

## **F**ARMERS' PERCEPTION ON THE MANAGEMENT OF INSECT PESTS ASSOCIATED WITH THREE SELECTED VEGETABLE TYPES IN JOS NORTH LGA OF PLATEAU STATE.

<sup>1</sup>OLADEJO A.O., <sup>1</sup>SIKIRU G.K., <sup>2</sup>POPOOLA A.S., <sup>1</sup>ISHAYA M. AND <sup>3</sup>ADEDIRE O.

<sup>1</sup>Department of Pest Management Technology, Federal College of Forestry, Jos Nigeria <sup>2</sup>Department of Forestry Technology, Federal College of Forestry, Jos. Nigeria <sup>3</sup>Department of Statistics, Federal College of Forestry, Jos. Nigeria

### **ABSTRACT**

*This research was conducted to unravel farmers' perception on insect pest activities as a constraint to vegetables production and their management practices. A baseline survey was conducted between May and November, 2019 using well-structured questionnaires. Three locations (Rikkos, Lamingo and Naraguta) were purposively selected from the Jos north LGA based on farmers growing capacity (both rainy and dry season). Simple random technique was used to select a total of 90 vegetable farmers from these 3 locations with 30 farmers from each locations. The data collected were analyzed using descriptive statistics and Fishers' exact test (FET) was used to compare the variables. The probability value (P-value) was estimated using two sided test at 5% level of significance. Almost all the farmers in the selected areas engaged in the production of two or all the three vegetables at one season or the other. The results indicated that most farmers (75.6%) in the study areas were men and more than*

### **Introduction:**

Cabbage (*Brassica oleracea*) carrot (*Daucus carota*) and spinach (*Spinacia oleracia*) belong to vegetable group of plant. Vegetables are parts of plants that are consumed by human or other animals as food. The original meaning is still commonly used and is applied to plants collectively to refer to all edible plants matter, including the flower fruits, stems, leaves, roots and seeds (Ayto, 1993). Vegetable plays an important role in human nutrition it can be eaten raw or cooked and it play an important role in human nutrition, being mostly low in fat and carbohydrate but high in vitamins, mineral and dietary fiber. Many nutritionist encourage people to consume plenty of vegetables in their diet (CDCP 2015). When

56% on the average were not educated beyond Primary school in all the locations, with only view Secondary School (37.78%) and very view that go beyond Secondary School (5.56%). This influences farmers' perception on insect pests of the selected vegetables (cabbage, spinach and carrot). They believed that the fastest and only way to solve pest problem is the use of synthetic pesticides. Therefore, indiscriminate use, handling and disposal of pesticides containers characterized farmer's attitude in all the locations. There is therefore, serious need for field education of farmers on judicious use of pesticides to protect agro-ecosystem, the environment and non-target animals' especially human being.

**Keywords:** *Vegetables, Arthropod pests, Farmers' perception, Pesticides, questionnaires*

Vegetables are included in the diet, there is tendency of reduction in the incidence of cancer, stroke, cardiovascular disease and other chronic ailments [Olasanta (1992); Terry *et al.*, (2011); Buchner *et al.*, (2010)]. Research has shown that compared with individuals who eat less than three servings of vegetables each day, those that eat more than five servings of vegetables have an approximately twenty percent (20%) lower risk of developing coronary heart disease or stroke (HSPH 2012). The nutritional content of vegetables varies considerably, some contain useful amount of protein though generally they contain little fat (CDCP 2015). Vegetables are rich in thousands of different beneficial plant phytochemical. Phytochemicals abound in antioxidant, anti-inflammatory and other health-promoting properties. With increasing knowledge of their food value, the level of vegetable consumption in Nigeria is rising annually (HSPH, 2012).

Apart from having good nutritional value, vegetables are considered as potential income generating crop and as a supplements to diet consisting mainly of carbohydrates (Chadha and Oluoch 2003). Despite the importance of vegetable there are various production constraints whenever they are grown in the country, which includes high cost of input transportation, accessibility to market, and insect pest / disease infestation. Agricultural pests cause great losses by reducing either the quantitative or qualitative efficiency of a production system (Sithannatham *et al.*, 2003) i.e. they reduce productivity and economic value of the product through direct feeding, contamination or by

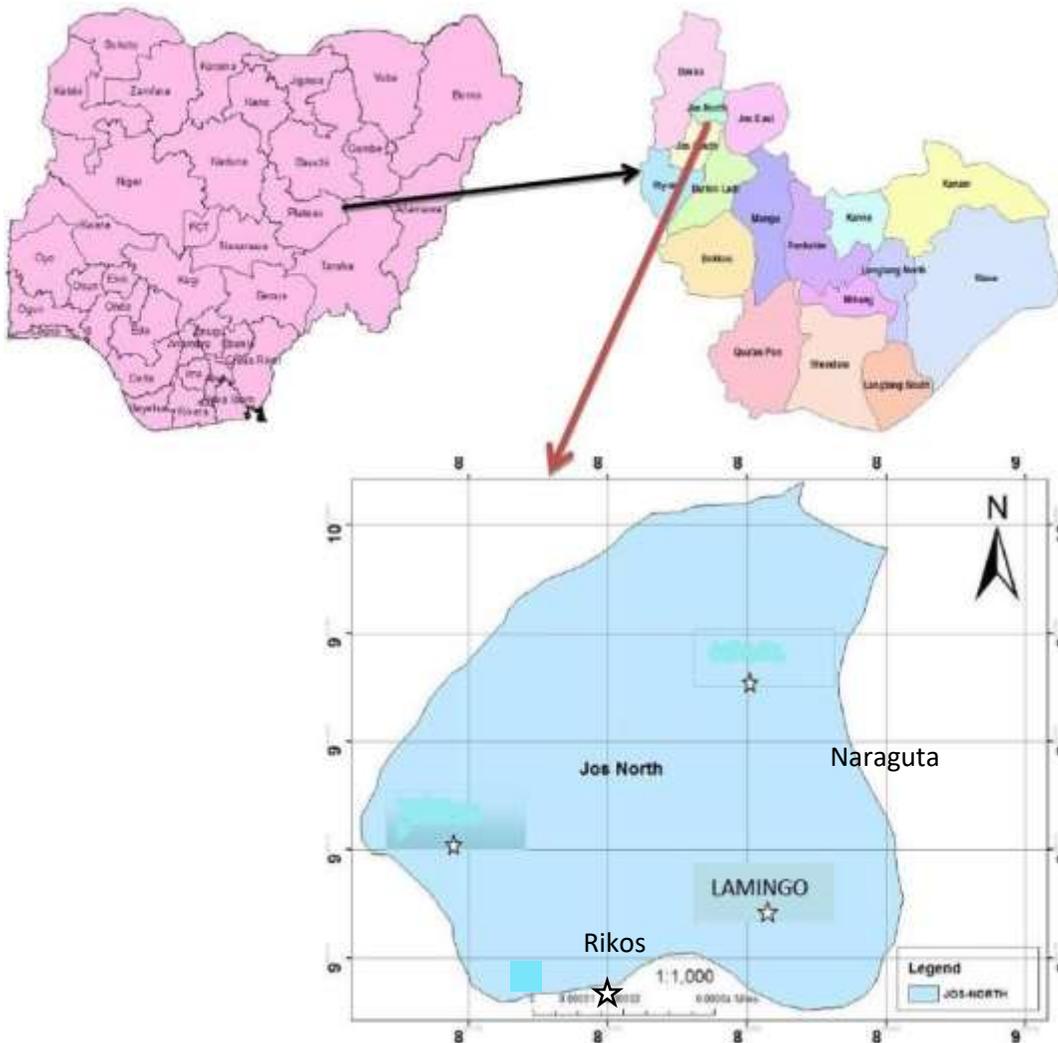
introducing pathogens or toxic metabolites into their hosts. According to Januaris (2019), the major pests of vegetable includes; Thrips, Aphids, cutworms, grasshopper, cabbage-looper, beetles, green vegetable bugs, leaf miners, stem borers earworms and horn worm, root knot nematodes snail and slugs among others.

Most farmers especially the small scale farmers, who grew vegetables all year round using both rain-fed and irrigation water, identified insect pests' infestations as a major constraint to their production (Obopile, 2008). Different efforts has been used to control pest damage on vegetables. These include; chemical, biological, cultural, physical/mechanical, regulatory and genetic control methods. However, the use of chemical pesticides is very common in vegetable pest management in Nigeria and the resultant health effects can be acute or chronic in those who are exposed to it (Bentley, 1992)). A 2007 systematic review found that "Most studies on non-Hodgkin Lymphoma and leukemia showed positive associations with pesticides exposure" and thus concluded that cosmetic use of pesticides should be decreased (Bassil *et al.*, 2007). Strong evidence also exist for other negative outcomes from pesticides exposure including neurological problems, birth defects, fetal death (Sanborn *et al.*, 2007) and neurodevelopment disorder. (Jurewicz and Hanke, 2008). Expose routes other than consuming food that contains pesticide residues, pesticide drifts, are potentially significant to the general public (Bentley, 1992). It is therefore expedient to investigation into farmer's perception on insect pest management of cabbage, carrot and spinach in Nigeria especially in Jos North Local Government of Plateau State were most them are produced. The objective of this study is therefore to generate socio economic characteristic of vegetable farmers, their source of information about insect pest of these vegetables and to investigate farmers' management practices for the insect pest control.

## MATERIALS AND METHOD

### Study Area and Site

Three area were selected in Jos North Local Government Area (Rikkos, Lamingo and Naraguta) all in Jos Metropolis. Jos, the capital of Plateau state of Nigeria is located at the extreme north part of the state. Jos North LGA is located around 9° 55' and 8° 54' (Fig.1), it has average height of about 1200m above sea level.



Map of Nigeria indicating Plateau state, Jos North local government and the three study sites.

### Survey and sampling technique

To determine which pest affect vegetable crop, a field survey was conducted in three selected areas of Jos North LGA of Plateau state. The field survey was carried out between May and November, 2019. The 3 zones were purposively selected from the LGA of the state based on farmers growing capacity (both rainy and dry season). Simple random technique was used to select a total of 90 vegetable farmers from these 3 zones; 30 farmers was selected from each of the zone. Only farmers that are involved in vegetable production (solely or mixed) will be selected for the study (Okrikata and Ogunwolu, 2017). The objective of

the activity will be briefly explained to the respondent high-lightening the need, importance and the possible outcome. The field survey will include collection of information through farmers' interview.

On the basis of questionnaires, farmers will be interviewed and details will be obtained concerning these three vegetable crops (cabbage, carrot and spinach) and their pests. Personal interaction with each respondent will be supplemented by field visit to authenticate information given. Options will be provided for the respondents to which best reflects their views on vegetable production. Before conducting an interview, the questionnaire will be explained to respondents for them to freely participate in the study without being coerced. The information gathered through the questionnaire covers farmers' demographics, farm practice, production profiles and pest management practices along with the side effects if any.

#### Statistical Analysis:

The primary data collected from farmers, were analyzed using **descriptive statistics** and **Fishers' exact test** (FET) was used to compare the variables constituting farmers' characteristic among surveyed areas to determine association between farmers' characteristics and insecticide spraying frequencies. The probability value (*P*-value) was estimated using **two sided test** at 5% level of significance.

## RESULTS AND DISCUSSION

### Socio-economic characteristics of cabbage farmers in the study area

It is a fact that in commercial crop farming, age, education, farming experience, contact with extension workers and membership of co-operative societies are known to exert significant impact on technical efficiency of farmers (Ibrahim *et al.*, 2014; Alenen & Hassan, 2003 and Adewuyi and Okunmadewa, 2001). Table 1 shows that vegetable farmers in the three zones of Jos North LGA were not significantly different ( $P < 0.05$ ) with respect to gender, marital status, age range, educational levels and farm size/ scale of production. However, male form the majority of vegetable farmers in the three zones. Male dominance of vegetable production was evident with mean 76% male to 24%. This is in line with the findings of Banjo *et al.*, (2003) and Yusuf *et al.*, (2013). Also, the larger percentage of men as the major producer of vegetable as recorded in this study is in line with the work of Obopile *et al.*, (2008) who reported that most farmers

in Botswana are men and concluded that agriculture is not considered as an activity of women. This could be attributed to easier access men have to land and economic empowerment (Paradza, 2011; United Nations, 2012). Going by Okonya *et al.*, (2014), women should therefore be encouraged and empowered to go into vegetable production.

The age bracket between 31 and 50 years had the highest mean frequency of respondents with age bracket 31 – 40years (45.55%) and age bracket 41 – 50 years (33.33%) (table 1). This is similar to the findings of Oladoja *et al.*, (2006) and Olaniran *et al.*, (2014) that people that are active in the high labour intensive peasant farming are in the age bracket 30 – 50 years. As pointed out by Adenugan *et al.*, (2013) that age usually influences farm and farmers productivity significantly. More than 56% on the average were not educated beyond Primary school with only view Secondary School (37.78%) and very view that go beyond Secondary School (5.56%). This is similar to the findings of Banjo *et al.*, (2003) that most farmers growing horticultural crops in Southwestern Nigeria had no formal education. This has implication for farmers' efficiency in production decision-making, openness to innovative ideas and new technologies, which are the key to enhanced productivity (Madisa *et al.*, 2010; Amaza and Olayemi, 2000). The lower percentage (5.56%) of farmer that went beyond secondary school in this study corroborating our findings that most farmers are less educated. This confirms the conclusion by Ratta (1993) that farming is a viable alternative to waged labour for those who lack formal employment due to limited education.

Generally across the zones, the respondents practiced small scale farming with farm size less than one hectare (table 1). The results also indicated that all the farmers interviewed engaged in the cultivation of two or all the vegetable at one season or the other. Hovorka (2005) reported that urban agriculture is an important source of food and jobs in many countries. This was not the case in this study as most vegetable farmers were living in the peripheries of the city. Most vegetables are produced in rural areas and the peripheries of the cities where people are not buoyant and less educated farmers are found (table 1). This could be the reason for the small scale production and low level of farmers' knowledge of vegetable pests and diseases management methods.

**Table1: Socio-Economic Characteristics of Sample Vegetable Farmer's Location**

Variable/location	Rikkos	Gangere	Naraguta	Mean (%)	P value
<b>Gender</b>					
Male	23(76.67) <sup>l</sup>	18(60.00) <sup>l</sup>	27(90.00) <sup>l</sup>	75.56	0.562 <sup>ns</sup>
Female	7(23.33)	12(40.00)	3(10.00)	24.44	
<b>Marital status</b>					
Married	21(70.00)	18(60.00)	22(73.33)	67.77	0.057 <sup>ns</sup>

Single	6(20.00)	5(16.67)	5(16.67)	17.45	
Divorce	2(6.67)	1(3.33)	1(3.33)	4.44	
Widowed	1(3.33)	6(20.00)	2(6.67)	10.00	
<b>Education level</b>					
No Formal	5(16.67)	11(36.67)	3(10.00)	21.11	0.030*
First LC	9(30.00)	9(30.00)	14(46.67)	35.56	
SSCE	15(50.00)	8(26.67)	11(36.67)	37.78	
PSSCE	1(3.33)	2(6.67)	2(6.67)	5.56	
<b>Age Range</b>					
20-30	6(20.00)	0(0.00)	7(23.33)	14.44	0.062 <sup>ns</sup>
31-40	10(33.33)	18(60.00)	13(43.33)	45.55	
41-50	12(40.00)	11(36.67)	7(23.33)	33.33	
≥51	2(6.67)	1(3.33)	3(10.00)	6.67	
<b>Farm Size</b>					
≤1ha (small)	30(100.0)	30(100)	30(100)	100.00	0.001**
2-4 ha (medium)	0(0.00)	0(0.00)	0(0.00)	0.00	
≥5 ha (large)	0(0.00)	0(0.00)	0(0.00)	0.00	

1. Percentage of respondent: ( )<sup>1</sup>

2. Fisher's exact test *p* value: \* = significant ( $p \leq 0.05$ )

\*\* = significant ( $p \leq 0.01$ )

ns = not significant ( $p > 0.05$ )

**Table 2. Season and Method of vegetable cultivation in the selected area**

<b>Farming season</b>				
Dry only	9 (30.00) <sup>1</sup>	2 (6.67)	11 (36.67)	24.45
Rain only	1 (3.33)	0 (0.00)	2 (6.67)	3.33
Both	20 (66.67)	28 (93.33)	17 (56.67)	72.22
<b>Farming Method</b>				
Rain fed	2 (6.67)	5 (16.67)	3 (10.00)	11.11
Irrigation	28 (93.33)	25 (83.33)	27 (90.00)	88.89

<sup>1</sup>Percentage of respondent

### Season and Method of vegetable cultivation in the selected area

Table 2 shows that almost all the respondents (72.22%) in the study areas farm vegetables both in dry and rainy season. However, 30% respondents in Rikkos and about 37% of the respondents in Naraguta cultivate vegetables during the dried season only, while less than 4% cultivate vegetable during the rainy

season only in all the locations. This could be as a result of other opportunity in other crops that performed better under rain fed cultivation with less attention. It was also gathered that vegetable sell better during the dry season than rainy season, for this reason more than 88% of the respondent engaged in irrigation practices with river been the source of the irrigation.

**Table 3. Farmers' perception on pests of vegetables.**

<b>Most Problematic Pest<sup>2</sup></b>				
<b>Insect Pest</b>	29 (96.67) <sup>1</sup>	18 (60.00)	30(100.00)	85.56
<b>Rodent</b>	7 (23.33)	5 (16.67)	7 (23.33)	21.11
<b>Birds</b>	0 (0.00)	10 (33.33)	1 (3.33)	12.22
<b>Pathogen</b>	11 (36.67)	9 (30.00)	7 (23.33)	30.00
<b>Weed</b>	0 (0.00)	4 (14.33)	0 (0.00)	4.78
<b>Frequency of Pest occurrence.</b>				
<b>Occasionally</b>	21 (70.00)	20 (66.70)	19 (63.33)	66.68
<b>Frequently</b>	9 (30.00)	10 (33.33)	11 (36.67)	33.33
<b>Rarely</b>	0 (0.00)	0 (0.00)	0 (0.00)	0.00
<b>Pest damage level</b>				
<b>High</b>	6 (20.00)	12 (40.00)	10 (33.33)	31.11
<b>Moderate</b>	24 (80.00)	18 (60.00)	20 (66.67)	68.89
<b>Low</b>	0 (0.00)	0 (0.00)	0 (0.00)	0.00

<sup>1</sup>Percentage of respondent

<sup>2</sup>Multiple responses allowed

**Table 4. Adopted methods of pest Protection.**

<b>Method of control</b>				
<b>No Control</b>	0 (0.00)	3 (10.00)	0 (0.00)	3.33
<b>Crop Rotation</b>	0 (0.00)	1 (3.33)	0 (0.00)	1.11
<b>Synthetic Insecticide</b>	30 (100.00)	27 (90.00)	30 (100.00)	96.67
<b>Wood Ash</b>	8 (26.67)	5 (16.67)	10 (33.33)	25.56
<b>Source of information on pest control</b>				

Own Experience	3 (10.00)	13 (43.33)	3 (10.00)	21.11
Open market	10 (33.33)	14 (46.67)	13 (43.33)	41.11
Extension Agents	3 (10.00)	2 (6.67)	2 (6.67)	7.78
Other Farmers	14 (46.67)	1 (3.33)	12 (40.00)	30.00
Frequency of synthetic pesticide application				
1-5	0 (0.000)	2 (6.67)	0 (0.00)	2.22
6-10	0 (0.00)	3 (10.00)	0 (0.00)	3.33
11-15	2 (6.67)	3 (10.00)	4 (14.33)	10.00
16-20	5 (16.67)	5 (16.67)	8 (26.67)	20.00
21-25	6 (20.00)	11 (36.67)	17 (56.67)	37.78
≥26	17 (56.67)	6 (20.00)	1 (3.33)	26.67
Percentage of	respondent () <sup>1</sup>			

Table 5 Information on human safety during Pesticide application

NO protection	20 (66.67)	22 (73.33)	21 (70.00)	70.00
Nose mask	3 (10.00)	1 (3.33)	2 (6.67)	6.67
Boots	6 (20.00)	5 (16.67)	6 (20.00)	18.89
Over-raw	1 (3.33)	2 (6.67)	1 (3.33)	4.44

#### Farmers' perception on pests of vegetables on the study area

During varietal selection, higher premium was placed on crop yield, market value and availability of seed than on avoidance of pest infestation and damage, hence pest attack freely (Alghali 1991). Arthropods were tagged the most frequently encountered, abundant and economically damaging pest causing qualitative and quantitative losses as well as increasing cost of production. This fact collaborated with this findings that an average of 85.56% respondent in all the 3 zones claimed that arthropods is the major pest of vegetable (table 3). Farmers' also intimated us that pest attacked could be frequently or occasionally in all the locations as it will be indicated by sign of changes on the vegetable leaves and this affects their yield and market value. However, on the average about 67% respondents attested to occasional occurrence while about 33% respondents went for frequent pest attack on their vegetable farms. This could probably explain the information gathered on level of pest damage that about 69% farmers responded that the damage done by pest is moderate while about 31% respondents acclaimed that pest damage is usually high with

negative effects on yield (table 3). Then the use of insecticide to mitigate the damage is inevitable. Januaris (2019) also affirmed this through his finding that 13 different arthropods were identified as the major pest of vegetable which called for control.

This study also revealed that most respondents obtain their pesticides from open market (41.11%) and other got theirs from friends (30%), own-experience (21.11%) while only 7.78% got theirs from certified agro chemical agent (table 4). Table 5 shows that an average of 70% respondents do not wear any protective clothing while applying pesticides in all the selected areas. However, the few farmers (25.56%) either cover their noses or wear boots only, while only 4.44% respondents cover the body completely (table 5). It is obvious that respondents in the selected areas who applied pesticides frequently have not weighed its impact on human being, agro-ecosystem and the environment. This could probably linked the educational gap of the respondents in all the locations.

## CONCLUSION AND RECOMMENDATION

Pesticide usage among the farmers in the survey area was very high and quite extensive in its usage. This is because they believed that pesticides is the best and last option known for the control of vegetable crops. Farmers also recognize damage by sign and attached it to insect attack hence, spray insecticide without considering any effect on man, natural enemies, agro-ecosystem and environment in general. This is probably as a result of serious gap in education among the farmers in the selected areas. There is therefore, serious need for field education of farmers on judicious use of pesticides to protect agro-ecosystem, the environment and non-target animals' especially human being. Examination on pesticide related health issue in the selected area is also recommended to know the farmers health status.

## REFERENCES

- (Adewuyi, S.A and Okunmadewa, F.Y (2000). Economic efficiency of crop farmers in Kwara State, Nigeria. Niger. Agric. Dev. Stud. 2:45-57
- Adenegan, K.O.; Adams, O. and Nwauwa, L.O.E (2013). Gender impacts of small scale farm house-holds on agricultural commercialization in Oyo State, Nigeria. Br.J. Econ. Manage. Trade. 3:1-11
- Alenen, A.D. and Hassan, R.M. (2003). The determinations of farm-level technical efficiency among adopters of improved maize production technology in Western Ethiopia. Agrekon, 42:1-14

- Alghali, A.M. (1991). Studies on cowpea farming practices in Nigeria, with emphasis on insect pest control. *Trop. Pest Manage.*, 37:71-74
- Amaze, P.S. and Olayemi, J.K. (2000). The influence of education and extension contact on food crop production in Gombe State, Nigeria. *J. Agricbus. Rural Dev.*, 1:80-92
- Ayto, John (1993). *Dictionary of Word Origins*- New York; Arcade publishing. ISBN 978-1-55970-214-0. OCLC 33022699.
- Banjo, A.D.; Lawal, O.A; Fapojuwo, O.E. and Songonuga, E.A. (2003). Farmers' knowledge and perception of horticultural insect pest problems in Southwestern, Nigeria. *Afri. J. Biotechnol.* 2:434-437.
- Bentley, J.W. (1992). The epistemology of plant protection: Hondurancampsino Knowledge of pests and natural enemies. Proceedings of the CTA/NRI seminar on crop protection for resource-poor farmers, university of Sussex, UK, pp: 107-118
- Bassil, K.L.; Vakil, C.; Sanborn, M.; Cole, D.C.; Kaur, J.S. and Kerr, K.J. (2007). "Cancer Health Effects of Pesticides: systematic review". *Can Fam Physician.* 53 (10); 1704-11
- CDCP (2015), "Fruits and Vegetables" Nutrition for everyone. Centers for Disease Control and Prevention.
- Chadaha, M.L. and Oluchi, M.O, (2003). Home based Vegetable gardens and other strategies to over income micronutrient malnutrition in developing countries. *Food Nutrition and Agriculture*, Rome, Italy 1014-806x.
- Havorka, A.J. (2005). Gender, Commercial Urban agriculture and Supply in great Gaborone, Botswana, P. 126-138. In: L.J.A mougeot (ed) *Agropolis. The Social Political and environmental dimensions of urban agriculture.* Earthscan, London.
- HSPH (2012). "*Vegetables and Fruits*". Havard School of Public Health.
- Ibrahim, U.W.; Umar, A.S.S. and Ahmed, B. (2014). Technical efficiency and its determinants in water melon production in Borno State, Nigeria. *J. Econ Sustain Dev.*, 5:205-211
- Januaris S.F (2019). 13 common pests of leafy vegetables: photo prevention and control. *Dengarden Gardening Garden pests Control.* [www.dengarden.com/gardening/pests-leafy-vegetable-prevention-control-treatment-management-photo](http://www.dengarden.com/gardening/pests-leafy-vegetable-prevention-control-treatment-management-photo)
- Jurewicz, J. and Hanke, W. (2008). "Prenatal and Childhood exposure to pesticides and neurobehavioural development review of epidemiological studies". *Int. J. Occup. Med. Environ. Health.* 21(2):121-32. doi:10.2478/V10001-008-0014-z.
- Madisa, M.E.; Assefa, Y. and Obopite, M. (2010). Assessment of production constraints, crop and pest management practices in peri-urban vegetable farms in Botswana. *Egypt. Acad. J. Biol.Sci* 1:1-11
- Mohmud, M.M.; Akan, J.C.; Mohammed, Z. and Battah, N. (2015). Assessment of organophosphorus and pyrethroid pesticide residues in water melon (*Citroillus lanatus*) and soil samples from Gashua, bade local government area Yobe State Nigeria. *J. Enviro: Pollut. Hum. Health*, 3:52-61
- Okonya, J.S.; Mwangi, R.O.; Syndikus, K. and Kroschel, J. (2014). Insect pests of sweet potato in Uganda: Farmers' perception of their importance and control practices *springer plus*, Vol.3 10. 1186/2193-1801-3-303
- Okrikata, E. and Ogunwolu, E.O. (2017). Farmers' Perception on Arthropod Pests of Watermelon and their Management Practices in the Nigerian Southern Guinea Savanna. *Interna. J. Agric. Res.* ISSN 1816-4897
- Oladoja, M.A.; Adisa, B.O. and Ahmed-Akinola, A.A. (2006). Effectiveness of Communication methods used in information delivery to cocoa farmers in Oluyale local government area of Oyo State. *Ogun J. Agric. Sci.* 4:78-88
- Olaniran, O.A.; Babarinde, S.A.; Odewole, A.F.; Aremu, P.A. and Popoola, K. (2014). Rural Farmers' perceptions knowledge and management of insect pests of fruit vegetables in Ogbomoso agricultural zone of Nigeria. *Int. Lett. Nat. Sci.* 25:18-28

- Olasanta, F.O. (1992). Vegetable production in traditional farming system in Nigeria. *Outlook on Agriculture* 2, (2) : 117-127.
- Opobile, M.; Munthali, D.C.; Malilo, B. (2008). Farmers Knowledge, Perceptions and management of Vegetable Pests and disease in Botswana, *Crop Prot.* 27:1220-1224.
- Paradza, G.G. (2011). Innovations for securing women's access to land in East Africa Working paper No. 13, International Land Coalition Rome Italy, pp 1-15
- Ratta, A. (1993). City Women Farm for food and Cash intl. *Ag-aieve* 6 (2): 1-2.
- Sanborn, M.; Kerr, K.J.; Sanin, L.H.; Cole, D.C.; Bassil, K.L. and Vakil, C. (2007). "Non -cancer health effects of pesticides: systematic review and implications for family doctors". *Can Fam Physician.* 53(10): 1712-20. PMC 2231436. PMID 17934035.
- Srithanthan, S.; Matok, C.M.; Nyarko, K.A.; Reddy, K.V.S.; Sileshi, G. and Olubayo, F. (2003). Occurrence of Insect pests and associated yield loss on some African Indigenous Vegetable crops in Kenya, *African Crop Science Journal* 10(4): 281-310
- Souza C.R; Sarmiento R.A; Venzon M, Barros E.C; Dos-Santos GR and Chaves C.C (2012). Impact of insecticides on non-target arthropods in watermelon crop. *Sermina: ciencias Agrarias*, 33:1789-1801
- Terry, Leon (2011). *Health- Promoting Properties of Fruits and Vegetables* CABI. pp2-4 ISBN 978-1-84593-529-0.
- United nations (2012) Challenges and barriers to women's entitlement to land in India. United Nations Entity for Gender equality and the empowerment of women Asia and the Pacific, LANDESA/Rural Development Institute, India pp 1-28
- Yusuf S.F.G; Lategan F.S and Ayinde I.A. (2013). Profitability and adoption of watermelon technologies by farmers in Moro Local government of Kwara State Nigeria. *J. Agric. Sci* 5:91-99.