

## **A STUDY ON SWEET ORANGE PRODUCTION AND ITS POST-HARVEST LOSSES AMONG FARMERS IN NORTH- EASTERN ZONE OF BENUE STATE, NIGERIA**

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### **ABSTRACT**

The study assessed sweet orange production and its post-harvest losses among farmers in North-Eastern Zone of Benue State, Nigeria. Specifically, the objectives of the study were to: find out the quantity of oranges produced by farmers, examine the extent of post-harvest losses of orange and explore possible ways to reduce post-harvest losses of orange in the area. One hypothesis was formulated to authenticate the result of the study. The study adopted diffusionist theory. Cross-sectional design was employed. A sample size of 313 respondents was drawn from a population of 1442 registered orange farmers using multi-stage sampling technique. The instruments for data collection were questionnaire, KII and FGD. Data collected through these methods were analysed using descriptive statistics to address research objectives, while ANOVA was used to test the hypothesis at 0.05 level of significance. Findings revealed that most orange plantations in the study area were within one hectare and less than a hectare. The cultivars grown were mostly Ibadan Sweet and Valencia. An average of 22,164.6bags of oranges were harvested, 16,672.3bags were sold while 5,492.3bags of oranges were lost. Findings revealed that the extent to which post-harvest losses of orange

occurred in the area was as high as 21-30 per cent. These losses were noticed to occur in all the post-harvest stages of orange. However, plucking and bagging (31% and above) were the principal stages of post-harvest losses of orange. The study therefore recommended awareness and sensitisation creation on post-harvest losses of orange among farmers, change in settlement pattern among the people of the study area, farmers before harvesting the fruits should endeavour to spread cushions around the tree canopies and harvest at the appropriate time of the day, possibly when the grounds are dry, among other recommendations as strategies to increase orange plantations and reduce post-harvest losses in the area.

**Keywords:** *Sweet orange production, Post-harvest losses, Farmers, North-Eastern Zone*

## **INTRODUCTION**

The importance of food to humans cannot be overemphasised. Nutrition Guide (2009) notes that food plays very vital role in maintaining proper health and also helps in prevention and cure of diseases. It is in recognition of the relevance of food to man that the International Covenant on Economic, Social and Cultural Rights (ICESCR), instituted the "right to an adequate standard of living, including adequate food", as well as the "fundamental right to be free from hunger". Foods are categorised into carbohydrate, protein, fats, water, vitamins and minerals (Marion, 2013). Del Rosario (2017) observes that fruits are not only colourful and flavourful components of our diet, but they also serve as a major source of energy, vitamins, minerals, and an excellent source of dietetic fibre as well. Among these fruit types commonly consumed are apple,

banana, lime, mango, pear, pineapple, watermelon, cashew, guava, orange, etc.

Orange is one of the most common fruits grown around the world (Musasa, Mvumi, Manditsera, Chinhanga, Musiyandaka & Chigwedere, 2013; Olatilewa, Omotesho & Mohammad-Lawal, 2017). This is as a result of its importance in nutrition and medicinal attributes (Ugoh, Clarke & Jewitt, 2015). Delicious and juicy orange fruit contains an impressive list of essential nutrients, vitamins, minerals for normal growth, development and overall well-being (Umesh, 2016). Oranges, which are high in vitamins A and C and potassium, are eaten fresh or processed into juice, which can be consumed directly or further processed into concentrate, both used in numerous soda and cocktail drinks, punches, orangeades, and liqueurs (Jacqueline, 2012). Prokopova (2015) notes orange to have the following medicinal attributes: "lower blood pressure, relieves anxiety and depression, serves as mosquito repellent, relieves constipation and lower cholesterol" (p.16). The rinds produce essential oils used broadly as pharmaceutical components, in supplements and in cosmetic industry and aromatherapy (Maria, Rubria, Jose, Gloria, Jose & Hugo, 2012). Orange is equally important in terms of monetary value. Orange fruit production plays an important role in income generation and poverty alleviation of the rural population (Kumeka, 2015).

Food and Agriculture Organisation (FAO) estimated that in 2012, Brazil was the world's largest producer of oranges which produces 18 million metric tonnes. It is mostly cultivated in the states of Sao Paulo and Minas Gerais. More than 50% of the world's share is produced by this country. About 99% of their production is produced for export. Other

countries include United States of America with 8.2 million metric tonnes, China 6.7, India 5 and then Mexico with 4.1 million tonnes. The global production of orange in Nigeria as at 2012 estimation was 3.9 million metric tonnes. In Nigeria, orange is cultivated in 15 states: Benue, Nasarawa, Osun, Anambra, Ekiti, Imo, Kogi, Ebonyi, Edo, Delta, Oyo, Kwara, Ogun, Taraba and Kaduna (Olife, Ibeagha & Onwualu, 2015). Benue State is the largest producer in the country (Avav & Uza, 2002). Benue State Agricultural Zone A which is made up of seven (7) local government areas namely, Katsina-Ala, Konshisha, Kwande, Logo, Ukum, Ushongo and Vandeikya Local Government Areas are the major producers in the state (Kumeka, 2015).

Despite the huge potential of the orange fruit in terms of yield and value, farmers are unable to realise the expected income on their investment due to post-harvest losses. Post-harvest losses according to Kiaya (2014), is the degradation in both quantity and quality of food production from harvest to consumption. Quality losses include those that affect the nutrient/caloric composition, the acceptability and the edibility of a given product and are more common in developed countries. Quantity losses on the other hand are those that result in the loss of the amount of product and are more common in developing countries. Previous studies (Muyengi *et al.*, 2014; Musasa *et al.*, 2015; Hossain, Khatun, Matin & Dewan, 2017) have reported that 30 to 50 per cent or even more of fruits especially oranges are lost before they can be consumed, mainly due to high rates of bruising, water loss and subsequent decay during post-harvest handling. From this backdrop therefore, it is pertinent to embark on a study on sweet orange production and its post-harvest losses among

farmers in North-Eastern Zone of Benue State, Nigeria. Specifically, the study sought to:

- i. find out the quantity of oranges produced by farmers in the study area.
- ii. examine the extent of post-harvest losses of orange in the area.
- iii. explore possible ways to reduce post-harvest losses of orange in the area.

### **Hypothesis**

- i. There is no significant difference between quantity of oranges harvested and quantity sold by farmers in North-Eastern Zone of Benue State.

### **Theoretical Framework**

Diffusionist theory was used to explain the subject of study. Diffusionism emerged as a theory of explaining social change when evolutionary theory was discredited as being conjectural. According to diffusionists, cultural change and progress were merely as a result of cultural borrowing. They were of the view, however, that different cultures had diffused from a common source. For example, Smith and Perry claimed that all civilisations everywhere had diffused from an original source in ancient Egypt (Idyorough, 2015).

Diffusionist approach is based on two major assertions: (1) that development is largely the result of the spread of certain cultural patterns and material benefits from the developed to the underdeveloped nations; (2) that within each underdeveloped nation a similar process of diffusion takes place from the modern to the traditional sectors. The underlying assumption of diffusionist approach is the

traditional/modern dichotomy. The approach is based on the notion of a "dual society". In application of the theory, Ugande (2017) studied farmers' perception of the contributions of radio to the prevention of post-harvest losses of agricultural produce in Benue State, Nigeria and found out that radio messages on post-harvest management practice of agricultural produce can arouse farmers' interest to try and adopt the new practice disseminated to them for effective post-harvest management of agricultural produce. It also shows that radio dissemination of information on best post-harvest management practices of agricultural produce is crucial for trial and adoption of such practices. Similarly, if orange farmers could adapt to this technique, losses during post-harvest periods will be drastically reduced and by implication upsurge orange production.

## **MATERIALS AND METHODS**

In this study, cross-sectional design was used to obtain valuable data from the respondents. This type of design was preferred because it requires meeting with the target respondents to sample their opinion on quantity of orange fruit production and extent of post-harvest losses among farmers in the study. Moreover, because it uses survey techniques to gather data, it is relatively inexpensive and takes up little time to conduct. The study setting is in North-Eastern Zone of Benue State. The zone consist of seven LGAs, namely, Katsina-Ala, Konshisha, Kwande, Logo, Ukum, Ushongo and Vandeikya LGAs. The choice of this area is largely informed due to the fact that, it is the major producer of oranges in Benue State.

Orange farmers in North-Eastern Zone of Benue State constituted the population of the study. According to statistics from Farmer's Initiative for Agricultural Development, Benue Valley (FIAD) as at 2017, there were 1442 registered orange farmers in the zone. It is from this population that a sample size of 313 respondents was drawn using Yamane (1967) sample size determination formula. Consequently, multi-stage sampling technique was used to arrive at the desired number of respondents. Three methods were employed in the course of data collection, they include questionnaire, key informant interview (KII) and focus group discussion (FGD). Data collected from the field were analysed both quantitatively and qualitatively. Data gathered through these techniques were triangulated. Under quantitative technique, data obtained through the use of questionnaire were analysed using descriptive statistics. This involved the use of frequencies, simple percentages, cross-tabulation and mean. While under qualitative technique, methods such as KII and FGD after transcription were analysed using explanatory, interpretative and analytical approaches. One hypothesis formulated earlier was tested using ANOVA. Data were entered into the computer and analysed using SPSS version 20.

## **Results and Discussion**

This section is aimed at presentation, analysis of data collected during field survey along with discussion of findings. The major components that formed this section were demographic characteristics of respondents, quantity of oranges produced by farmers, extent of post-harvest losses of orange and ways post-harvest losses of orange can be

reduced. Data collected through questionnaire, KII and FGD were simultaneously presented and analysed.

### Demographic Characteristics of Respondents

**Table 1: Demographic characteristics of respondents**

<b>Demographic Characteristics</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Sex</b>		
Male	262	84.5
Female	48	15.5
<b>Total</b>	<b>310</b>	<b>100</b>
<b>Age (in years)</b>		
18-35	24	8
36-55	133	43
56 and above	153	49
<b>Total</b>	<b>310</b>	<b>100</b>
<b>Marital Status</b>		
Single	32	10.3
Married	247	79.7
Divorced/Widowed	31	10
<b>Total</b>	<b>310</b>	<b>100</b>
<b>Level of Education</b>		
None	31	10
Primary	38	12
Secondary	95	31
Tertiary	146	47
<b>Total</b>	<b>310</b>	<b>100</b>
<b>Occupation</b>		
Civil Service	62	20
Farming	187	60
Trading	23	7
Crafts making	8	3

Others	30	10
<b>Total</b>	<b>310</b>	<b>100</b>
<b>Years of Orange Farming</b>		
1-10	88	28
11-20	155	50
21-30	36	12
31 and above	31	10
<b>Total</b>	<b>310</b>	<b>100</b>

**Source:** Field Survey, 2018.

Table 1 above described the demographic characteristics of respondents. The above table showed that, 84.5% (262) of the respondents were males while, 15.5% (48) were females. This indicates that the Tiv tradition gives the males more access to land which is one of the prerequisite for orange orchard ownership. In terms of age, respondents within the age range of 56 years and above were 49% (153). Those that were between 36-55 years of age constituted 43% (133), while 8% (24) of the respondents were of the ages of 18-35 years. This implies that orange farming was mostly practiced by the middle-aged. This age is also an indication of their knowledge of post-harvest losses of orange and its implications on the production as well as income. With regards to marital status, 79.7% (247) of the respondents were married, 10.3% (32) of the respondents were single, while 10% (31) of the respondents were either divorced or widowed. This symbolises that most married people have more responsibilities hence their involvement in orange farming as an alternative means of survival. The level of education of the respondents showed that, 47% (146) had attended one form of tertiary institution or the other and acquired certificate such as ND, NCE, HND, B.A/B.Ed/B.Sc, M.A/M.Ed/M.Sc or

even PhD. Respondents who acquired secondary education were 31% (95). Respondents who had primary school certificate numbered 12% (38), while those with no formal education were 10% (31). This signifies that most of the respondents were literate as they attained one form of education or the other which enhanced their level of understanding of post-harvest losses and how it affects orange production and income.

Apart from the respondents' primary occupation as orange farming, 60% (187) of them were engaged in other types of farming such as yam, cassava, rice, groundnut, beans, vegetables and other fruits. Respondents who were civil servants totaled 20% (62) while those who had other occupations separate from the ones mentioned in this data constituted 10% (30). Other occupations were trading, 7% (23) and 3% (8) crafts-making. This means that the respondents do not only rely on orange farming as they are also engaged in different types of farming for sustenance, in an event they incurred post-harvest losses of orange. The above table also indicated the number of years respondents have been into orange farming. The data presented shows that, 50% (155) of the respondents had been in this phase of farming for about 11-20 years, 28% (88) of the respondents had the experience of orange farming for over 1-10 years. Those with 21-30 years and 31 years and above constituted 12% (36) and 10% (31) respectively. This presupposes that the respondents started orange farming early in life which is important in enhancing sustainable production. This also shows that long years of orange farming experience would ensure resourceful production and supplemented knowledge on post-harvest losses.

## Quantity of Oranges produced by the Respondents in North-Eastern Zone of Benue State Sizes of Orange Farms

**Table 2: Sizes of orange farms**

Size (in hectare)	Frequency	Percentage
Less than 1 hectare	90	29.0
1 hectare	92	29.7
2 hectares	54	17.4
3 hectares	21	6.8
4 hectares and above	53	17.1
<b>Total</b>	<b>310</b>	<b>100</b>

**Source:** Field Survey, 2018.

Table 2 above showed the sizes of orange farms or orchards of the respondents. From the presentation, one hectare of orange farm contains 400 orange trees, which is the globally accepted standard for orange plantation. Thus, some of the responses that reflected the number of orange trees owned by the respondents were convened into appropriate hectare(s). The distribution indicates that most of the farmers, 29.7% (92) and 29.0% (90) have oranges within one hectare and less than a hectare respectively, 17.4% (54) of the respondents have two hectares of orange farms. Respondents that have four hectares of orange farms and above were 17.1% (53), while those with three hectares were 6.8% (21). This result implies that most farmers plant oranges in blotches of land due mostly to the nature of settlement pattern in the area which does not warrant ownership of large expanse of land. The data also depicts that farmers are discouraged to venture into planting of more oranges as the

expected yield and income is not gained grossly owing to post-harvest losses.

Contrary, key informant interviews and focus group discussions conducted specifically in Konshisha, Ushongo and some parts of Vandeikya LGAs showed that most orange farms were within four hectares and above because of vastness of land and eagerness of farmers to have more orange plantations, but were constrained by some precipitating factors such as poor access roads, poor pricing policy, lack of buyers, etc. This therefore implies that concentration of oranges in Agricultural Zone A is in the aforementioned local government areas. Orange farming in these areas is a household name, which portrays this type of farming as one of the main occupations of farmers in the area.

A 68 year old Male Retired Civil Servant from Mbanor Council Ward, Konshisha LGA in an interview noted:

...I have planted not fewer than eight hectares of oranges and I intend to plant more when some of these stalemates like poor access roads that link our villages where these farms are located, lack of buyers and poor pricing policy are tackled...  
(Source: KII, 4<sup>th</sup> June, 2018)

Another 61 year old Male Artisan from Mbagba Council Ward, Ushongo LGA in an interview responded:

...I have over 2000 orange trees on some of the lands I came back to my village and possessed. Though, some of the orange trees have been affected by *Nonon* (parasitic plant - *Cuscuta dodder*) due to bird's defecation and they no

longer produce much fruits. I have recently planted 1000 stands that are yet to produce. However, I'm hoping that in an interval of three to four years, they can start producing fruits...  
(Source: KII, 4<sup>th</sup> June, 2018)

The disposition of farmers to plant orange trees in these areas to a large extent is also attributed to the soil texture of the zone. The area portrays a tropical ferruginous soil type. The soils are well-drained and are of the fine sandy texture, sandy-clay, and sandy-loans, very permeable and quite good for rainfall agriculture which is predominant in the area. The geographical distribution of the soils allows a zoning influenced by climate loose reddish clay, several meters thick abounds in most of Ishangev, Sankera, Ukan and Kunav areas. Sand-loan thrives in several parts of the area therefore allowing orange production to flourish. Another reason for orange farming in the area is due to its economic value. Farmers in these areas relied on orange farming for food, shelter and clothing, which are basic necessities for human existence. This to a great extent has added to their income and reduced their poverty level.

Findings revealed that the quantity of oranges produced in the area is largely attributed to the size of orange farms as most farmers have orchards within the range of one hectare (30%) and at times less than a hectare (29%). The above scenario could be related to the type of settlement pattern of the Tiv people especially those from the study area. The type of settlement pattern practiced by people of the area is dispersed in nature, which is an impediment to development. Thus, it will be difficult for most farmers to plant oranges in

many hectares as homesteads interspaced the landscape. There is therefore no large expanse of land to create large orange plantations. The land tenure system also does not help matters as individual families own the land. It must be noted that scattered settlement affect all facets of the society be it in terms of agriculture, infrastructural development such as provision of basic amenities like clinics, schools, electricity, water supply, social and financial institutions, and above all security against external aggression. Consequently, Akaafele (2013) affirmed that a Tiv community of 500 persons may be scattered across tens of square kilometers while a similar one in the south or north may live in just one or two square kilometers. It will cost a lot less to provide for a compact community of 500 persons with a borehole, clinic and electricity than for a scattered one. Similarly, Nwachukwu (2018) reported that a First Class Traditional Ruler in Benue State, Chief Abu King Shuluwa (Tor Sankera) said the Tiv people were seriously considering changing their settlement pattern as this was a way of curbing the incessant attacks and killings the Tiv people suffer in the hands of marauding herdsmen.

### **Cultivars of Orange Grown by the Respondents**

**Table 3: Cultivars of orange grown by the respondents**

<b>Cultivars</b>	<b>Frequency</b>	<b>Percentage</b>
Only Valencia	21	6.8
Only Ibadan Sweet	26	8.4
Only Washington	6	1.9
Valencia and Ibadan Sweet	132	42.6
Valencia, Ibadan Sweet & Washington	90	29.0
Valencia, Ibadan Sweet & other varieties	35	11.3
<b>Total</b>	<b>310</b>	<b>100</b>

**Source:** Field Survey, 2018.

Table 3 above presented the cultivars of orange fruit grown by respondents. The above data shows that a total of 42.6% (132) of the respondents planted Valencia and Ibadan Sweet oranges. The second highest cultivars of orange planted by farmers were a combination of Valencia, Ibadan Sweet and Washington. Respondents who have Valencia, Ibadan Sweet and other varieties such as California, Tangerine, Grape and Kings Orange were 11.3% (35) in number. Ibadan Sweet was planted by 8.4% (26) of the respondents. Results from the above table also indicated that a total of 6.8% (21) respondents planted only Valencia orange. A total of 1.9% (6) of the respondents planted only Washington orange. This implies that farmers within this enclave agricultural zone plant most of Valencia and Ibadan Sweet cultivars. This is because the cultivars grow in warmer seasons. They are exposed to more sunlight, which can trigger the production of chlorophyll in the peel to help protect the fruit from sunburn. Another reason is due to high demand of the cultivars, high production yields and monetary value.

Key informants also stressed that they planted most of Valencia, Ibadan Sweet and Washington oranges, but Valencia and Ibadan Sweet cultivars were planted on a large scale than Washington. This is because there was much patronage for the duo owing to the fact that their sizes were more profitable as compared to other varieties especially Washington which was complained to be too big and easily filled-up bags at the disadvantage of the buyers. Another reason for the preference of Valencia and Ibadan Sweet oranges was that they were not harvested at the same time, which made it possible for the farmers to have an all year round harvest. Ibadan Sweet orange for example was

preferred because it is less susceptible to microbial infections as it has thick covers so is difficult for insects penetration. Valencia specie on the other hand has soft backs and is harvested when the rains are not regular. Few of the key informants stated that, they have in addition planted other varieties of oranges like Tangerine, Grape, Lime, Lemon, California and Kings.

The key informants also indicated the month(s) which these oranges were harvested and specified that the month of harvest depend on the variety of the fruit. The implication of time of harvest to the study is that orange fruits are harvested when matured or ripe. Therefore, harvesting at the wrong time will lead to undesirable consequence such as fruit rot and post-harvest losses. Unfortunately, this is the situation most farmers in the study area have found themselves due to unavailability of buyers when it is the right time to harvest the fruit. Also, the reason why farmers plant different varieties is because the level of susceptibility to post-harvest losses and yields differs.

According to a 71 year old Male Traditional Ruler from Iwar Council Ward, Katsina-Ala LGA:

...I have Valencia, Ibadan Sweet, Washington and Tangerine. But I have planted more of Valencia and Ibadan Sweet because they produce more fruits and buyers prefer them more than other species. I harvest my Valencia and Ibadan Sweet almost the same time. But Valencia is harvested much earlier because it easily got rotten on the tree if it has over stayed. Ibadan Sweet is harvested after Valencia has finished on the trees because it has

very thick back and easily not affected by fungi. I harvest Valencia around January and February while Ibadan is harvested around February till May.... (Source: KII, 24<sup>th</sup> February, 2018)

In a related response, a 68 year old Male Retired Civil Servant from Mbanor Council Ward, Konshisha LGA stated:

The first variety of orange I ever planted was Ibadan Sweet. Before it had started yielding fruits I when ahead and planted Valencia in more number. When I started harvesting them, I saw the need to bring other varieties, which then was also on demand. So I came to College of Agriculture Yandev and bought Grape, Tangerine, California, Washington and Kings from their farm. But as time when on, the demand for Valencia and Ibadan Sweet were higher. I have now given my whole attention to Valencia and Ibadan Sweet and I prefer them more because they attract more buyers than other varieties.... The month or period of harvest depends on the variety of orange. For Ibadan Sweet and Valencia, the harvest can be done throughout the year because they produce fruits twice a year especially when it is fertilized. For Ibadan Sweet, when you harvest for the first time, and if fertilized, you can still harvest the ones popularly called "green". This one is more valued in money than the first batch of harvest. For Valencia, the harvest time is around January to April and June. (Source: KII, 4<sup>th</sup> June, 2018)

A 43 year old Male Police Officer from Mbakuha, Ushongo LGA in an interview also recapped:

...the cultivars of oranges I have planted are Valencia, Ibadan Sweet and Washington. Their seasons of maturity and harvest are June to April for Ibadan Sweet, October to July for Valencia while the fully ripped Washington is harvested May to November.... (Source: KII, 24<sup>th</sup> March, 2018)

Discussions with focus group members also indicated that cultivars of oranges that were planted and sold on commercial basis were Ibadan Sweet and Valencia. Other cultivars which were not sold on profitable level were Washington, California, Kings, Tangerine, Lime and Lemon. These types the discussants observed were eaten mostly by household members and family friends. The discussants pointed out that before now cultivars such as Washington and Tangerine were also sold at commercial level but complains from the buyers emerged that Washington particularly was too big therefore could filled up bags easily at the disadvantage of the buyers. Some of the discussants who have Tangerine cultivars complained of lack of buyers due to the nature of the orange. They stated that when packed in bags the level of damage was much because of its soft back. It was also noted among discussants that the cultivars of oranges planted in particular areas were due to soil texture of the areas.

Findings from the study showed that Ibadan Sweet and Valencia cultivars were planted most (43%). The preference of the two varieties over others is as a result of soil characteristics of the area, season of harvest, demand for the fruit and total yield. Apparently, the concentration of

orange plantations in the area is due to the soil type. Orange trees need good soil to live in so they can produce fruits. The growth, development and production of oranges in Agriculture Zone A depend on the physical characteristics of the soil such as drainage, density, texture, water-holding capacity, structure, soil depth, the homogeneity of the profile, erodibility, and the degree to which water can infiltrate the soil. The above discussion tends to agree with Kumeka (2015) who observed that Zone A lies in the Southern Guinea Savannah, abundant with rich natural endowment in terms of surface fertility and mineral resources. This is indicated in the nature of the soil type and richness in vegetation and climate of the area.

Inspite of the fact that different cultivars of oranges have specific months of harvest as contained in the literature (Ibua, 2016), study findings revealed that the commonly grown cultivars in the area were harvested all year round (28.7%). The reason for this difference is simply lack of patronage from the buyers. There are situations where a farmer leaves the oranges on the tree and harvest at the start of new rains under the probability that the fruits might reabsorb fluid. Peradventure the oranges does not absorb fluid, they are plucked away to give room for proper flowering. This has tremendous effect on the quantity of oranges produced in the area.

**Table 4: Mean computation for quantity of oranges harvest, sold and lost with monetary values**

Qty. harvested ( <del>₦</del> 1500/50kg)		Qty. sold ( <del>₦</del> 1500/50kg)		Qty. lost ( <del>₦</del> 1500/50kg)	
No.	%	No.	%	No.	%
22,164.6bags	100	16,672.3bags	75.2	5,492.3bags	24.8
<del>₦</del> 33,246,900.00		<del>₦</del> 25,008,450.00		<del>₦</del> 8,238,450.00	

**Source:** Field Survey, 2018.

The result from Table 4 above indicated that an average of 22,164.6bags of oranges at the cost of ~~₦~~1,500 each valued at ~~₦~~33,246,900.00 was harvested. However, a quantity of 16,672.3bags of oranges were sold at the cost of ~~₦~~25,008,450.00. Meanwhile, a total of 5,492.3bags of oranges valued at ~~₦~~8,238,450.00 were lost. Furthermore, the result shows that out of the 100% of oranges harvested, 75.2% were sold, while 24.8% were losses. This implies that post-harvest losses of oranges are high in the area. What is termed losses by the respondents were rejected oranges as a result of unripe or overripe, oversize or undersize, disease infested, bruises, punctures, and also those harvested and completely abandoned on the farms or collection spots.

Findings revealed that even though the quantity of oranges produced is affected by post-harvest losses, there is still high demand for the fruit because of accruing benefits. Orange fruit has nutritional, medicinal as well as monetary attributes. The fruit contains some essential nutrients for normal growth, development and general wellbeing. Orange fluids and peel are known to lower blood pressure, reduce depression and anxiety, relieves constipation, lower cholesterol and also serve as mosquito repellent. It also adds to the income of farmers and reduces poverty of the rural

people. The above discussion is confirmed by several studies (Gonzalez *et al.*, 2013; Kumeka, 2015; Prokopova, 2015; Umesh, 2016). The above finding equally agrees with this present study hypothesis that there is a significant difference between quantity of oranges harvested and quantity sold by farmers as shown in Table 8.

### Extent of Post-harvest Losses of Orange in North-Eastern Zone of Benue State

**Table 5: Extent of post-harvest losses of oranges**

Extent of PHLs	Frequency	Percentage
1-5%	15	5
6-10%	28	9
11-20%	43	14
21-30%	139	45
31% and above	85	27
<b>Total</b>	<b>310</b>	<b>100</b>

**Source:** Field Survey, 2018.

Table 5 above presented data on the extent to which respondents suffer post-harvest losses of oranges. The extent was categorised on a scale of very low (1-5%), low (6-10%), moderate (11-20%), high (21-30%) and very high (31% and above). This was done to enable a logical presentation and discussion. The results therefore showed that 45% (139) of the respondents suffered post-harvest losses of oranges within the range of 21-30%, 27% (85) of the respondents recorded 31% and above post-harvest losses of oranges, 14% (43) of the respondents underwent 11-20% post-harvest losses of oranges. Others include 9% (28) and 5% (15) of the respondents who experienced post-harvest losses of oranges within 6-10% and 1-5% respectively. The above data implies

that post-harvest losses of oranges is a major problem of farmers in the area. This also shows that the respondent's investment in orange farming is not yielding the desired results as such this can discourage them from taking proper care of the farms for the next harvest season and even expanding the sizes of their farms because of these colossal losses.

During key informant interviews and focus group discussions, the key informants and discussants only expressed their views on the extent to which they suffered post-harvest losses of oranges as there was no quantifiable unit of measurement on the extent of these losses. That is, the number of orange losses was not counted to ascertain to actual quantity of losses as they were littered and abandoned by buyers around the orchards and collection spots. Thus, they assessed their losses in the following words: *alum wam ka a saa ishe kpishi*, *alum saam ishe gbing hen nyom ne*, *alum wam ka a saa ishe dedoo*, *alum wam ka a saa ishe tsembelee*, and *alum u m dzÔr hen shie ne cii saa ishe*. These expressions by the informants and discussants on the extent of post-harvest losses of orange are translated to mean: "my oranges waste a lot", "my oranges wasted much this year", "my oranges are lost to a very high extent", "my oranges waste very well", and "all the oranges I harvested this period wasted". This simply indicates that there is high level of post-harvest losses of oranges in the study area.

Findings revealed that the extent to which post-harvest losses of orange occur in North-Eastern Zone of Benue State was high (21-30%). This can be further expressed that, of the 100% of oranges harvested in a season, 75.2% were sold,

while 24.8% were lost. The rate of post-harvest losses of oranges in the zone is also within Kader (2002) estimation that post-harvest losses in fresh fruits especially oranges are between 20-50% in developing countries. In Philippines, Muyengi *et al.* (2014) gave the range of post-harvest losses from 15-35 per cent. Asati (2015), who classified India as one of the developing countries, states that post-harvest losses of oranges are in the range of 25-30% as against 5-10% in developed orange growing countries like Brazil, USA, Australia, Spain, Italy and Israel. From these empirical evidences, a wide disparity in post-harvest losses of oranges is noticed to occur between developed and developing countries. It is therefore observed that post-harvest losses of oranges are high in developing countries and low in developed countries.

### Extent of Post-harvest Losses of Orange along Different Stages

**Table 6: Extent of post-harvest losses of oranges along different stages**

Extent of PHLs	Stages				
	Plucking	Packing	Sorting	Bagging	Transportation
1-5%	35 (11.3)	169 (54.5)	84 (27)	66 (21.3)	185(59.7)
6-10%	60 (19.4)	61 (19.7)	74 (24)	55 (17.7)	39 (12.6)
11-20%	66 (21.3)	36 (11.6)	41 (13)	56 (18.1)	51 (16.5)
21-30%	64 (20.6)	25 (8.1)	58 (19)	31 (10.0)	11 (3.5)
31% and above	85 (27.4)	19 (6.1)	53 (17)	102 (32.9)	24 (7.7)
<b>Total</b>	<b>310 (100)</b>	<b>310 (100)</b>	<b>310 (100)</b>	<b>310 (100)</b>	<b>310 (100)</b>

**Source:** Field Survey, 2018.

Table 6 above presented data on the extent to which post-harvest losses of oranges occur along different stages according to the respondents. The data indicates that,

majority, 27.4% (85) of the respondents lost a ratio of 31 per cent and above of their oranges while harvesting or plucking the fruits, 21.3% (66) of the respondents lost 11-20 per cent of their oranges, 20.6% (64) of the respondents lost a proportion of 21-30 per cent of their fruits, a fraction of 6-10 per cent of the oranges were lost by 19.4% (60) of the respondents, while 11.3% (35) of the respondents lost only 1-5 per cent of the oranges. This implies that very high post-harvest losses of oranges are recorded by the respondents during plucking or harvesting. The nature of losses during this stage is mainly due to bruises, injuries, pest and insect infestations, over ripen, cut, immature, decomposing, physical damage, soften, scratches and puncturing of the orange fruits. And these losses are caused by lack of expertise harvesting skills that result to the fruits falling from a distance to bare ground, open piling, fungal attack, cracked and spoiled fruits.

According to a 68 year old Male Retired Civil Servant from Mbanor Council Ward, Konshisha LGA:

...I experienced losses in each of the stages while harvesting my oranges. But these losses mostly come while plucking the oranges due to the recklessness of the youth who are engaged to pluck these oranges. When it is the season for orange, they will be rushing to complete their job and engage with as much farmers as they can so as to make more money. This therefore leads to more waste especially the method of shaking the branches where oranges are falling from a distance and some of them because they are fully ripped

cannot withstand the pressure so they break easily.... (Source: KII, 4<sup>th</sup> June, 2018)

With regards to the level of post-harvest losses of oranges during packing, a significant number, 54.5% (169) of the respondents lost a ratio of 1-5 per cent, 19.7% (61) of the respondents lost about 6-10 per cent of their oranges, 11.6% (36) of the respondents lost a proportion of 11-20 per cent of their fruits, a fraction of 21-30 per cent of the oranges were lost by 8.1% (25) of the respondents, while 6.1% (19) of the respondents lost 31 per cent of their oranges and above. This indicates that post-harvest losses of oranges were very low at the packing stage. This stage involves conveying oranges using different kinds of materials such as nylon sacks, wheelbarrows, bowls, containers, buckets, etc from the orchards to collection spots where the fruits are properly sorted and bagged. The nature of injuries at this stage is blamed on the quality of these materials as they compress and scratch the oranges in the course of packing them to collection spots and these injuries allow post-harvest decay organisms gain easy entry. Most of these materials are substandard and therefore contributes to post-harvest losses.

A 61 year old Male Artisan from Mbagba Council Ward, Ushongo LGA in an interview responded:

...oranges are lost mostly during plucking and packing, though there might be losses in other stages too. During plucking, the way the oranges hit the ground causes a lot of damage particularly when the surface is dry and hard. And even when the ground is too wet, the oranges are likely to be infected by bacteria. During packing too, some

damages are noticed on the heaps because it is usually children who are involved in packing the oranges and most times are properly monitored. They packed these oranges from the farms to a point where they will be sorted and bagged and at times released them from the head to a distance ground and this causes a lot of damage.... (Source: KII, 4<sup>th</sup> June, 2018)

Data from the above table showed that, 27% (84) of the respondents lost a ratio of 1-5 per cent of oranges during sorting, 24% (74) of the respondents lost between 6-10 per cent of their oranges, 19% (58) of the respondents lost a proportion of 21-30 per cent of their fruits, a fraction of 31 per cent of oranges and above were lost by 17% (53) of the respondents, while 13% (41) of the respondents lost about 11-20 per cent of oranges. This entails that post-harvest losses of orange during sorting was also very low. Sorting is mainly done to expunge the bad orange fruits from the good ones. The type of losses recorded in this stage was as a result of grading the sizes of oranges. The most preferred orange fruit size by the buyers is the medium size. The choice of this fruit size is based on market acceptability and profit maximisation. For instance, if the sizes of the fruits are smaller for a line of production, it will be difficult for most of the oranges to follow successfully through the entire process and then be crushed into concentrate or juice and also customers who buy to consume in fresh form can find it hard to peel-off the covers. On the other hand, if the fruits are oversized, the buyers feel cheated as the bags easily filled-up. At this stage too, the immature oranges are screened out because of high level of acidity. Even though, most of the damages found on

the fruits are caused by other stages, they are easily noticed and separated during sorting.

Orange losses during bagging were also noticed. The respondents indicated that a good proportion, 32.9% (102) of the respondents lost a ratio of 31 per cent of oranges and above, 21.3% (66) of the respondents lost between 1-5 per cent of their oranges, 18.1% (56) of the respondents lost a quantity of 11-20 per cent, 17.7% (55) of the respondents recorded a ratio of 6-10 per cent loss of the their fruits, while a fraction of 21-30 per cent of the oranges were lost by 10.0% (31) of the respondents. The above result shows that post-harvest losses of oranges were found to be very high during bagging. This is an indication that losses at this stage were not properly sorted; therefore, they were carefully identified and thrown away before they were put into bags and sealed or loaded without bagging for transportation. The nature of losses at this stage can be due to over-ripen, insect infestation and decomposition as a result of direct contact with sunlight and rainfall especially if they are already sorted without bagging for a couple of days.

Responses from the above table showed that a significant fraction, 59.7% (185) of the respondents lost a ratio of 1-5 per cent of their oranges during transportation, 16.5% (51) of the respondents lost 11-20 per cent of their oranges, 12.6% (39) of the respondents lost a proportion of 6-10 per cent of their fruits, a fraction of 31 per cent of oranges and above were lost by 7.7% (24) of the respondents, while 3.5% (11) of the respondents lost between 21-30 per cent of their fruits. The above result shows that post-harvest losses during transportation were very low. This is because most of the

farmers do not make direct sales to the consumers and as such cannot estimate the level of losses during this stage except for those who sell their orange fruits directly to wholesalers in distant markets and not middlemen. The kind of losses experienced during transportation are over-ripen, bruises or cuts, which results to rotten fruits. The principal cause of these losses is due to the nature of vehicle transporting the fruits; especially if they are open trucks that exposed the fruits to direct contact with the sun. The dilapidated state of roads also calls for concern as most roads cause bruises, scratches or cuts, which lead to decomposing of fruits particularly in the study area where the routes to major orange producing areas are poor.

A 45 year old Male Businessman from Kundav Council Ward, Ukum LGA in an interview noted:

...oranges are loss in all the stages, but I noticed major losses during bagging and transportation. At the point of putting them in bags, most of the oranges are rejected because they have bruises, scratches, cuts, fungi infections, and immature ones. There are major losses during transportation too. Let me share my experience with you. I pluck my oranges and boat a truck to Kano to sell, before we could reach to Lafia, there was a major mechanical fault in the engine and the truck stayed on the road for two good days before it was fixed. The journey itself took like a day and half. On arrival, we still have to wait and make consultations before selling. So it took a whole lot of time to sell these oranges and at the end of the day a greater part of them got damaged. I didn't make any profit

out of these sales rather ended up suffering. Since them I have not imagined myself going to Kano again to sell oranges. I sell as little as I can at Zaki-Biam where I am also having a yam shield...  
(Source: KII, 10<sup>th</sup> March, 2018)

Discussions with focus group members conducted throughout the sampled areas proved to be consistent with views from the respondents and the key informants. It was gathered among group members that post-harvest losses of oranges were mostly found during plucking, sorting and bagging. Losses during these stages were believed to occur due to human errors and most importantly unavailability of buyers. The fact remains that post-harvest losses of oranges occur at all stages, however, some of the stages are noticed to record more losses than others due to increasing number of activities found at these stages.

Study findings revealed that post-harvest losses of oranges occurred along different stages but bagging and plucking (32.9% and 27.4%) emerged as the predominant stages where these losses occurred most. A ratio of 31 per cent and above of orange losses were noticed while harvesting or plucking the fruits. These losses were caused by improper handling, which most times results into bruises, cuts, physical damage, scratches and puncturing of the fruits. During packing and sorting, 1-5 per cent of post-harvest losses of orange occurred. Losses recorded at sorting were as a result of grading the sizes of oranges, and also screening out the immature ones which have much level of acidic content and those without fluid. Orange losses during bagging were also noticed as a ratio of 31 per cent of oranges and above were

identified. Losses noticed at this stage were oranges not properly sorted, therefore, they were carefully identified and expunged before they were put in the bags and sealed for transportation. The nature of losses at this stage was due to over-ripen, insect infestation and immature fruits. It was also revealed that respondents lost a ratio of 1-5 per cent of their oranges during transportation mainly due to over-ripen, bruises or cuts, which results to fruits rotten. The principal cause of these losses was due to the nature of vehicle transporting the fruits; especially if they are open trucks that exposed the fruits to direct contact with the sun. The dilapidated state of the roads also calls for concern as most roads cause bruises, scratches or cuts, which lead to decomposing of fruits particularly in Benue State where the routes to major orange producing areas are poor.

The above findings agree with the observations by the Department of Horticulture, Assam Agriculture University, Jorhat in April, 2005 on post-harvest practices and loss assessment of some commercial horticultural crops of Assam, the North-Eastern Region of India. The study revealed that, due to absence of proper post-harvest management system, a bulk quantity of oranges were damaged during the process of harvesting, grading, transportation, marketing or storage or wholesale, and retailer with their corresponding levels of losses as: 3.25, 0.75, 1.25, 1.20 and 7.50 respectively amounting to a total loss of 13.95%. Similarly, Hossain *et al.* (2017) studied post-harvest losses of different fruits at different operational stages at farm level in hilly areas of Bangladesh and found out that a major portion of losses occurred during harvesting and also due to spoilage especially during rainy season. The authors by this ratio meant that one-

quarter of what is produced never reaches the consumer for whom it was grown. Fruits are much less hardy and are mostly quickly perishable, and if care is not taken in their harvesting, handling and transport, they will soon decay and become unfit for human consumption.

### Ways of Reducing Post-harvest Losses of Orange in North-Eastern Zone of Benue State

**Table 7: Suggested ways of reducing post-harvest losses of orange by the respondents**

<b>Ways</b>	<b>Frequency</b>	<b>Percentage</b>
Establishment of orange factories	111	35.8
Giving of grants and loans to farmers	45	14.5
Creation of access roads and rehabilitation of dilapidated ones	60	19.4
Subsidisation of pesticides, insecticides and fertilizers to farmers	41	13.2
Farmers' education on global best practices	17	5.5
Constitution of price control groups	12	3.9
Farmers registration with recognisable associations	6	1.9
Reduction in tax rates	18	5.8
<b>Total</b>	<b>310</b>	<b>100</b>

**Source:** Field Survey, 2018.

Data collected on ways of reducing post-harvest losses of orange was presented in Table 7 above. The results suggested that the establishment of orange processing factories in the agricultural zone or state would possibly reduce post-harvest losses of orange as noted by 35.8% (111) of the respondents. Creation of access roads and rehabilitation of damaged ones was also indicated by 19.4% (60) of the respondents as an

alternative to reducing post-harvest losses of orange. 14.5% (45) of the respondents suggested that if grants and loans were accessible to farmers, post-harvest losses of orange would be reduced. Subsidisation of pesticides, insecticides and fertilizers was another measure to reducing post-harvest losses of orange as noted by 13.2% (41) of the respondents. Also, 5.8% (18) of the respondents were of the thought that the number of taxes in the state should be reduced as an alternative to encourage buyers outside the state to patronise the indigenous farmers. This would seriously reduce the amount of wastages that have been experienced over the years.

Educating farmers on improved method of orange farming was mentioned by 5.5% (17) of the respondents as also one of the ways through which post-harvest losses of orange can be reduced in the area. Another measure as advocated by 3.9% (12) of the respondents was constitution of price control groups. There should be price control groups that would determine orange prices for middlemen (agents) or buyers as this would help farmers achieved some level of fulfillment in orange farming. While, 1.9% (6) of the respondents held that farmers should join recognisable associations to be able to obtain loans and other benefits in order to improve on their plantations. The implication of these data is that the establishment of orange processing facilities, creating access points and giving grants and loans to farmers among other benefits would re-awaken farmers who along the process were discouraged to invest more in orange and also reduced their poverty level as it is the sole aim for this farming.

During key informant interviews, some of the informants argued that if farmers were provided the necessary logistics, post-harvest losses of orange would be greatly reduced. They therefore suggested that if orange factories were established, orange would be a scarce commodity in the agricultural zone and state generally. There will be serious competition between the factory owners and marketers as demand for the fruit will exceed supply.

A 45 year old Male Businessman from Kundav, Ukum LGA noted:

...orange is a perishable fruit that need close attention. I'm of the opinion that orange processing industries should be established especially in Zone A where these fruits are mostly produced so that the losses can be reduced....  
(Source: KII, 10<sup>th</sup> March, 2018)

A 55 year old Female Widow from Ishangev-ya, Mbape, Mbaketsa Council Ward, Kwande LGA also responded:

...we need orange industries in the state so that marketers can be encouraged to buy from us farmers and by so doing, the losses can be reduced.... (Source: KII, 2<sup>nd</sup> January, 2018)

Another area of emphasis was the system of taxes in the state, which scared most buyers. The informants re-emphasised that the tax system be revised to create the enabling environment for buyers and other investors in Benue State. Some of the key informants observed with dismay that this same challenge of taxes in the state led to the closure of Teragro Commodities Ltd, who were producing orange, mango

and pineapple concentrates for export to multinational companies like as Coca cola, Chivita, etc.

According to a 47 year old Female Lecturer from Tiir Council Ward, Katsina-Ala LGA:

...if the problems of lack of buyers and poor prices of orange due to levies at different check points of BIRS, the police, and at times hoodlums are looked into, we orange farmers will have a lot...  
(Source: KII, 17<sup>th</sup> February, 2018)

Key informant interviews were also highlighted on creation of access roads and rehabilitation of the damaged ones so that the roads will be motorable at the farms. Key informants noted that insecticides and fertilizers were germane to reducing post-harvest losses and increase yields of the fruits. They however suggested that fertilizers and insecticides be given at subsidised rates to encourage farmers. Most of the key informants interviewed also opined that if farmers were given grants or loans to be redeemed at flexible installments, this would help reduced post-harvest losses and further encouraged them. Educating farmers especially the illiterate ones on improved methods of handling oranges particularly during harvest was also stressed. The key informants held that the conventional methods of harvesting orange fruits have done more harm than good, therefore improved methods as practiced by world leading producers where post-harvest losses are at minimal level be introduced to farmers to avoid losses of oranges.

According to a 43 year old Police Officer from Mbakuha Council Ward, Ushongo LGA:

...farmers really need to be educated on how the orange business works because I'm aware that

most farmers who have been in orange farming for quite some time now have never fertilised their oranges and even spray chemicals. So their orange doesn't yield fruits as expected and there are a lot of losses due to lack of knowledge. Even the few ones with the requisite knowledge do not have the resources, so loans should be given to farmers to improve on their farms... (Source: KII, 24<sup>th</sup> March, 2018)

The discussants across focus group sessions pointed out that orange farming was a lucrative business therefore, the federal and state governments should recognised the plight of farmers and provide them with the needed supports to fast-track the business in order to reduced post-harvest losses. Among the measures discussed during group sessions were provision of loans, fertilizers and insecticides, construction of more access roads and repair of the dilapidated ones, establishment of orange processing industries, farmers' education, and research findings should be directed to the government to respond swiftly to their predicaments.

### **Test of Hypothesis**

**Hypothesis One:** There is no significant difference between quantity of oranges harvested and quantity sold by farmers in North-Eastern Zone of Benue State.

**Table 8: ANOVA Results for Difference between Quantity of Oranges Harvested and Quantity Sold by Farmers**

<b>Source of Variation</b>	<b>Sum of Squares</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>P-value</b>
Between Groups	293.796	4	73.449	268.003	.000
Within Groups	83.588	305	.274		
<b>Total</b>	<b>377.384</b>	<b>309</b>			

The above hypothesis stated that, there is no significant difference between quantity of oranges harvested and quantity sold by farmers in North-Eastern Zone of Benue State. From the ANOVA results presented in Table 8 above, the P-value of the F Statistics is less than 0.05, thus, we reject the null hypothesis and conclude that, there is significant difference between quantity of oranges harvested and quantity sold by farmers in North-Eastern Zone of Benue State.

### **CONCLUSION**

From the above results and discussion, the study concludes that orange plantations in North-Eastern Zone of Benue State were mostly within one hectare and less than a hectare due to the nature of settlement pattern (dispersed) practiced by the people. The predominant varieties of oranges grown were Valencia and Ibadan Sweet which were specifically harvested from October-February and May-July, and June-November and January-April respectively but because of low patronage from the buyers, the oranges were harvested throughout the year. It was also established that an average of 22,164.6bags of oranges was harvested out of which 16,672.3bags were sold while 5,492.3bags were lost.

The study also concludes that the extent to which post-harvest losses of orange occurred in the area were as high as 21-30 per cent. These losses were noticed to occur in all the post-harvest stages of orange. However, plucking and bagging were the main stages of post-harvest losses of orange. The occurrences of post-harvest losses of orange along these stages were observed to be very frequent, hence the need for proactive measures to eliminate post-harvest losses of orange in the area.

## **RECOMMENDATIONS**

1. Awareness and sensitisation on post-harvest losses of orange ought to be created among farmers as most of them are not aware of best farming practices. For instance, losses from microbial infections were caused by lack of knowledge of the application of insecticides while those incurred during plucking were as a result of lack of expertise to harvest these fruits. Agricultural extension workers have a primary role to play in this wise. They should carry out sensitisation and awareness campaigns on pre and post-harvest practices.
2. There should be change in settlement pattern among the people of the study area and Tiv race generally. The scattered settlement pattern practiced by the Tiv people over time has serious impediments on orange plantations and other areas of development. The Tiv Traditional Council should therefore formulate a law that would change the settlement pattern to clustered, which studies have proved to more beneficial to the people.
3. High post-harvest losses of orange was recorded during plucking, therefore, farmers before harvesting the fruits should endeavour to spread cushions around the tree

canopies as this will reduce the level of damages. They should also ensure that the oranges are harvested at the appropriate time of the day, possibly when the grounds are dry. The orange fruits should equally not be exposed under sun to avoid scorches.

4. Since oranges produced in the study area are lost in large quantity, there is need for the government (Federal, State and Local), abled-individuals and organisations to establish orange processing factory in the state particularly the affected area. As this will to a large extent reduce post-harvest losses of oranges and further encouraged farmers to invest more in this agribusiness.
5. Evaporative cooling system. This is another alternative to reduce post-harvest losses of orange in the absence of processing machines. It is an approach that reduced the temperature and increase relative humidity in an enclosure and this effect has been extensively tried for increasing shelf life of horticultural produce.

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