JOURNAL OF AGRICULTURAL ECONOMICS, EXTENSION & SCIENCE ISSN (Print) 2545-5179, ISSN (Online) 2714-5018
Official Journal of the College of Agricultural Economics, Extension & Science JAEES Vol. 7 No. 2 2021, Pages 191 - 201
www.jaees.org

ASSESSMENT OF POSTHARVEST MANAGEMENT PRACTICES OF VEGETABLE CROPS AMONG RURAL FARMERS IN ZONE B LOCAL GOVERNMENT AREAS OF BENUE STATE, NIGERIA

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Abstract
The study assessed the postharvest management practices of vegetable crops among rural farmers in Zone 'B' agricultural zone of Benue State, Nigeria. Using multistage purposive and random sampling techniques, 120 respondents were selected from three local government areas in the zone. Data were obtained using structured questionnaire and interview schedule and were analyzed using descriptive and inferential statistics such as frequencies percentage mean scores factor analysis and Kruskal-Wallis (H) test. The result on the level of utilization of endogenous and exogenous postharvest management practices showed grand mean scores of 2.45 and 1.29 respectively which indicates low level utilization of the practices. The grand mean score (x = 2.60) on the level of effectiveness of endogenous postharvest management practices showed high level of effectiveness of the practices. The result of Kruskal-wallis test of significance on the utilization of endogenous postharvest practices showed significant difference on precooling after harvesting (p=0.000), sorting (p=0.000), washing and cleaning (p=0.000) as well as packaging (0.000) at 5% degree of probability. It was recommended that horticulture-allied industries should be established in the study area by government, private organizations and individuals in order to mop up the harvested crop produce from the vegetable farmers and encourage production and marketing.

Keywords: Postharvest, vegetable, crop, management, produce, practice

Introduction
Nigeria has a diverse climate ranging from the tropical areas of the coast to the arid zone of the north which makes it possible to produce virtually all agricultural products that can be grown in the tropical and semi-tropical areas of the World (Olayemi, *et al*. 2011). The country is one of the leading producer of vegetables (Charles, 2009). Vegetables are edible

plant parts which include stems, stalks, roots, tubers, bulb, leaves, flowers and fruits, generally consumed raw or cooked with main dish. Examples of vegetables include onion, tomato, okra, pepper, amaranthus, carrot, and melon, among others (Ibeawuchi, *et al*. 2015). Vegetable crops add variety toenjoyment and a sense of satisfaction to the diet because of their appealing colours, flavour and texture (Atanda, 2011, Ahmed, 2013). They also form a substantial percentage of the major food crops cultivated in the tropics and a source of livelihood for a considerable section of the population. Production of fruits and vegetables for marketing and consumption also has comparative advantage to generate income as compared to cereals, as they require shorter time for production, yield more and has more market outlets (Rahiel, *et al.* 2018).

The production of fresh fruits and vegetables has its own complexity. Their perishability and Hugeness makes them difficult to manage easily during postharvest period unlike that of dry grains. As a result of the perishable nature of the produce and lack of knowledge as well as shortage of capital, horticulture industry in sub-Saharan Africa in general is still at its infant stage (Gebru and Belew, 2015).

Post-harvest losses can be caused by a wide variety of factors, ranging from harvesting conditions, handling to retail level. Hence, the elimination of post-harvest losses of agricultural products is important to boost food security in the countries (Gebru and Belew, 2015). Olayemi*et al*. (2012) also estimated that as much as 25% and 40% fruits and vegetables, respectively are lost after harvest in Nigeria due to poor postharvest handling measures.

In underdeveloped and developed tropical countries, both quantitative and qualitative losses of agricultural products occur at all stages in the postharvest chain, from harvesting, through handling, storage, processing, packaging, transportation and marketing until crops are delivered to the final consumers (Gebru and Below, 2015). In developed countries however, losses are generally small during processing, storage and handling because of the efficiency of equipment, good quality storage facilities and close control of critical variables by a highly knowledgeable cadre of managers. In contrast, in developing countries losses due to processing, storage and handling tend to be rather high because of poor facilities and frequently inadequate knowledge of methods to care for the vegetables properly (Kitinoja and Adel, 2015). Postharvest management is about maintaining quality from production in the paddock to the vegetables being placed on a plate for consumption. Maintaining vegetable quality requires good systems. According to Javed (2013), maintaining vegetable quality requires better postharvest practices and good

communication throughout the supply chain as each step is influenced by the previous. Post-harvest management will reduce post-harvest losses thus, generate income, improve product quality and safety, and contribute to food and nutritional security (Chukwunta, 2014 and Gustavsson*et al*. (2011).

This research set out to answer the following research questions:

i. What is the level of utilization of the indigenous management practices of vegetable crops in the study area?
ii. What is the level of adoption of the exogenous management practices of vegetable crops? and
iii. What is the level of effectiveness of indigenous management practices of vegetable crops in the study area?

The broad objective of the study is to assess the postharvest management practices of vegetable crops among rural farmers in Zone 'B' Agricultural Zone of Benue State. The specific objectives were to:

i. assess the level of utilization of the indigenous management practices of vegetable crops study area;
ii. determinethe level of adoption of the exogenous management practices of vegetable crops; and
iii. ascertain the level of effectiveness of indigenous management practices of vegetable crops.

The following hypotheses were stated and tested;

H_{01}: There is no significant difference on the level of utilization of indigenous management practices among farmers in the three local government areas.

HO_2: There is no significant difference on the level of utilization of exogenous management practices among farmers in the three local government areas.

Methodology

The study was carried out in Benue State, Nigeria. Benue State was created on the 23rd of February, 1976 from the former Benue-Plateau State. The state is located in the middle belt region of Nigeria, which is the transition zone from the Northern and Southern ecologies, between longitude 6° 31' E and 10° E and between latitudes 6°30'N and 8°10'N (BNARDA, 2005). The state shares boundaries with five states; Nasarawa to the North, Taraba to the East, Cross River to the South East, Enugu to the South-West and Kogi to the West. The

southern part of the state is also bounded by the Republic of Cameroun.Benue State has a land mass of about 33,955 Km^2 with 23 Local Government Areas. The state is geographically and agricultural divided into three zones, zone A, zone B and zone C (BNARDA,2005). The state has a projected total population of 6,010,5632 people at 3 % growth rate year on year. The major occupation of the people of the state is farming which gives the state the recognition as the "Food Basket of the Nation".

The state has favourable agro-climate ecologies for arable crops, tree crops and livestock production and enjoys two distinct seasons; rainy season, beginning from April to October, and the dry season, from November to March. Annual rainfall records vary from 1,700 mm in the southern part to 1,250 mm in the northern ecology with annual temperature variations of 30 ^{o}C and 38 ^{o}C (BNARDA, 2005).

ThePopulation of the study consisted of all the vegetable farmers in Makurdi, Gboko and Tarka Local Government Areas of Benue State. A sample size of 120 respondents was selected using multistage, purposive and simple random sampling techniques. Data for this study were analyzed using both descriptive and inferential statistics. Data for this study were collected mainly from primary sources using a well-structured questionnaire. The objectives were achieved using descriptive statistics such as frequency, percentage and mean score while hypotheses 1(Ho_1) and 2 ($Ho_{2)}$was tested using Kruskal-Wallis (H) test.

Results and Discussion

Level of Utilization of the Indigenous Management Practices of Vegetable Crop Produce.

Table 1 shows the mean scores on the utilization of indigenous postharvest management practices of vegetable crops. The result showed that the overall utilization of endogenous postharvest management practices in the area, on a 4-point rating scale was low with a grand mean (x = 2.4) lower than the decision mean cut-off (x = 2.55). The result showed low utilization on grading (x = 2.38), packaging (x = 1.65), storage (x = 1.44) and processing (x = 1.89). High level of utilization was however recorded in time of harvesting (x = 3.01), precooling after harvesting (x = 2.70), sorting (x = 3.22), washing and cleaning (x = 3.17), and time of transportation (x = 2.6). The standard deviation on thelevel of utilization of the indigenous management practices of vegetable crop produce shows that one of the variables had a standard deviation of greater than 1. This indicates that there is no uniformity in the responses of the respondents as regards their level of utilization of

indigenous management practices of vegetable crop produce in the area.

The overall low utilization of the endogenous postharvest management practices could be due to resultant failure of the practices in preserving the shelf life of vegetable crop produce. This finding is contrary to those of Saran, et al (2011) who reported that the adoption and use of postharvest practices locally available and low-cost materials in developing countries like Nigeria was important in saving the values perishable in them till consumption.

Table 1: Distribution of respondents according to level of utilization of indigenous postharvest management practices (n=120)

Practice	Mean score	Standard deviation
Time of harvesting	3.01	0.63
Precooling	2.70	1.03
Sorting	3.22	0.65
Grading	2.38	0.62
Washing and cleaning	3.17	0.86
Packaging	1.65	0.90
Storage	1.44	0.68
Processing	1.89	0.64
Time of transporting	2.59	0,59
Grand mean		2.45

Source: Field survey, 2019

Level of Adoption of Exogenous Postharvest Management Practices of Vegetable Crop Produce

Results on the level of adoption of exogenous postharvest management practices of vegetable crops showed that the overall adoptionof exogenous postharvest management practices of vegetable crop produce was low (x = 1.29). The result specifically showed low

level of adoption on modified atmosphere packaging (x=1.32), storage using refrigerator, oven (x =1.30), processing/preservation using calcium chloride, 1- methylchlopropene and post heat treatment (x =1.28), transportation using refrigerator truck (x = 1.25). The standard deviation on the level of adoption of the exogenous management practices were all less than 1. This indicates uniformity in responses of the respondents that the level of adoption of the exogenous management practices by vegetable farmers in the area is low.
The low level of adoption of the exogenous management practices may be due to high cost of the technologies, lack of infrastructure, lack of knowledge, lack of awareness, irregular power supply, among others. This finding agrees with those of Armachius and Zakankuba (2017) who reported that most postharvest technologies that are necessary approach to reduce fruits and vegetable losses, build a sustainable food and nutrition security and alleviate poverty are still unpopular is sub-Saharan Africa (SSA).

Table 2: Distribution of respondent according to the level of adoption of exogenous postharvest management practices (n=120)

Practice	Mean	Standard. Deviation
Packaging (use of modified atmosphere packaging)	1.32	0.608
Storage (refrigerator, oven)	1.30	0.603
Processing/preservation (use of calcium chloride, 1-methylchlopropene and post heat treatment)	1.28	0.582
Transportation (refrigerator trucks)	1.25	0.612
Grand mean		1.29

Source: Field survey, 2019

Level of Effectiveness of Indigenous Management Practices of Vegetable Crop Produce

Table 3 shows the result on the level of effectiveness of indigenous management practices in preserving the shelf life of vegetable crops produce. The overall result revealed high effectiveness with a grand mean (x=2.60), higher than the decision mean cut-off (x=2.55).
The result showed high level time of harvesting (x=3.22), precooling after harvesting

(x=2.97), sorting (x=3.08), washing and cleaning (x=3.04) and time of transportation (x=2.82). The result however revealed low effectiveness on grading (x=2.48), packaging (x=2.04), storage (x=1.82), and processing (x=1.95). All the variables had a standard deviation of less than 1. This indicates that there is uniformity in the responses of the respondents as regards the level of effectiveness of indigenous management practices.The effectiveness of some of the indigenous practices could be due to low level technology required, skills and less cost involved in their utilization and their ability to preserve the shelf life of the vegetable for some time. This findings disagrees with those of Hurst (2010) who discovered that most of the package materials do not provide protection needed by the commodity due to their locally made which some of them like woven basket have rough surfaces and edge causing mechanical injuries to the produce, nylon sack do not allow good aeration within the package commodity causing build-up of heat due to respiration, then wooden crate due to its height creates a compressive force on fruit located at the base of the crate.

Table3: Level of Effectiveness of Endogenous Postharvest Management Practices of Vegetable Crop Produce (n=120)

Practice	Mean	Std. Dev
Time of harvesting	3.22	0.510
Precooling	2.97	0.704
Sorting	3.08	0.668
Grading	2.48	0.722
Washing and cleaning	3.04	0.834
Packaging	2.04	0.864
Storage	1.82	0.806
Processing	1.95	0.834
Time of transporting	2.82	0.756
Grand mean		2.60

Source: Field survey, 2019

Test of Significance of the Utilization of Indigenous Postharvest Management Practices

The result of Kruskal-Wallis (H) test of significance in the utilization of indigenous postharvest management practices among vegetable crop farmers in the area is presented in Table 4. The result showed thatthere was significant difference on the utilization of precooling after harvesting (p=0.000), sorting (p=0.000), washing and cleaning (p=0.000) as well as packaging (p=0.000). The significant difference in the practices could be due to differences in the level of awareness,accessibility of information sources on the practices as well as difficulties in accessing the practices. The null hypothesis which states that there is no significant difference in the level of utilization of indigenous management of practicesin the study area was rejected.

Table 4: Results of Kruskal-Wallis (H) test of significance in the utilization of indigenous postharvest management practices among vegetable crop farmers in the three local government areas. (n=120)

Practice	LGA	Obs	Ave. Rank	H	DF	Probability.
Time of harvesting	Mkd	40	66.2			
	Gboko	40	54.3	2.46	2	**0.177**
	Tarka	40	61.0			
Precooling after harvesting	Mkd	40	57.4			
	Gboko	40	89.5	55.16	2	**0.000*****
	Tarka	40	34.7			
Sorting	Mkd	40	52.5			
	Gboko	40	86.1	43.29	2	**0.000*****
	Tarka	40	42.9			
Grading	Mkd	40	61.6			
	Gboko	40	66.1	3.36	2	**0.186**
	Tarka	40	53.8			
Washing and cleaning	Mkd	40	71.8			
	Gboko	40	83.9	71.36	2	**0.000*****
	Tarka	40	25.8			
Packaging	Mkd	40	44.0			
	Gboko	40	50.5	46.52	2	**0.000*****
	Tarka	40	87.0			
Storage	Mkd	40	59.9			
	Gboko	40	57.4	1.12	2	**0.572**
	Tarka	40	64.2			
Processing	Mkd	40	54.0			
	Gboko	40	71.3	8.65	2	**0.013****
	Tarka	40	55.0			
Time of transporting	Mkd	40	61.6			
	Gboko	40	58.2	0.34	2	**0.845**
	Tarka	40	61.8			

Source: Field survey, 2019

Test of Significance in the Utilization of Exogenous Postharvest Management Practices

The result of Kruskal-Wallis (H) test of significance on the utilization of exogenous postharvest management practices among vegetable crop farmers among the three local government areas is presented in Table 5. The result showedthat there was no significant difference in the utilization of exogenous postharvest management practices. This implies that farmers do not differ on their utilization of exogenous management practices which may be due to similarities in terms of availability and affordability of these management practices. The null hypothesis which states that there is no significant difference in the level of utilization of exogenous management of practicesin the study area is therefore accepted.

Table 5: Result of Kruskal-Wallis (H) test of significance in the utilization of exogenous postharvest management practices among vegetable crop farmers among the three local government areas (n=120)

Practice	LGA	Obs	Ave. Rank	H	DF	Probability.
Packaging (use of modified atmosphere packaging)	Mkd	40	54.3			
	Gboko	40	67.8	5.33	2	0.069
	Tarka	40	59.4			
Storage (refrigerator, oven)	Mkd	40	53.9			
	Gboko	40	65.9	4.49	2	**4.49**
	Tarka	40	61.7			
Processing/preservation (use of calcium chloride, 1-methylchlopropene and post heat treatment)	Mkd	40	58.7			
	Gboko	40	61'9	0.33	2	0.849
	Tarka	40	60.9			
Transportation (refrigerator trucks)	Mkd	40	57.3			
	Gboko	40	64.6	2.11	2	0.348
	Tarka	40	59.6			

Source: Field survey, 2019

Conclusion and Recommendations

The study revealed that there was low level utilization of both endogenous and exogenous postharvest management practices by vegetable crop farmers in the area. The result also revealed that endogenous postharvest management practices like time of harvesting, precooling after harvesting, sorting, washing and cleaning, as well as time of transportation was effective in preserving the shelf life of vegetable crop produce in the area. The study

also established that there was a significant difference in the utilization of endogenous postharvest management practice like precooling after harvesting, sorting, washing and cleaning, as well as packaging. It however established that there was no significant difference in the utilization of exogenous postharvest management practices in the area.The research further revealed that there was significant difference in effectiveness of indigenous postharvest practices such as time of harvesting, precooling, harvesting, grading, washing and cleaning, as well as packaging storage and processing.

It is recommended that farmers should be encouraged to utilize indigenous postharvest management practices since they are cheaper and does not require much skills and finance for their usage, they should be trained on the use of exogenous postharvest management practices as well as ensuring the development of their skills in handling management facilities.In addition, government should create an enabling environment to encourage the production and marketing of vegetable crop produce by providing the needed facilities that are identified as constraints to effective management of postharvest losses such as electricity, storage facilities, markets, improved transportation system as well as good packaging facilities.

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