Population and Sample

Trifoliate yam farmers in Enugu State constituted the population for the study. A multi-stage sampling technique [12] was employed in selecting the respondents as follows;

Stage one: from the six agricultural zones in the state, three zones namely Udi, Enugu Ezike and Nsukka, were purposively selected because of their involvement in trifoliate yam production.

Stage two: two blocks where trifoliate yam were mostly produced were purposively selected from each of the zones giving a total of six blocks for the study.

Stage three: from each of the selected blocks three cells where trifoliate yam farmers can be mostly found were purposively selected giving a total of eighteen circles for the study.

Stage four: from each of the circles, six trifoliate yam farmers were purposively selected giving a total of one hundred and eight (108) respondents for the study.

Data for the study were collected from the respondents through the use of well structured and validated interview schedule. It contained relevant questions based on each of the objectives of the study. Data were collected on

age, sex, marital status, educational level: and years spent in acquiring formal education, years of farming experience, years of experience in trifoliate yam production, household size and monthly income. In order to assess trend in production of trifoliate yam, respondents were requested to estimate size of farmland they allocated/cultivated with trifoliate yam (in hectare), cost of input (in Naira), output (in kg) and income (in Naira) realized from the product (trifoliate yam) before 2001, 2001 to 2007 and 2008 to 2014.

A list of possible potentials/ uses of trifoliate yam was provided while the respondents were also requested to include other potentials/uses of trifoliate yam that were not in the list. Further, they rated the extent they perceive them as potentials/uses of trifoliate yam on a four point Likert-type scale of "to a great extent, to a moderate extent, to a little extent, and to no extent", with nominal values of "3, 2, 1 and 0" respectively. These values were added to obtain 6, which was further divided by four to obtain 1.5 that is the mean and decision point. Variables with mean scores greater than or equal to 1.5 were regarded as potentials/uses of trifoliate yam while variables with mean scores less than 1.5 were regarded otherwise.

Causes of decline in trifoliate yam production were captured using a three point Likert-type scale of "to a large extent, to a little extent and to no extent", with nominal values of "2, 1 and 0" respectively. Respondents were requested to rate the causes using the scale mentioned above. Data generated were further subjected to factor analysis.

Percentage, mean score standard deviation, Pearson correlation [13] and factor analysis (varimax rotation and Kaiser Normalization where a variable with a loading of 0.4 and above is considered as having a high loading and may be used in naming a factor) were used in data analysis.

3. RESULTS AND DISCUSSION

3.1 Socioeconomic Characteristics of the Respondents

3.1.1 Sex and age

Greater proportion (66.7%) of the respondents were males while 33.3% were females (Table 1).

The domination of male respondents in this study may be derived from the fact that traditionally in most rural communities of Nigeria, yam (including trifoliolate yam) is an economic and gender stereotypic crop. Yam requires fertile land, nutrients as well as time and energy because of drudgery (staking, several weeding operations, harvesting etc) associated with its production. Women who are “weaker sex” and are already engaged in domestic chores may not cope with these laborious activities coupled with the fact that they lack access to credit, inputs and extension services, as well as landownership and rights which limit their agricultural production [14]. Hence, men anchor yam production and it is regarded as men’s crop.

Entries in Table 1 further show that 29.7% of the respondents were between 41 and 50 years, 27% were above 60 years while 16.7% were between 31 and 40 years. The mean age of the respondents was about 54 years implying that these respondents were fairly old people. These aging farmers in trifoliolate yam production implies that the future of agriculture and specifically trifoliolate yam production in the area is bleak because there will be reduced rates of productivity and a loss of competitiveness for the sector in the future. Old farmers may not be energetic to carry out strenuous tasks associated with trifoliolate yam production and even expand their trifoliolate yam farm for more output and yield. In line with this, a study that examined the perception of farmers as to the effects of ageing on their involvement in agricultural activities concluded a significant difference in their level of involvement in all the agricultural activities examined for the two periods [15]. Also, if younger farmers or successors are not groomed in trifoliolate yam production, the conservation and availability of the crop in the universe may not be guaranteed.

3.2 Marital Status and Household Size

Table 1 further shows that majority (89.8%) of the respondents were married while about 70% of them had household size of 6 to 10 persons. Mean household size of the respondents was about 7 persons. The higher percentage of married farmers in trifoliolate yam production and relatively large household size of the respondents are common among rural households in Nigeria. The importance of these features lies on the fact that they lead to increase in human population which in turn provides

cheap labour for manual agriculture that characterize agriculture in developing countries. In congruence, [16] posited that number of persons in the household is the source of family labour to work on the farm. Hence easy access to cheap family labour reduces cost of labour and production, and increases food production /productivity.

3.3 Educational Level

Table 1 also indicates that 30.6% of the respondents completed primary education, 23.1% attempted primary education, 17.6% attempted secondary education while 15.7% had no formal education. The mean number of years spent in acquiring formal education was about seven (7) years. Thus, 84.3% of the respondents may be said to be literate but at different levels. Education is important in the improvement of agricultural productivity such that formal education opens the mind of the farmer to knowledge, non- formal education gives the farmer hands- on training and better methods of farming and informal education keeps the farmer abreast with changing innovations and ideas and allows farmer to share experience gained [17]. It is also a precondition for adoption and diffusion of innovation. Therefore, trifoliolate yam farmers that are educated are more likely to access, experiment and adopt useful innovation that will help to boost trifoliolate yam production.

3.4 Farming Experience and Years of Experience in Trifoliolate Yam Production

Forty eight percent of the respondents had 21 to 40 years of experience in farming, 30.4% had 41-60 years while their mean years of experience in farming was about 38 years (Table 1). Table 1 also shows that 49% of the respondents had 21 to 40 years of experience in trifoliolate yam production, 23% had 1 – 20 years of experience, 22.2% had 41 – 60 years of experience in trifoliolate yam production while their mean years of experience in trifoliolate yam production was about 34 years. The findings suggest that the respondents moved into trifoliolate yam production after four years of engagement in agriculture. They also had quite a long years of experience in trifoliolate yam production specifically and farming generally. Which will make them to be less risk averse, invest in agriculture with prediction of the successful outcome of their farming ventures.

Table 1. Percentage distribution of the respondents based on their socio economic characteristics

| Socio economic | Frequency | Percentage (%) | Mean (M) |
|---|------------------|-----------------------|-----------------|
| Sex | | | |
| Male | 72 | 66.7 | |
| Female | 36 | 33.3 | |
| Marital status | | | |
| Single | 3 | 2.8 | |
| Married | 97 | 89.8 | |
| Widowed | 8 | 7.4 | |
| Household size | | | |
| 0 | 3 | 2.8 | |
| 1-5 | 25 | 23.1 | |
| 6-10 | 74 | 68.6 | 7 |
| 11 and above | 6 | 5.6 | |
| Age | | | |
| 21-30 | 1 | 0.9 | |
| 31-40 | 18 | 16.7 | |
| 41-50 | 32 | 29.7 | 53.7 |
| 51-60 | 29 | 27 | |
| 61 and above | 28 | 25.9 | |
| Educational level | | | |
| No formal education | 17 | 15.7 | |
| Primary education attempted | 25 | 23.1 | |
| Primary education completed | 33 | 30.6 | 7 |
| Secondary education attempted | 19 | 17.6 | |
| Secondary education completed | 10 | 9.3 | |
| Tertiary education | 4 | 3.7 | |
| Farming experience in years | | | |
| 1-20 | 17 | 15.7 | |
| 21-40 | 52 | 48 | 38.2 |
| 41-60 | 33 | 30.4 | |
| >60 | 6 | 5.6 | |
| Years of experience in trifoliolate yam production | | | |
| 1-20 | 17 | 23 | |
| 21-40 | 52 | 49 | 33.6 |
| 41-60 | 33 | 22.2 | |
| 61-80 | 6 | 5.6 | |
| >80 | | | |
| Monthly income | | | |
| None | 31 | 28.7 | |
| 1001-10000 | 19 | 17.6 | |
| 10001-20000 | 22 | 20.3 | ₦17,458.33 |
| 20001-30000 | 16 | 14.8 | |
| 30001-40000 | 9 | 8.3 | |
| >40000 | 2 | 1.8 | |

Source: Field survey, 2014

3.5 Monthly Income

About 20% of the respondents earned between ₦ 10,001 and ₦ 20,000; 17.6% earned between ₦1,001 and ₦10,000 while 14.8% earned between ₦ 20,001 and ₦ 30,000 (Table 1). Their

mean monthly income was ₦17,458.33 (approximately 62USDollars) showing that these respondents were low income earners and hence poor irrespective of their involvement in yam/trifoliolate yam production. The finding contradicts the fact that yam production

significantly improves the living standard of farmers and serves as an important tool for poverty alleviation [18]. In corroboration with the finding, [19] stated that despite Nigeria's plentiful agricultural resources and oil wealth, poverty is widespread in the country, especially in rural areas, where up to 80 percent of the population lives below the poverty line.

3.6 Total Size of Farm Land Owned and Portion Cultivated with Trifoliate Yam

Table 2 reveals that majority (76.9%) of the respondents had 0 to 1 hectare of farm land, 22.3% had 2 to 3 hectares while 0.89 hectare was average size of farmland owned by the respondents. Out of these farmlands owned 38% of the respondents cultivated 0 to 0.20 hectare of farmland with trifoliate yam, 29.7% cultivated 0.21 – 0.40 hectare, 21.2% cultivated 0.41 – 0.60 hectares while 11.2% cultivated more than 0.60 hectare of farmland with trifoliate yam. The mean size of land allocated to trifoliate yam production by the respondents was 0.29 hectare which was about one third of the mean size of land they owned. This small size of land owned and cultivated with trifoliate yam may be an indication that these respondents are subsistent farmers. Smallholder agriculture has long served as the dominant economic activity for people in sub-Saharan Africa, and will remain enormously

important for the foreseeable future [20]. Unfortunately, investments in subsistence agriculture may not necessarily yield high benefits in comparison to other possible uses of development resources. Boosting the scale of production should be seen as one of the major strategies that will enhance viability of agriculture especially in developing countries.

3.7 Production Trend of Trifoliate Yam

Entries in Table 3 reveal production trend of trifoliate yam. The Table shows that a mean (M) of 0.21 hectares of land was cultivated with trifoliate yam before 2001 while 0.22 hectares and 0.21 hectares were cultivated with trifoliate yam in 2001-2007 and 2008 to 2014.

The Table further reveals that the mean cost of production of trifoliate yam before 2001 was ₦ 650.47 whereas ₦1,777.78 and ₦ 2,756.48 were spent by the respondents between 2001-2007 and 2008 to 2014 respectively on trifoliate yam production.

The table also shows that the respondents produced about 634.95 kg of trifoliate yam before 2001 while 456.44 kg and 445.23 kg of trifoliate yam were produced between 2001 to 2007 and 2008 to 2014 respectively.

Table 2. Distribution of respondents according to farm size

| Farm size | Frequency | Percentage (%) | Mean (M) |
|---|-----------|----------------|----------|
| Farm size (in hectare) | | | |
| 0-1 | 83 | 76.9 | 0.89 |
| 2-3 | 24 | 22.3 | |
| >3 | 1 | 0.9 | |
| Portion of farm land cultivated with trifoliate yam (in hectare) | | | |
| 0.00-0.20 | 41 | 38 | 0.29 |
| 0.21-0.40 | 32 | 29.7 | |
| 0.41-0.60 | 23 | 21.2 | |
| >0.60 | 12 | 11.2 | |

Source: Field survey, 2014

Table 3. Production trend of trifoliate yam

| Production trend | Before 2001 Mean (M) | 2001 to 2007 Mean (M) | 2008 to 2014 Mean (M) |
|---|-------------------------|--------------------------|--------------------------|
| Size of land cultivated to trifoliate yam (in hectares) | 0.21 | 0.22 | 0.21 |
| Cost of production (₦) | 650.47 | 1,777.78 | 2,756.48 |
| Quantity of trifoliate yam produced (kg) | 634.95 | 456.44 | 445.23 |
| Income from trifoliate yam (₦) | 3,611.11 | 6,004.63 | 8,208.33 |

Source: field survey, 2014

The mean income earned by the respondents from trifoliolate yam production before 2001 was ₦3,611.11 while ₦6,004.63 and ₦8,208.33 were earned by the respondents in 2001-2008 and 2008 to 2014 respectively in its production (Table 3).

The findings show that production trend of trifoliolate yam in the area is not stable which corroborates with the fact that yam production has gone some dramatic changes in many parts of the world and growth rate of yams output is far from consistent, especially in Ghana and Nigeria partly due to the unattractiveness of farming and low prices of yams in the market [21]. Specifically, the mean cost of input used for growing this specie of yam has been recording increase before 2001 to 2014. The mean size of land allocated to trifoliolate yam production may be said to be relatively steady from 2001 to 2014. It further shows that the quantity of trifoliolate yam produced before 2001 to 2014 has been decreasing whereas income generated/earned from trifoliolate yam over the years has been tremendously increasing. This is in contrast with the fact that there is a positive relationship between the producer price and the volume of yam production such that increase in the producer price will induce smallholder farmers to increase productivity [21].

However, increase in income irrespective of decrease in output seen in this research, may be as a result of increase in price of the commodity due to its scarcity which may be termed inflation. This condition is not ideal because actually farmers are investing more and harvesting less. When this trend continues, there may be money to buy trifoliolate yam but no trifoliolate yam to buy which is a way of losing this specie and aggravating food insecurity.

3.8 Relationship between Socio-economic Factors and Output of Trifoliolate Yam Farmers

Entries in Table 4 indicate that respondents' years of experience in trifoliolate yam production (0.254; $p \leq 0.008$), farm size (hectare) (0.364; $p \leq 0.000$) and portion of farm land cultivated with trifoliolate yam (hectare) (50.421; $p \leq 0.000$) were socio-economic factors that had positive and significant relationship with quantity of trifoliolate yam they produced. The implication of this finding is that as the years of experience of these farmers in trifoliolate yam production, farm size and portion of farmland allocated to trifoliolate yam

production increase their output (on trifoliolate yam) increases as well. Thus, a change in these socio-economic characteristics brings about a considerable change in the output of trifoliolate yam and may be said to be determinants of trifoliolate yam production in the area.

This is expected because it is a known fact that "experience is a good teacher". Long experience in trifoliolate yam production may enable these farmers to gain skill, technique and expertise to manage their farm well which invariably culminates to efficiency that is manifested in increased output and even productivity. Land is a major asset/ factor of production especially in agriculture. Although, land/ farm size may not always and directly reflect productivity or yield but size of land a farmer has or has access to use for agriculture determines his scale of production and possibility of expansion and mechanization of the farm. Hence, ownership of large farm, may increase the possibility of putting big land in to agricultural use specifically trifoliolate yam production and this will invariably increase output and productivity and vice versa. Also, as farm size increases, farmers take more interest in farming business and would likely search for needed information on how to improve their yields [16].

3.9 Potentials/Uses of Trifoliolate Yam

Data in Table 5 reveal that only income generation (M=2.62) was perceived by the respondents as economic potential/use of trifoliolate yam. Also, use of trifoliolate yam as a staple food (M=2.29) was perceived as nutritional potential/use while promotion of good health through consumption (M=2.08) was perceived as medical/health potential/use of trifoliolate yam by these respondents. The findings tend to suggest that much have not been known about potentials and uses of trifoliolate yam especially it's uses in the treatment of certain diseases and ailments and in pharmaceutical and other industries. In conformity, [22] posited that trifoliolate yam is a specie of yam in which limited work has been done in terms of its production and utilization though it is high yielding compared to other yam species. Worst still, two localities in the country (Nigeria) were found to consider *D. dumetorum* (trifoliolate yam) as a food taboo [23] while there is lack of information on the usefulness and importance of the flours for functional food products [1] and its traditional food processing techniques [23]. These lapses associated with trifoliolate yam may

stifle initiative and inventive efforts geared towards boosting production, consumption and industrial utilization of the crop.

3.10 Causes of Decline in Trifoliate Yam Production

Technical/land, institutional/infrastructural and economic/physical problems were extracted as causes of decline in trifoliate yam production (Table 6). Specific loadings under the technical/land-related cause (factor 1) were land tenure system (0.812), land degradation/infertile

land/soil (0.680), poor tools and farm machines (0.617), insufficient land for large scale production (0.579) and lack of agricultural inputs (0.560). Land is a major factor of production especially in agriculture. Unfortunately, land tenure system (transferring of land from parents to male offspring) and increase in population that are prevalent in developing world like Nigeria lead to reduction in size of farm land owned and accessible to individual/farmers. Consequently, available farmlands are overused which leads to their degradation demanding inputs like organic and inorganic manures to boost their fertility.

Table 4. Relationship between some socio-economic factors and output of trifoliate yam farmers

| Socio-economic characteristics | Pearson correlation (r) | p. value level of significance | Mean | Standard deviation | N |
|--|-------------------------|--------------------------------|-----------|--------------------|-----|
| Age of respondents | 0.143 | 0.140 | 53.7 | 11.85 | 108 |
| Number of years in formal education | 0.057 | 0.561 | 7.35 | 5.55 | 108 |
| Household size | 0.083 | 0.395 | 6.78 | 2.23 | 108 |
| Farming experience | 0.174 | 0.072 | 38.17 | 15.73 | 108 |
| Years of experience in trifoliate yam production | 0.254** | 0.008 | 33.56 | 18.05 | 108 |
| Farm size | 0.364** | 0.000 | 0.89 | 0.69 | 108 |
| Portion of farm cultivated with trifoliate yam | 0.421** | 0.000 | 0.29 | 0.27 | 108 |
| Personal contact with extension agents | 0.106 | 0.275 | 0.25 | 0.57 | 108 |
| Monthly income | 0.015 | 0.875 | 17,458.33 | 17486.33 | 108 |

**Correlation is significant at the 0.05 level (2-tailed), n=number of respondents Source: field survey, 2014

Table 5. Mean scores on potentials/uses of trifoliate yam

| Perceived potentials/uses | Mean (M) | Std. deviation |
|---|----------|----------------|
| Medical/health potentials/uses | | |
| Treatment of diabetes | 1.04 | 1.03 |
| Treatment of rheumatoid Arthritis | 0.5 | 0.77 |
| Treatment of stomach pain (colic) | 0.6 | 0.96 |
| Treatment of menstrual disorders | 0.28 | 0.71 |
| Used as starch in diverse pharmaceutical preparations | 0.4 | 0.78 |
| Promotion of good health through consumption | 2.08* | 0.92 |
| Industrial potentials/uses | | |
| Used as flour for the bakery sector | 0.21 | 0.53 |
| Production of yam flakes | 0.46 | 0.81 |
| Economic potentials/uses | | |
| Generation of income | 2.62* | 0.65 |
| Enhancing foreign exchange earning | 1.45 | 1.11 |
| Nutritional potentials/uses | | |
| Staple food | 2.29* | 0.84 |
| Used as a vegetable | 0.39 | 0.76 |

Source: field survey, 2014

Table 6. Causes of decline in trifoliate yam production

| Perceived causes of decline | Technical/land -related (Factor 1) | Institutional /infrastructur al causes (Factor 2) | Economic / physical causes (Factor 3) |
|---|---|--|--|
| Problems of good storage and processing facilities | 0.589* | 0.117 | -0.108 |
| Poor extension activities | 0.062 | 0.483* | 0.361 |
| Poor marketing system | 0.215 | 0.686* | -0.115 |
| Pest and diseases attack | 0.032 | 0.105 | 0.641* |
| Unpredictable climate | 0.347 | 0.013 | 0.482* |
| Lack of agricultural inputs (e.g fertilizer) | 0.560* | 0.357 | -0.232 |
| Insufficient land for large scale production | 0.579* | 0.195 | 0.264 |
| Lack of seed yam | 0.367 | 0.059 | 0.571* |
| High cost of seed yam | 0.320 | -0.065 | 0.462* |
| Drudgery associated with trifoliate yam production | 0.430 | 0.406 | 0.056 |
| Problems of land tenure system | 0.812* | -0.118 | -0.017 |
| Problems of basic social amenities | 0.066 | 0.602* | 0.097 |
| Poor financing | 0.152 | -0.198 | 0.671* |
| Poor transport system | 0.128 | 0.717* | -0.010 |
| Lack of good agricultural education | 0.086 | 0.588* | 0.220 |
| Poor tools and farm machines | 0.617* | 0.093 | 0.307 |
| Unstable policies and programs of government | -0.363 | 0.500 | 0.438 |
| Erosion | -0.088 | 0.036 | 0.539* |
| Land degradation/infertile land/soil | 0.680* | 0.164 | -0.112 |
| Cultural barriers associated with trifoliate yam | -0.047 | -0.580* | 0.043 |
| Lack of awareness about the nutritional, economic and health values of trifoliate yam among farmers and consumers | -0.309 | 0.438* | 0.356 |
| Change in taste by the younger generation in terms of food/trifoliate yam consumption | 0.236 | -0.149 | 0.082 |
| Lack of interest on the part of the youths in agricultural production | -0.197 | -0.026 | 0.060 |
| Quest for 'white collar' jobs | 0.295 | -0.161 | 0.299 |
| The belief that trifoliate yam can kill or make one mad if consumed in some places | 0.086 | 0.330 | 0.183 |
| Destruction caused by stray animals | -0.112 | 0.350 | -0.033 |

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

Source: Field survey, 2014

Poor transport system (0.717), poor marketing system (0.686), problem of basic social amenities (0.602), lack of good agricultural education (0.588), cultural barriers (0.580), poor extension activities (0.483) and lack of awareness of nutritional, economic and health values of trifoliate yam among farmers and consumers (0.438) were variables that loaded high under institutional/ infrastructural cause (factor 2). Obviously, lack of social amenities that characterises rural area and cultural barrier as noted above can hinder production and consumption of trifoliate yam. Also agricultural extension service may be said to be weak in Nigeria. Many farmers lack education especially

informal type from agricultural extension that will empower them with skills, techniques and innovations on agriculture. However, Nigeria is currently in search of a tailor-made and home-grown agricultural extension system that will disseminate technologies, enhance good agricultural practices, facilitate farmer education, adoption and utilization of local and transferred modern trends in agriculture and fast-track wealth and job creation through the value chains and alleviate poverty [24]. Thus strengthening extension system may go a long way in reversing the decline in trifoliate yam production.

Also, poor finance (0.671), pest and disease attack (0.641), lack of seed yam (0.571), Erosion (0.539), unpredictable climate (0.482) and high cost of seed yam (0.462) were factors that loaded high under economic/physical cause (factor 3) (Table 6). Pests and diseases infestations and vagaries of weather are major problems in agriculture generally and trifoliolate yam specifically because they do not allow farmers to carry out agricultural tasks with precision and they can reduce yield substantially. In support of the finding of this study, [3] have identified lack of adequate farm inputs and lack of improved seed yam as problems faced by farmers in yam production.

4. CONCLUSION

It can be deduced from the study that trifoliolate yam farmers in the area were males who were married, literate and aged. They had long years of experience in farming and /trifoliolate yam production but owned small farm land and cultivated small portion of this farmland with trifoliolate yam. Cost of input and income from trifoliolate yam production had been increasing, land cultivated with trifoliolate yam had been steady while output had been decreasing before 2001 to 2014. Years of experience in trifoliolate yam production, farm size and portion of farm land cultivated with trifoliolate yam were factors that determined output of these farmers. Technical, land, institutional, infrastructural, economic and physical problems were causes of decline in trifoliolate yam production in the area.

5. RECOMMENDATIONS

1. Awareness campaign on the potentials/uses of trifoliolate yam should be carried out by extension agencies / organisations. This will help to boost the interest of farmers and other people in production, consumption and utilisation of the crop locally and industrially as well as in exportation of the crop for income.
2. Favourable land ownership policy/law that will allow farmers especially trifoliolate yam farmers to acquire and use land for agricultural purpose should be enacted and implemented by the government. In this way farmers can expand their enterprise for more output, yield, biodiversity conservation and income.
3. Government and non-governmental organisations should provide institutional

support like incentives and subsidies in form of loan, seed yam, manure, agrochemicals, extension services to these farmers. Infrastructural support like construction of good roads, market, hospital etc should also be provided in the area. These supports will invariably motivate, boost and consolidate the efforts of these farmers in trifoliolate yam production and agriculture.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Abiodun OA, Akinoso R. Physical and functional properties of trifoliolate yam flours as affected by harvesting periods and pre-treatment methods. *J Food Process Technol.* 2014;5:302. DOI:10.4172/2157-7110.1000302.
2. Ukpabi JU, Akobundu ENT. Production and quality evaluation of pre-gelatinized fermented breakfast food produced from edible trifoliolate yam (*Dioscorae dumetorum*) using intermediate technologies in Nigeria. *American Journal of Food Science and Nutrition.* 2014;1(4): 60-71.
3. Idumah FO, Owombo PT, Ighodaro UB. Economics of yam production under agroforestry system in Sapoba forest area, Edo State, Nigeria. *International Journal of Agriculture and Forestry.* 2014;4(6):440-445.
4. Egbuonu ACC, Nzewi DC, Egbuonu ONC. Functional properties of bitter yam (*Dioscorea dumetorum*) as influenced by soaking prior to oven-drying. *American Journal of Food Technology.* 2014;9:97-103.
5. Ukpabi JU. Farmstead bread making potential of lesser yam (*Dioscorea esculenta*) flour in Nigeria. *Aust. J. Crop Sci.* 2010;4:68-73.
6. Dike IP, Obembe OO, Adebisi EF. Ethnobotanical survey for potential anti-malarial plants in South-Western Nigeria. *J. Ethnopharmacol.* 2012;144:618-626.
7. Owuamanam CI, Iwuoha CI, Onuegbu NC, Ogueke CC, Nwosu JN. Quality characteristics of processed flours from trifoliolate yam (*Dioscorea dumetorum*) as influenced by steeping and boiling in

- varying concentration of trona solution over time. Am. J. Food Technol. 2013;8:162-172.
8. Iwuchukwu JC, Onwubuya EA. Trends in production of selected species of yam (*Dioscorea* spp) In Enugu North Agricultural Zone, Enugu State Nigeria: Implication for Food Security and Bio Diversity Conservation. International Journal of Agricultural Science and Research. 2012;2(3):97-115.
 9. International Institute for Tropical Agriculture (IITA) Yams (*Dioscorea* spp). 2013; Retrieved Nov. 28, 2013.
 10. Onuegbu NC, Iwuoha CI, Onwuamanam CI, Ihediohanna NC. Effects of boiling solution (trona) concentration and time on the proximate composition and physico-chemical properties of flour from three-leaved yam (*Dioscorea dumetorum* Pax) tubers. Afr. J. Food Sci. 2011;5:1-5.
 11. Ezeocha VC, Ojmelukwe PC, Onwuka GI. Effect of cooking on the nutritional and phytochemical components of trifoliolate yam (*Dioscorea dumetorum*). Global Advanced Research Journal of Biochemistry and Bioinformatics. 2012;1(2):026-030.
 12. Ladele AA, Chah JM. Sampling techniques in agricultural extension research (ed) Madukwe, M.C. A Guide to Research in Agricultural Extension. Publication of Agricultural Extension Society of Nigeria. 2015;36-54.
 13. Agwu AE, Egbule CL. Application of correlation analysis in agricultural extension research (ed) Madukwe, M.C. A Guide to Research in Agricultural Extension. Publication of Agricultural Extension Society of Nigeria. 2015;246-261.
 14. The Guardian. How can we empower women in agriculture to end hunger. Wednesday 18th March 2015.
 15. Fasina OO. Farmers perception of the effect of aging on their agricultural activities in Ondo State, Nigeria. The Belogradchik Journal for Local History, Cultural Heritage and Folk Studies. 2013;4(3):371-387.
 16. Abu GA, Soom A. Analysis of factors affecting food security in rural and urban farming households of Benue State, Nigeria. International Journal of Food and Agricultural Economics. 2016;4(1):55-68.
 17. Oduro-Ofori E, Aboagye A, Pand Acquaye NAE. Effects of education on the agricultural productivity of farmers in the offinso municipality. International Journal of Development Research. 2014;4(9):1951-1960.
 18. Osayande I, Osabuohien JI. Effect of yam-based production on poverty status of farmers in Kabba/Bunu Local Government Area of Kogi State, Nigeria. International Journal of Environmental & Agriculture Research. 2016;2(6):13-20.
 19. International Fund for Agricultural Development (IFAD)(nd) Rural poverty in Nigeria. Available:<http://www.ruralpovertyportal.org/country/home/tags/nigeria>
 20. Gollin D. Smallholder agriculture in Africa: An overview and implications for policy. Working Paper October 2014, Food and agriculture, International Institute for Environment and Development London, UK; 2014.
 21. Verterl N, Bečvařova V. An analysis of yam production in Nigeria. Acta Universitatis Agriculturae Et Silviculturae Mendelianae Brunensis. 2015;76(2):659-665.
 22. Adelekan AO, Arisa NU, Adediran A, Racheal OF. Effect of Enrichment of trifoliolate yam flour with pumpkin seeds flour on the pasting characteristics and the acceptability of its product. Journal of Food Processing Technology. 2013;4:283. DOI:10.4172/2157-7110.1000283
 23. Ukpabi JU. Traditional food processing techniques of *Dioscorea dumetorum* in Nigeria. American Journal of Food Science and Nutrition. 2015;2(3):21-30.
 24. Nigerian Tribune. Nigeria in search of home grown Agricultural Extension System. May 4th, 2015.

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