

Original Research Article

YAM FARMERS' COPING STRATEGIES AGAINST YAM BEETLE (*Heteroligus* spp.) IN DELTA STATE, NIGERIA: IMPLICATION FOR FOOD SECURITY

ABSTRACT

The study examined the various strategies adopted by yam farmers of Delta State in coping with the menace of yam beetle (*Heteroligus* meles). The specific objectives were to: describe the socio-economic characteristics of yam producers in Delta State; ascertain the economic losses caused by yam beetle in Delta State; determine the various strategies adopted by farmers in Delta State in coping with the menace of yam beetle; examine the effectiveness of the various coping strategies. A multi-stage sampling procedure was used to compose a sample size of 225 respondents. Primary data were obtained from respondents with the use of structured and validated questionnaire. Various descriptive and inferential statistical methods were used in data analysis. The result showed that majority of the farmers (98.2%) adopted the use of multiple cropping in combating the menace of yam beetle; about 93% adopted late planting and 55.1% agrochemicals. Most of the farmers thus witnessed minimal losses in their farmers since they adopted one form of coping strategy or the other. The study further revealed that the use of agrochemical was the most effective coping strategy. The regression result showed that with the exception of gender, marital status and household size, all other factors were statistically significant at ($p \leq 0.05$), indicating that they influenced respondents' adoption of coping strategy. The implication of these findings for food security was that yam production in Delta State is likely to improve, thereby leading to increase in food supply in the area since farmers are combating the menace of beetles. However, from the findings of the study it was recommended, among others, that farmers should be enlightened on the need of using effective coping strategies.

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Keywords: Coping strategy, questionnaire, economic losses, agrochemical, Delta, Nigeria

INTRODUCTION

Nigeria is by far the world's largest producer of yam, accounting for over 76% percent of the world production (Wikipedia). According to the Food and Agricultural Organization report, in 1985, Nigeria produced 18.3 million tonnes of yam from 1.5 million hectares, representing 73.8% percent of total yam production in Africa (Wikipedia). Yam production in Nigeria has nearly doubled since 1985, with Nigeria producing 35.017 million metric tonnes with value equivalent of US\$5.654 billion. In perspective, the world's second and third largest producers of yams, Cote d'Ivoire and Ghana, only produced 6.9 and 4.8 tonnes of yams in 2008

38 respectively (FAO, 2009). According to the International Institute of Tropical Agriculture ,
39 Nigeria accounted for about 70% percent of the world production amounting to 17 million
40 tonnes from land area 2,837,000 hectares under yam cultivation. Yam, a tropical crop in the
41 genus *Dioscorea*-, has as many as 600 species out of which six are economically important
42 staple -species. Out of these, *Dioscorea rotundata* (white yam) and *Dioscorea alata* (water
43 yam) are the most commonly grown species in Nigeria (O'Hair, 1990). Yams are cultivated in
44 the coastal region in rain forests, woody savannah, and southern savannah habitats. Yam is in
45 the class of roots and tubers that is a staple of the Nigerian and West African diet, which
46 provides some 200 calories of energy per capita daily. In Nigeria, in many yam-producing
47 areas, it is said that "yam is food and food is yam." Yam also has an important social status in
48 gatherings and religious functions, which is assessed by the size of yam holdings one
49 possesses. Although it is grown widely in Nigeria, the area where it is grown most is the
50 Benue State (land area of 802,295 km²), one of the states in Benue valley of Nigeria where
51 the labour intensive practices are still the norm and the land holdings are small. Because of
52 high level of yam production in the State of Benue, Benue State is crowned as the Nigerian
53 Bread Basket. Pest and disease control is addressed by cultural control and chemical
54 methods; the pests which affect the plant are nematodes such as root knot (*Meloidogyne* spp.)
55 and yam nematode (*Scutellonema bradys*), and insects such as yam shoot beetle, yam tuber
56 beetle and crickets. Tuber is the main part of the yam plant which has high carbohydrate
57 content (low in fat and protein-) and provides a good source of energy. Unpeeled yam has
58 vitamin C-. Yam, sweet in flavour, is consumed as boiled yam (as cooked vegetable) or *fufu*
59 or fried in oil and then consumed. It is often pounded into a thick paste after boiling and is
60 consumed with soup. It is also processed into flour for use in the preparation of the paste. Its
61 medicinal use as a heart stimulant is attributed to its chemical composition, which consists of
62 alkaloids of saponin and sapogenin-. Its use as an industrial starch has also been established
63 as the quality of some of the species is able to provide as much starch as in cereals. Ritualism
64 and festivity restriction are also associated with yam, which is the staple in south-eastern
65 Nigeria. A yam festival is held every year to mark the harvesting of this crop. The village
66 chiefs and traditional title holders of lands in Nigeria who grow yam make it a religious
67 practice by not consuming yam till it is offered to the gods. During this festival, villagers
68 offer prayers thanking their ancestral gods for the blessings of the land and the women's
69 fertility. The festivity observed in villages is in the form of a parade of traditional dances.
70 One of the marriage custom observed in some communities in Nigeria is to measure the
71 bridegroom's wealth by the amount of yams that he can produce. Also, according to tradition,

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72 the groom has to present a minimum of 200 big tubers of yams to the in-laws as a proof that
73 he can take care of his wife and the future family. Yam is depicted as a male totem in some
74 areas of the Ibo land. Another custom observed is that women are not permitted to go to the
75 yam farms till it is ready for harvesting; however, harvesting of the crop is the prerogative of
76 the women.

77 However, the production of yam in Nigeria is very low and cannot meet the growing demand
78 at its present level of use. This is because there are several factors militating against
79 optimum yam production which include expensive planting materials (seed yams/setts)
80 labour, staking, weed menace, diseases and insect pests. In spite of the central role yam plays
81 in the lives of Nigerians, its production could be adversely affected, especially by pests and
82 diseases. Unreliable rains and pest and disease outbreaks cause wide variations in resource
83 availability and in crop yields. The major factor in this regard is the destruction to yams
84 caused by the yam tuber beetles, *Heteroligus* species (Taylor 1964; Tobih *et al.*, 2007, Inoni,
85 2010). These beetles are very serious insect pests of yam in riverine areas particularly in the
86 rainforest zones (McNamara and Acholo, 1995). Serious losses and drastic reduction in tuber
87 yield and market value as a result of the beetle damage has been reported by Tobih *et*
88 | *al.* (2009) and Inoni (2010). Inoni (2013) in his study on the effects of yam beetles
89 infestation in Oshimili North LGA of Delta State indicated that damage due to yam beetles
90 ranged from 27.69% to 39.72% with a mean beetle attack rate of 32.69% that caused a loss of
91 | tubers worth N1.09 million in market value. The menace of these insects had caused untold
92 hardships to farmers in terms of economic losses. It therefore becomes imperative that the
93 various ways farmers have coped in managing yam beetles in their farms be examined.

94 **Problem Statement**

95 Nigeria is the major producer of yam in the world. Yam is a major staple food crop for the
96 people of Nigeria in general and Delta people in particular. In spite of the importance of yam
97 in this area, its production has faced many challenges. One of the limiting factors to yam
98 production is the incidence of pests. Pests of yam could cause serious crop losses to farmers
99 | in Nigeria and Delta State in particular. Yam beetle (*Heteroligus meles*) is the most serious
100 pest affecting yam production in Delta State. Damage to yam beetles ranged from 27.69% to
101 39.72% with a mean beetle attack rate of 32.69% that caused a loss of tubers worth N 1.09
102 | million in market value in Delta North agricultural zone of Delta State, Nigeria (Inoni, 2010
103).

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Serious losses and drastic reduction in tuber yield and market value as a result of the beetle damage has been reported by -Tobih (2010) and Tobih *et al.* (2009). High cost of pesticides and cost of equipment and labour were reported as major obstacles to the effective control of yam tuber beetles (Inoni, 2010) Since the yam beetle could lead to considerable losses to farmers in the area, it therefore becomes imperative that farmers manage this pest properly in order to boost their productivity. The following research questions then arise: what are the socio-economic characteristics of yam producers in Delta State? What is the extent of losses caused by yam beetles? How have farmers in Delta State, ~~Nigeria~~, been able to cope with the menace of yam beetles over the years? How effective are these coping strategies in ameliorating the menace of yam beetle? The objectives of the study are therefore to: describe the socio-economic characteristics of yam producers in Delta State; ascertain the economic losses caused by yam beetle in Delta state; determine the various strategies adopted by farmers in Delta state in coping with the menace of yam beetle; examine the effectiveness of the various coping strategies. The study tested the following hypothesis, stated in the null form: there is no significant relationship between the socio-economic characteristics of farmers and their coping strategies against yam beetle.

Research Methodology

Delta State was the study area. Delta ~~S~~state was created from the then Bendel ~~S~~state on August 27, 1991 by the regime of General Ibrahim Babangida. Delta ~~S~~state shares common boundaries with Edo and Ondo States to the North-West, Imo and Anambra States to the North-East, Rivers and Bayelsa to the South-East. In the South and South-West it has approximately 122 kilometres ~~m~~of coast line bounded by the Bight of Benin on the Atlantic Ocean. The Major ethnic groups are Urhobo, Igbo, Ezon, Isoko and Itsekiri. Delta ~~S~~state lies approximately between longitudes 5°00' and 6°45' East and latitudes 5°00' and 6°30' North. It has an estimated population of 4098291 (NPC, 2006) and total land area of 18,050 ~~km~~²~~square-kilometres~~ and about one-third of this is swampy and waterlogged. It experiences average rainfall of about 2000mm per annum with an average monthly temperature of 30.4-36.4°C and a relative humidly varying room 56-86% ~~percent~~ per annum. Delta ~~S~~state is divided into three agricultural zones namely, Delta South, Delta North and Delta North.

Delta ~~S~~state is situated in the Niger Delta flood plain on the coast of Nigeria. A large number of the coastal towns in the ~~area~~State have already been displaced by flooding induced by sea level rise.

The economy of Delta State is dominated by the ~~o~~Oil and ~~g~~Gas sector because of its abundant reserves of ~~o~~Oil and ~~g~~Gas. This sector contributes as much as 40% of the ~~c~~Country's GDP

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137 and 83% of total government revenue. Other major activities of the sState which include
138 agriculture, fishing and trading are on the decline since the discovery of oOil. Despite the
139 success of the oOil industry, the level of poverty, unemployment, intercommunity conflict,
140 conflict over land and housing pressure are high.

141 The sState is rich in biodiversity and the mangrove swamps are the largest in Africa.
142 However, climate change impacts have led to loss of wetlands through deforestation, oil
143 spills and saline intrusion from sea level rise and flooding having devastating effect on the
144 sState's biodiversity resource and livelihood options (Welch and Okoh, 2013).

145 **Sampling Procedure and Sample Size**

146 A multi-stage sampling procedure was used to compose a sample size of 225
147 respondents. This was done as follows: out of the three agricultural zones in the state, one
148 local government area was randomly selected from each zone. Seventy-five (75) respondents
149 were selected from each of the randomly selected local government areas, giving a total of
150 two hundred and twenty five (225) respondents that were sampled and studied.

151 Primary data were obtained from respondents with the use of structured and validated
152 questionnaire. The instruments for primary data collection include a five point Likert Scale
153 with values: 1= strongly disagree, 2= disagree, 3= undecided, 4=agree and 5=strongly agree.
154 From point 3 will be regarded as effective while below 3 as non-effective as used by Akwiwu
155 et al. (2000). Furthermore, data were collected from secondary sources such as Journals, past
156 research work, Government records, documented statistics collected from the study area,
157 internet, and Library.

158 Descriptive and inferential statistical methods were used in data analysis. Information
159 was presented using tables and simple percentages. Inferential statistics that was used in
160 testing the stated hypothesis was a regression model. As all the farmers surveyed used one
161 form of coping strategy or the other, we apply an ordinary least square (OLS) estimation
162 instead of Tobit, Pprobit or Logit model to explain the variation in use of coping strategies.
163 The linear model was the best fit as it has the highest R² and most variables were significant.

164 **Results and Discussion**

165 **Socioeconomic characteristics of yam farmers**

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166 The socioeconomic characteristics of the respondents in the study area are presented in Table
 167 1. The result indicated that more women were actively involved in yam production than men.
 168 This result is contrary to expectations of many as yam is culturally regarded as a “man” crop
 169 in Delta State (Inoni, 2010). Most of the respondents (97.23%) ~~were~~are in their economically
 170 active age group. A relatively large household size was found in the study area with an
 171 average size of ~~eight~~8 persons per household. These findings support the preponderance of
 172 large family sizes among the poor in rural areas reported by many ~~scholars~~. About 93.33
 173 percent of the farmers had one form of formal education or the other. Most of the yam
 174 farmers had secondary education. Illiteracy and lack of education poses significant
 175 constraints to agricultural productivity in sub-Saharan Africa. According to Njoku (1991) and
 176 Biswanger (1989), farmers who are educated formally are more likely to adopt modern
 177 agricultural innovations in order to increase overall productivity, than their less educated
 178 counterparts. Moreover, apart from being early innovators that provide examples that may be
 179 copied by illiterate farmers, educated farmers are better able to copy those who adopt
 180 innovation, thereby enhancing wider diffusion of the new technology in the community (Weir
 181 and Knight, 2004)
 182 Most of the respondents had a lot of experience in farming. Over 90% of the farmers had more than
 183 ten years farming experience. Ogungbile, Rahman and Tabo (2002) indicated that length of time of
 184 farming business can be linked to the age of farmers, access to capital and experience in farming may
 185 explain the tendency to adopt innovations and new technology.

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188 **Table 1: Socio-economic characteristics of respondents**

Variable	Frequency(225)	Percentage (100%)
Gender		
Male	110	48.89
Female	115	51.11
Age		
20 – 30 years	13	5.78
31 – 40 years	65	28.89
41 – 50 years	105	46.67
51 – 60 years	36	16.00
61 and above	6	2.67
Marital Status		
Single	28	12.44
Married	162	72.00
Widowed	14	6.22
Divorced	11	4.89

Educational Background

No formal	15	6.67
Primary school	56	24.89
Secondary school	124	55.11
Tertiary education	20	8.89

Farming Experience

1 – 10 years	22	9.78
11 – 20 years	68	30.22
21 – 30 years	98	43.56
31 years and above	37	16.44

Household Size (number)

1 -5	94	41.78
6 – 10	131	58.22

Farm Size (ha)

2 and below	178	79.11
Above 2	47	20.89

Extension Agent Contact

Monthly	23	10.22
Weekly	14	6.22
Others	188	83.56

Source: Field survey, 2014

The economic losses to farmers, in monetary terms, as a result of yam beetle attack on their farms are presented in Table 2. The result in Table 2 indicates that majority of the respondents incurred minimal losses in their farms. For instance, whereas as much as 40.9% of the respondents incurred losses of only N10000 and below, only about 0.9% of them incurred losses of more than N50000. The reason adduced for this ~~is~~ was probably due to the fact that most of the respondents had adopted some strategies in one way or the other to combat yam beetle attack.

Table 2; Economic losses to yam farmers due to yam beetle attack

Economic loss (Naira/-ha)	Frequency	Percentage
Above 50000	2	0.9
40001- 50000	6	2.7
30001- 40000	6	2.7
20001- 30000	55	24.4
10001- 20000	64	28.4

Source: Field Survey, 2014

The various coping strategies adopted by yam farmers is presented in Table 3. The result shows that most of the farmers (98.2%) adopted the use of multiple cropping in combating the menace of yam beetle. This was followed by the adoption of late planting (92.9%) and agrochemicals (55.1%). Most of the yam farmers feel that multiple cropping (-i.e. growing different crops on the same piece of land at the same time-) serves as insurance for them against crop failure. Late planting of yam was adopted by most of the yam farmers as this helps the farmers' yams to escape attack of the pest. Some farmers also use agrochemicals like Aldrin dust or Gammalin 20 to dust their yams before planting. However, in view of the deleterious nature of most of these agrochemicals, their usage by yam farmers is dwindling.

Table 3: Coping strategies adopted by yam farmers

Strategy	Frequency	Percentage
Use of agro chemical	124	55.1
Late planting	209	92.9
Fallowing	12	5.3
Alternative cropping	56	24.9
Multiple cropping	221	98.2

Source: Field Survey, 2014**Effectiveness of the coping strategies adopted by farmers**

The effectiveness of the various coping strategies adopted by farmers is as shown in Table 4. From Table 3 it is obvious that, according to the respondents, [the](#) use of agrochemicals (mean = 4.79) was the most effective coping strategy adopted by farmers in the study area. This was followed by late planting (mean = 4.68) and multiple cropping (mean = 4.01-). Tobih (2014) reported that the use of insecticide was very effective in the control of yam beetle.

Table 4: Effectiveness of various coping strategies against yam beetle

Strategy	Mean	Standard deviation	Rank of mean
Use of agrochemical	4.79	0.51	1 st
Late planting	4.68	0.73	2 nd
Multiple cropping	4.01	0.66	3 rd
Alternative cropping	2.94	0.59	4 th
Fallowing	2.42	0.81	5 th

Source: Field Survey, 2014

Likert scale: 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = Agree, 5 = strongly Agree

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Test of hypothesis

H₀₁: There is no significant relationship between yam farmers' socioeconomic characteristics and their coping strategies against yam beetle.

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A regression analysis was run to determine the influence some selected socioeconomic characteristics on coping strategies of farmers; the variables included farmers' gender, age, marital status, educational level, farming experience, household size, and farm size. The model presents a good fit to the data (Chi-square of 89.1; $P < 0.01$) and indicates that all parameters considered were different from zero (Table 5). Five factors had a significant influence on the adoption of coping strategies by farmers. Table 5 shows that with the exception of gender, marital status and household size, all other factors were statistically significant at ($p \leq 0.05$), indicating that they influenced respondents' adoption of coping strategy. Farming experience positively affected the adoption of coping strategies ($P < 0.05$). This means that farmers with many years of experiences in agriculture were the major adopters of coping strategies against yam beetle. The level of education also positively affected farmers' decision to adopt coping strategy ($P < 0.5$). Thus, farmers who highly educated were more amenable to adopt various coping strategies. The adoption of hybrids requires extra costs such as buying suckers and hiring labour. There was a positive relationship between coping strategy and farm size of farmers. Extension services played a key role in the mechanism of diffusion and adoption. This result is corroborated by findings of Adesina *et al.* (2000) and Nkamleu and Coulibaly (2000), who asserted that extension had a positive impact on the adoption and the diffusion of agricultural practices.

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Table 5: Relationship between socioeconomic variables and coping strategies of farmers

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Characteristic	B	Standard error	T	p-value
Constant	1.754	1.988	0.842	0.192
Gender	-0.467	0.911	0.766	0.546
Age	-0.094	0.041	3.988	0.002*
Marital status	0.045	0.033	0.997	0.422
Educational level	0.512	0.042	3.124	0.031*
Farming experience	0.433	0.051	3.222	0.038*
Household size	0.866	0.085	0.688	0.450
Farm size	0.474	0.422	2.946	0.0441*

Source: Field Survey, 2014

*Significant at $p < 0.05$

Conclusion and Recommendation

Empirical evidence from the study indicated that the yam farmers in the area employed various strategies to cope with the menace of yam beetle ~~in the area~~. However, the farmers made ~~de~~ lesser use of agrochemicals in spite of the fact that agrochemicals were rated by the respondents as the most effective means of combating yam beetles. It was also observed that some socio-economic variables like age, educational level, farming experience, and farm size influence coping strategies adopted by farmers. The implication of these findings for food security ~~was~~ that yam production in Delta ~~S~~state is likely to improve, thereby leading to increase in food supply in the area. However, from the findings of the study, the following recommendations are made:

1. The cost of agrochemicals for controlling yam beetle should be reduced to encourage yam farmers to use them.
2. Since education is crucial to the adoption of coping strategy, farmers should be ~~enlightened~~ ~~trained~~ on the need of using effective coping strategies.

When these measures are instituted, this will go a long way in boosting yam production in the area, thus improving food security in the state.

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REFERENCES

Adesina, A., Mbila, D., Nkamleu, G. and Endamana, D.(2000). Econometric analysis of the determinants of adoption of alley farming by farmers in the forest zone of southwest Cameroon. *Agric., Ecosyst. Environ.* 80:255–265.

Akwiwu, C.D, Nwayiba, C.U. and Nnadi, F.N. (2000). Effects of commercial banks’ distresses on small scale rural livestock’s enterprise in Imo State, Nigeria. *Journal of Technology and Education in Nigeria.* 5(1): 12 – 15.

Biswanger H. (1989): Brazilian Policies that Encourage Deforestation in the Amazon. Environment Development Working Paper, 16, The World Bank, Washington, D.C .

FAO (2009). FAO Statistics Division Food and Agricultural Organization, Rome, Italy.

Ike, P. C. and Inoni, O. E. (2006). "Determinants of Yam Production and Economic

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306 Efficiency Among Small-Holder Farmers in Southeastern Nigeria". Journal of Central
 307 European Agriculture. 7(2): 337-341

308 Inoni, O. E. (2010). Economic Analysis of Yam Beetles (*Heterolygus Meles*, Billb)
 309 Infestation in the North agricultural zone of Delta State, Nigeria. *Agricultura Tropica Et*
 310 *Subtropica* Vol. 43 (4) 2010 242

311 McNamara N, Acholo M(1995). Problems of yam storage in Kogi State, Nigeria. Findings
 312 from DDS yam storage project in summary document – Workshop on Pests and
 313 Pathogens of Yam in storage, May 25th, 1995, IITA, Ibadan. Pp. 9.

314 Njoku, J.E. (1991): Factors influencing the adoption of improved oil palm technologies by
 315 small holders in Imo State of Nigeria. Appropriate Agricultural Technologies for
 316 Resource poor farmers. In Olukosi, J.O., Ogungbile, A.O. and Kalu B.A. (eds) National
 317 Farming System network. Pp 51-55.

318 Nkamleu, G. and Coulibaly, O.(2000). Le choix des méthodes de lutte contre les pestes dans
 319 les plantations de cacao et de café au Cameroun. *Economie Rurale* 259:75–85.

320 Ogungbile, A.O. Tabo, R. and Rahman, S.A. (2002). Factors affecting adoption of ICSV111
 321 and ICSV 400 Sorghum ~~varieties~~^{varieties} in Guinea and Sudan Savanna of Nigeria. *The*
 322 *plant Scientists* 3:21-23.

323 O'Hair, S.K. 1990. Tropical Root and Tuber Crops. p. 424-428. In: J. Janick and J.E. Simon
 324 (eds.), *Advances in new crops*. Timber Press, Portland

325 Taylor T.A. (1964): Studies on the Nigeria Yam Beetles II: Bionomics and Control.
 326 *Journal of West African Science Association*, 9: 13–31.
 327

328 Tobih FO (2014). Methods of insecticide application to control yam tuber beetles
 329 (*heteroligus* spp; coleoptera: dynastidae) in yam monocrop system in Delta State,
 330 Nigeria. *Standard Scientific Research and Essays* 2(11): 604-609, November 2014
 331 (ISSN: 2310-7502)

332 | Tobih FO, Eruotor PG, Okonmah LU, Egho EO (2009). Field evaluation of eight cultivars of

333 Dioscorea for possible resistance to yam beetle damage in Oshimili Area of Delta
 334 State, Nigeria. *Nig. Agric. J.* 40(1): 104 – 110.
 335
 336 Tobih FO (2010). Evaluation of Some Plant Materials as Organic Mulch for the Control of
 337 Yam Tuber Beetles (*Heteroligus spp*) in Delta State, Nigeria. *American-Eurasian*
 338 *Journal of Agronomy*, 3 (3): 44-50.
 339
 340 Tobih F.O., Emosairue S.O., Okonmah I. U. (2007): Studies On The Occurrence and
 341 Damage by Yam Tuber Beetles (*Heteroligus Spp*) in Aniocha and Oshimili Areas of
 342 Delta State, Nigeria. *Journal of Central European Agriculture*, 8 (1): 129–134.
 343
 344 Weir S. and Knight J. (2004): Externality Effects of Education; Dynamics of the Adoption
 345 and Diffusion of an Innovation in Rural Ethiopia. *Economic Development and*
 346 *Cultural Change*, 53: 93–113.
 347
 348 Welch, D and Okoh, R. (2013). Delta State Integrated Territorial Climate Plan(ITCP). First
 349 Order Draft, September, 2013
 350
 351 | Wikipedia ([The free encyclopedia](#)). "Top production Nigeria 2008" (2008) . faostat.fao.org.
 352 | Retrieved 17 June 2011.
 353 | Wikipedia ([The free encyclopedia](#)). "Yams (Dioscorea)" . cigar.org. Retrieved 17 June 2011.
 354 | 5.
 355 | Wikipedia ([The free encyclopaedia](#)). "A Breakthrough in Yam Breeding" . Worldbank.org.
 356 | Retrieved 17 June 2011. 6.
 357 | Wikipedia ([The free encyclopedia](#)). Production Efficiency in Yam Based Enterprises in Ekiti
 358 | State, Nigeria/ (pdf) 7. *Journal of Central European Agriculture*. 2006. pp. 627-634.
 359 | Retrieved 17 June 2011. 7.
 360 | Wikipedia ([The free encyclopedia](#)). "Commercial Crop Prooduction Guide Series:Growing

361 Yams in Nigeria" . Information and Communication Support for Agricultural Growth
362 in Nigeria. Retrieved 17 June 2011.

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