ASSESSMENT OF POSTHARVEST MANAGEMENT TECHNOLOGIES OF SELECTED HORTICULTURAL CROPS AMONG RURAL FARMERS IN KOGI STATE, NIGERIA.

Adole, P., Peter I.N and Muhammad M.U
Department of Agricultural Economics and Extension, National Open University of Nigeria.
Corresponding Author E-mail: padole@noun.edu.ng,odohpriscilla@gmail.com 07061202664

ABSTRACT
The study assesses postharvest management technologies of selected horticultural crops (fruits and vegetables) among rural farmers in kogi state, Nigeria. A sample size of 205 respondents was selected using stratified and simple random sampling technique. A well-structured questionnaire was used for data collection. Data collected were analysed using both descriptive and inferential statistics. The results revealed that six (6) traditional method of postharvest management technologies were mostly practiced (use of hot water for washing and cleaning (x=3.14), use of hand for sorting and grading (x = 2.99), use of head and truck for transportation of produce (x = 2.83), use of woven basket for packaging (x = 2.76) and hand picking for harvesting (x = 2.72). Evidence from the study also shows that the use of modern postharvest management technologies by horticultural farmers was generally low. Result equally revealed that there were three major challenges faced by horticultural farmers in reducing post-harvest losses of their produce namely: socio-economic challenges (Factor 1), environmental challenges (Factor 2) and infrastructural challenges (Factor 3). Kruskal Wallis (H) test shows that R1=100.4, R2=100.9, R3=99.9. With Px = 0.995 indicating that, there is no significant difference among farmers in the three agricultural zones in terms of their level of awareness on modern post-harvest management technologies. It was therefore recommended that research institutes mandated with research on horticulture and post-harvest technologies should step down their research output to Agricultural Extension Workers at the state ADPs and also to concerned farmers. Agricultural extension workers should regularly be enlightening horticultural farmers (fruits and vegetables) on new and more improved technologies and skills for handling, processing, storage and packaging of their produce, also international/national investors and non-governmental organisations can establish agro-based industries for processing and packaging of horticultural produce in Kogi State.

Key Words: Post- Harvest, Management, Handling, technologies, Horticulture.

INTRODUCTION
Horticulture , the branch of plant agriculture dealing with garden crops, generally fruits, vegetables, and ornamental plants. The word is derived from the Latin *hortus*, "garden," and *colere*, "to cultivate." As a general term, it covers all forms of garden management, but in ordinary use it refers to intensive commercial production. In terms of scale, horticulture falls between domestic gardening and field agriculture, though all forms of cultivation naturally have close links.

Horticulture is divided into the cultivation of plants for food (pomology and olericulture) and plants for ornament (floriculture and landscape horticulture). Pomology deals with fruit and nut crops. Olericulture deals with herbaceous plants for the kitchen, including, for example, carrots (edible root), asparagus (edible stem),

lettuce (edible leaf), cauliflower (edible flower buds), tomatoes (edible fruit), and peas (edible seed). Floriculture deals with the production of flowers and ornamental plants; generally, cut flowers, pot plants, and greenery. Landscape horticulture is a broad category that includes plants for the landscape, including lawn turf but particularly nursery crops such as shrubs, trees, and vines.(Jules *et al.,* 2023)

Good sources of vitamin c include horticultural crops such as citrus, mango, pepper, tomatoes and okra which function to modify the metabolic activation and detoxification of carcinogens, or even influence processes that alter the course of the tumour cell (Hailu, 2015). They also form a substantial percentage (about 25%) of the major food crops cultivated in the tropics and so it is the source of livelihood for a considerable section of the population (Ahmed, 2015). In addition, horticultural crops add variety, enjoyment and a sense of satisfaction with the diet because of their appealing colours, flavours and textures. For example, it has been said that although onions and garlic are not rich in nutrients, they make a vegetarian diet acceptable because of the savoury flavour they impart to the monotonous starchy diet in a developing country **(**Atanda, 2011**).**

In Nigeria, enormous quantities of fruits and vegetables are produced. For instance, 3.8 million tons of onions, 6 million tons of tomatoes, 10 million tons of plantain and 35 million tons of citrus are reportedly produced annually (Pandey *et al.,* 2013). However, the staggering production figures notwithstanding, it is the amount of the produce available to the consumer. It is really an ironic situation where high production figures are churn-out, yet the populace suffers acute shortages of fruits and vegetables.

Production of fresh fruits and vegetables has its own complexity. The perish-ability of horticultural crops makes it difficult to manage easily during postharvest period compared to dry grains. The perishable nature of the produce and lack of knowledge as well as shortage of capital in horticultural industry in Nigeria, Kogi State in particular is still at its infant stage (Hailu, 2015). Farmers growing horticultural crops are faced with high economic loss because of their ineffective indigenous methods used for increasing the shelf life of these crops. The other reason is that most of these perishables are produced by small-scale farmers who have limited access to modern postharvest technologies and are financially poor with low input-output production systems (Olayemi *et al.,* 2012). The technical knowhow and extension services on operations of improved technologies are not available, as a result of this; average productivity of the crops is low both in quality and quantity (Hailu, 2015). Qualitative losses such as loss in edibility, nutritional quality, caloric value and consumer acceptability of fresh produce are much more difficult to assess than the quantitative losses, that is why; these perishable commodities need very careful handling at every stage so that deterioration of produce is restricted as much as possible during the period between harvest and consumption.

Postharvest management is a set of post-production practices that deals with harvesting, selection, washing, grading, disinfection, drying, packing and storage. These eliminate undesirable elements and improve product appearance as well as ensuring that the product complies with established quality standards for fresh and processed products (El-Ramad, 2015). Postharvest practices include the management and control of variables such as temperature and relative humidity, the selection and use of packaging and application of such supplementary treatments as fungicides. (Food and Agriculture Organization FAO), 2009.

Despite the huge advantages in using modern postharvest technologies in processing horticultural crops which boost agricultural production and reduce wastage, farmers in rural areas have little or no access to modern postharvest management technologies which are considered of great benefit to them. The implication here is that, despite efforts made by government to transform agricultural sector in

our farming communities, horticultural crops continue to perish or waste in the farm, Nigeria continues to import horticultural product outside its environment which affects the economy negatively. The above scenario indicates that even when farmers have access to these modern postharvest management technologies, they may lack the technical knowhow on its operation. It is therefore necessary to understand why farmers in the study area have little or no access and probably lack the technical knowhow of postharvest technologies.

Statement of Hypotheses

Ho_1**:** There is no significant difference between the farmer in the three agricultural zones in terms of their level of awareness of modern postharvest management technologies of crops.

This study employed survey design which entailed the collection of data from a cross section of respondents using questionnaire.

The study was carried out in Kogi State, Nigeria. Kogi state has an estimated population of 3,314,043 people and occupies a land area of 35,123 square kilometres (NPC, 2006). It is located between Latitude $7^0$30'N, $6^0$42'N Longitude 7.500^{0}E and 6.700E (Shell Road of Nigeria, 1996). Kogi state has 21 Local Government areas (LGAs') and these LGAs are grouped into four (4) agricultural zones by agricultural development programme (ADP) as follows; Zone A: Aiyeotro Gbedde, Zone B: Anyigba Zone, Zone C: Koton-Karfe and Zone D: Alloma (KGADP, 2011).

Kogi State experiences two distinct seasons, the rainy and the dry season. The rainy season commences from April to October with annual rainfall ranging between 150 and 180 mm. the dry season begins in November to March. The state is one of the major producers of fruits and vegetables crops and cash crops like orange, tomatoes, lettuce, pepper, mango, cash crops like cowpea, bambara nut, groundnut, yam, cassava, maize, melon, sweet potatoes, oil palm, banana and plantain and rearing of livestock such as sheep, goat and poultry (KGADP, 2011)

A sample size of 205 respondents was selected using stratified and simple random sample technique. Two LGAs were randomly selected from each of the three zones, namely; Olamaboro and Ofu were selected from Alloma Zone D, Omalla and Ankpa were selected from Anyigba Zone B, while Lokoja and Kogi were selected from Koton-karfe Zone C. this give a total of six Local Government Areas. Furthermore, two extension cells were randomly selected from each of the LGAs. A sampling frame was developed for each of the selected Local Government Areas using a proportional allocation of $10_{\%}$ [0.1] across board, and a total sample size of 205 respondents was selected. A well-structured questionnaire was used for the collection of primary data alongside interview techniques. Data collected were analysed using both descriptive and inferential statistics these are; frequency distribution, percentage and mean score, standard deviation, factor analysis and the Kruskal Wallis (H) test.

Model Specification

(A) The Kruskal Wallis (H) test model.

The Kruskal Wallis (H) test that will be used for testing hypothesis 1 is stated below:

$H = 12/N(N+1) \times \sum Ri^2/ni - 3(N+1)$ where

H=Kruskal Wallis

N=Total No. of observations over all samples

ni= Sample size of samples i

R^2i= Square of the sum or rank for sample i

$\sum Ri^2/ni$= the squares of sum or ranks divided by the corresponding sample size (ni) in the samples as are summed across all samples.

(B) Factor analysis.

The principal component of factor analysis for objective

$Y_1 = a_{11}X_1 + a_{12}X_2 + \text{----------} + a_{19}X_9$

$Y_2 = a_{21}X_1 + a_{21}X_2 + \text{----------} + a_{29}X_9$

$Y_9 = a_{n1}X_1 + a_{n2}X_2 + \text{----------} + a_{n9}X_9$

$Y_1, Y_2, Y_3 \ldots\ldots\ldots Yn =$

$a_1 \ldots\ldots a_n$ = factor loadings, and $X_1, X_n \ldots\ldots$ Xn= unobserved underlying factors challenging horticultural farmers on postharvest management of their produce in line with Kaiser`s rule of thumb, variables with factor loading score of 0.30 was selected.

RESULT AND DISCUSSION

Traditional/Modern Methods of Post-Harvest Management Technologies.

Traditional Post-Harvest Management Technologies

The result for the used traditional post-harvest management technologies by horticultural farmers in the study area are presented in Table 1. The result shows that washing and cleaning using hot water has the highest mean of 3.14, followed by sorting by hand (2.99). While harvesting with knife is with least mean of 1.0 this shows that up to now farmers are still using their traditional ways of post-harvest handling and some are now using another technology probably modern technology for harvest practice. This result agrees with that of Soyebo *et al* (2005) who reported that, most horticultural farmers were poor and could not afford modern post-harvest management technologies.

Table 1: Distribution of Respondents According to Traditional Post-Harvest Management Technologies A

Management practices	Methods	Mean	Std. Deviation
Harvesting	Use knife	1.0	0.000
Hand picking		2.72	0.461
Packing house operation	Dumping	2.26	0.454
Sorting	Use of hand	2.99	0.158
Grading	Use of hand	2.99	0.141
Washing and cleaning	Use of cold water	1.16	0.368
	Use of hot water	3.14	0.2127
Package containers	Sack	2.00	0.071
	Woven basket	2.76	0.652
	Bags	1.23	0.640
Storage	Sun-drying	2.60	0.695
	Keep under shade	2.15	0.376
Temperature	Head load	2.83	0.390
	Truck	2.43	0.506
	Use of animal	1.0	0.000
Post-harvest treatment	Use of hot water	1.16	0.368

Source: field survey (2017)

Modern Postharvest Management Technologies

Modern post-harvest management technologies practiced by horticultural farmers in the study area were use of motor cycle (Ẍ=2.99) and motor car (Ẍ=2.07) for transportation of produce, use of chlorine solution for packing house operation (Ẍ=1.25), among others. The low use of modern post-harvest management technologies by farmers could be attributed to paucity of technical information on modern post-harvest management technologies among horticultural farmers in the study area. The result of the finding is not surprising since majority of the farmers relied on friends and relatives instead of extension agents as a source of information and advice.

Table 2: Distribution of Respondents According to Modern Postharvest Management Technologies

Management Practices	Method	Mean	Std. Deviation
Harvesting	Harvester	1.00	0.000
Packing house operation	use of chlorine	1.25	0.432
Sorting	Automatic sorting	1.00	0.000
Grading	Automatic grading	1.00	0.000
Washing and cleaning	Chlorine solution	1.00	0.000
Package container	Plastic crate	1.00	0.000
Storage	Refrigerator	1.00	0.000
Transportation	Motor car	2.07	0.282
	Motor cycle	2.99	0.141
	Train	1.00	0.000
Postharvest treatment	Use of chemical	1.11	0.314

Source: field survey (2017)

Level of Awareness on Modern Postharvest Management Technologies of Horticultural Crops.

Table 3 shows that only 15% of the respondents were very much aware of the modern postharvest management technologies, while most of the respondents (76%) were sparingly aware of the modern postharvest management technologies, and the remaining are completely not aware of the modern postharvest management technologies. It indicates that the level of awareness of modern postharvest management technologies in the study areas is very poor, this is why the respondent depend mostly on the traditional method of postharvest management technologies which does not generate much output. Modern technologies fasten the activities on the farm which can lead to more output, this means that, the respondents need more services of extension agents to sensitize them on modern postharvest management technologies and their importance.

Table 3: Level of Awareness on Modern Post-Harvest Management Technologies of Horticultural Crops

Variables	Frequency	Percentage (%)
Level of awareness		
Very much aware	30	15.0
Sparing aware	150	76.0
Completely unaware	18	9.0
Sub-total	200	100
Mean awareness	2.0	

Challenges faced by the Horticultural Farmers on Postharvest Management Technologies in Kogi State

Table 4 reveals that there were three major challenges faced by horticultural farmers in controlling post-harvest losses of their produce namely: socio-economic challenges (Factor 1). The result in Table 4 shows that eight of the socio-economics challenges (factor1) are significant and positive, these includes; low level of skilled labour, low income of producer, low level of awareness, Poor access to credit facilities, lack of extension services, low level of education, high cost of transportation and high cost of labour.

For the environmental challenges (factor 2), only 2 factors are significant and positive strong wind and low humidity. So also, the infrastructural challenges (factor 3) only three factors are significant and positive, these are; inadequate storage facilities, poor transportation system and poor packaging facilities.

In factor 3, the infrastructural challenges faced by horticultural farmers in controlling post-harvest losses of their produce were inadequate storage facilities, poor transportation system and poor packaging facilities.

These findings have several implications as far as control of post-harvest losses of horticultural produce is concerned. Firstly, socio-economic challenges as low level of skilled labour, low level of education, lack of extension services and high cost of transportation may affect effective and efficient handling, processing, storage and transportation of harvested horticultural produce that are perishable in nature. Take for instance, farmers with no formal education who have not been taught by Agricultural extension agents on how to handle process and store tomatoes pepper and leafy vegetables, may end up damaging parts of these produce through poor handling, processing and storage. As a result of the foregoing, this produce may become dehydrated and vulnerable to the attack of pathogenic organisms such as fungi and bacteria that are capable of causing deterioration or decay of produce. Farmers need to acquire skills and knowledge on how to handle; process, store and package their produce through extension agent, sensitisation, on-field training, and or demonstration. in such a way that may prevent spoilage during transportation.

Secondary, the environmental challenges such as high ambient temperature and high humidity can adversely influence deterioration of horticultural produce. According to Agi (2015), increase in normal physiological changes can be caused by high ambient temperature, low atmospheric humidity and physical injury resulting from careless handling and processing of produce. According to this scholar, fresh produce continues to dehydrate or lose water after harvest as a result of high ambient temperature and injury. Water loss in horticultural produce causes shrinkage and loss of weight. In order to increase the shelf life or storage life of produce, farmers are advised to try and minimise the rate of dehydration by stirring vegetables and fruits in a moist atmospheric.

Finally, the infrastructural challenges such as lack of processing and storage facilities can

greatly contribute to high rate of post- harvest losses of horticultural produce in Kogi State. In fact, there are no agro based industries in Kogi State that can process tomatoes, pepper citrus and manages into finished products. The excess produce that are not sold by our farmers end up being heaped in market places or by the roadsides as waste, thus becoming an eyesore to passers-by. International investors and other well to do individuals and the private sector can take advantage of this and establish agro-based industries for processing and packaging of horticultural produce in Kogi State.

Table 4: Factor Analysis of Challenges Faced by the Horticultural Farmers on Post-harvest Management

Variables	Factor 1	Factor 2	Factor 3
Inadequate storage facilities (ISF)	0.007	-0.064	0.685***
Low level of skilled labour (LLSL)	0.362*	0.882E02	-0.027
Low income/capital (LI/C)	0.733*	0.007	0.003
Low level of awareness (LLA)	0.915*	0.359E02	-0.011
Poor access to credit facilities (PACF)	0.733*	0.077	0.175
Lack of extension services (LES)	0.363*	0.875E03	-0.022
Low level of education (LLE)	0.887*	-0.243	-0.095
Poor transportation system (PTS)	0.082	-0.063	0.697***
Poor packaging facilities (PPF)	0.079	0.224	0.608***
High cost of transportation (HCT)	0.817*	-0.356E02	0.323E02
High cost of labour (HCL)	0.909*	0.373E02	0.122
High temperature (HAT)	-0.013	-0.982**	0.106
Strong wind (SW)	0.902E02	0.365**	0.118
Low humidity (LH)	-0.223	0.841**	0.016
High altitude (HA)	-0.006	0.0018	0.051

Method: Varimax with Kaiser Normalisation (0.30 or above)
* Factor 1: socio-economic challenges
** Factor 2: Environmental challenges
*** Factor 3: Infrastructural challenges

Kruskal Wallis (H) Test on the Difference in the Level of Awareness on Modern Post-Harvest Management Technologies across the three agricultural zones

The result in Table 5 reveals that there is no significant difference among the farmers in the three agricultural zones in terms of their level of awareness of modern postharvest management technologies of horticultural crops. Kruskal Wallis (H) test on the difference in the level of awareness on modern post-harvest management technologies across the three agricultural zones shows that R1=100.4, R2=100.9, R3=99.9. this implies that H-Cal is conventional meaning that the level of awareness of modern post-harvest management technologies of the respondent is the same across the three agricultural zones. Consequently, we accept the null hypothesis that said there is no significant difference among farmers in the three agricultural zones in terms of their level of awareness on modern post-harvest management technologies and reject the alternative hypothesis.

Table 5: Kruskal Wallis (H) Test on the Difference in the Level of Awareness on Modern Post-harvest Management Technologies across the three Agricultural Zones

Location	Number	Median	Average Rk	Z
Zone A	55	2	100.4	-0.01
Zone B	91	2	100.9	0.09
Zone C	54	2	99.9	-0.09
Overall	200			
H = 0.01	$P^x = 0.995$	H = 0.02	P = 0.991	P shows no significant difference

Source: field survey (2017)

Conclusion And Recommendations

The study assesses postharvest management technologies of selected horticultural crops among rural farmers in kogi state, Nigeria. Evidence from the study indicated that the use of modern postharvest management technologies by horticultural farmers was generally low, it equally established that traditional method of postharvest management technologies was mostly practiced by the respondents compared to modern postharvest technologies. Result equally revealed that there were three major challenges faced by horticultural farmers in controlling post-harvest losses of their produce namely: socio-economic challenges (Factor 1), environmental challenges (Factor 2) and infrastructural challenges (Factor 3).

It was therefore recommended:

1. Farmers should organize themselves into co-operatives societies in order to have financial assistance from financial institution and from government.
2. There is need for Extension agent to sensitize and create more awareness on the importance and use of modern post-harvest management technologies of fruits and vegetables
3. It was therefore recommended that research institutes mandated with research on horticulture and post-harvest technologies should step down their research output to Agricultural Extension Workers at the state ADPs and also to concerned farmers
4. Agricultural Extension Workers should regularly sensitise and organise on-field training and or demonstration for farmers (fruits and vegetables) with a view to improving their skills and knowledge on how to handle, process, store and package their produce, also
5. International investors and non-governmental organisation and private sector to establish agro-based industries for processing and packaging of horticultural produce in Kogi State.

REFERENCES

Agi A.I. (2015). Agricultural Extension Policy; contemporary cum topical issues.Keney printing press, Makurdi Benue State Nigeria.pp149-152

Ahmed, B. O., Idris. A.K.M. and Lawal, A.O. (2015). Food Security and Postharvest Losses in Fruit Marketing in Lagos Metropolis, Nigeria. *Discourse Journal of Agricultural and Food Sciences*. 3(3): 52-58.

Atanda, S.A., Pessu P. O., Agoda, S., Isong, I. U. and Ikotun, (2011). The concepts and problems of postharvest food losses in perishable crops.*African Journal of Food Science* 5 (11) pp.603-6013, 15 October, 2011.

El-Ramady H.R., Domokos-szabolcsy E., Abdalla N. and Taha H. (2015), *post-harvest management of fruits and vegetables storage*. Sustainable Agriculture Reviews. DOI:10.1007/978-3-319-09132-7 2. Pp 65-152.

FAO (2009) *Course on agribusiness management for producers' associations.* Module 4 – Post- harvest and marketing. Santacoloma P, Roettger A, Tartanac F (eds) Training materials for agricultural management, marketing and finance, vol. 8. Food and Agriculture Organization of the United Nations, Rome approach to sustainable agriculture. Agriculture, Ecosystems, and Environment. 46 147-160.

Hailu G. (2015), extent, causes and reduction strategies of post-harvest lossess of fruit and vegetables. *Journal of biology agriculture, health care*. ISSN22243208. Vol. 5:5.

Jules J, Patric M. S, Geoffrey A.C, (2023) Horticulture, the Editor of Encyclopaedia Britannica. https://www.britannica.com/science/horticulture/Propagation

Kogi State Agricultural Development Project (KGADP) (2011) Impact of Fadama Development Project 11 on Rice farmer's Profitability in Kogi State Nigeria, Journal of Agricultural Extension Vol, 15 No.1

National Population Commission (NPC) (2006) Nigeria National Census: Population Distribution by Sex, State, LGAS and Senatorial District; 2006 Census, Priority table Vol. 3.

Olayemi, F.F., Adegbola, J.A., Bamishaiye E.I. and Aawagu, E.F. (2012), Assessment of postharvest losses of some selected crops in eight local government areas of rivers state, Nigeria. *Asian journal of rural development*, 2(1): 13-23.

Pandey N, Joshi SK, Singh CP, Rajput S, Kumar S, Khandal RK. (2013). *Enhancing shelf life of litchi (Litchi chinensis) fruit through integrated approach of surface coating and gamma irradiation.* Radiat. Phys. Chem. 85, 197–203

Shell Road of Nigeria (1996). Shell Petroleum Development company of Nigeria Limited V. Federal Board of Inland Revenue (1996) Lawglobal Hub Lead Judgment Report.

Soyebo K.O. Farinde A.J, and Dionco-Adetayo E.D (2005) Constraints of oil Palm Production in Ife Central Local Area of Osun State, Nigeria, Journal of Social Sciences 10(1):55-59 DOI: 10.1080/09718923.2005.11892460W argovich, M.J. (2000), Anticancer properties of fruits and vegetables. *HortScience*, 35:573 575

APPENDIX

Traditional Post-Harvest Management Technologies

Management practices	Methods	Mean	Std. Deviation
Harvesting	Use knife	1.0	0.000
Hand picking		2.72	0.461
Packing house operation	Dumping	2.26	0.454
Sorting	Use of hand	2.99	0.158
Grading	Use of hand	2.99	0.141
Washing and cleaning	Use of cold water	1.16	0.368
	Use of hot water	3.14	0.2127
Package containers	Sack	2.00	0.071
	Woven basket	2.76	0.652
	Bags	1.23	0.640
Storage	Sun-drying	2.60	0.695
	Keep under shade	2.15	0.376
Temperature	Head load	2.83	0.390
	Truck	2.43	0.506
	Use of animal	1.0	0.000
Post-harvest treatment	Use of hot water	1.16	0.368

Modern Postharvest Management Technologies

Management Practices	Method	Mean	Std. Deviation
Harvesting	Harvester	1.00	0.000
Packing house operation	use of chlorine	1.25	0.432
Sorting	Automatic sorting	1.00	0.000
Grading	Automatic grading	1.00	0.000
Washing and cleaning	Chlorine solution	1.00	0.000
Package container	Plastic crate	1.00	0.000
Storage	Refrigerator	1.00	0.000
Transportation	Motor car	2.07	0.282
	Motor cycle	2.99	0.141
	Train	1.00	0.000
Postharvest treatment	Use of chemical	1.11	0.314

Level of Awareness on Modern Post-Harvest Management Technologies

Variables	Frequency	Percentage (%)
Level of awareness		
Very much aware	30	15.0
Sparing aware	150	76.0
Completely unaware	18	9.0
Sub-total	200	100
Mean awareness	2.0	

Factor Analysis of Challenges Faced by the Horticultural Farmers

Variables	Factor 1	Factor 2	Factor 3
Inadequate storage facilities (ISF)	0.007	-0.064	0.685***
Low level of skilled labour (LLSL)	0.362*	0.882E02	-0.027
Low income/capital (LI/C)	0.733*	0.007	0.003
Low level of awareness (LLA)	0.915*	0.359E02	-0.011
Poor access to credit facilities (PACF)	0.733*	0.077	0.175
Lack of extension services (LES)	0.363*	0.875E03	-0.022
Low level of education (LLE)	0.887*	-0.243	-0.095
Poor transportation system (PTS)	0.082	-0.063	0.697***
Poor packaging facilities (PPF)	0.079	0.224	0.608***
High cost of transportation (HCT)	0.817*	-0.356E02	0.323E02
High cost of labour (HCL)	0.909*	0.373E02	0.122
High temperature (HAT)	-0.013	-0.982**	0.106
Strong wind (SW)	0.902E02	0.365**	0.118
Low humidity (LH)	-0.223	0.841**	0.016
High altitude (HA)	-0.006	0.0018	0.051

Kruskal Wallis (H) Test

Location	Number	Median	Average Rk	Z
Zone A	55	2	100.4	-0.01
Zone B	91	2	100.9	0.09
Zone C	54	2	99.9	-0.09
Overall	200			
H = 0.01	$P^x = 0.995$	H = 0.02	P = 0.991	P shows no significant difference

SECTION A : Post Harvest Management Technologies

1. Which of the postharvest management technology do you use?

(a) Traditional postharvest practices

Management Practices	**Methods**	**Low**	**Moderately high**	**Very High**
Harvesting	- Use of knife			
	- Hand picking			
Packing House Operation	- Dumping			
Sorting	- Use of hand			
Grading	- Use of hand			
Washing and cleaning	- Use of hot water			
	- Use of cold water			
Package container	- Use of sack			
	- Woven basket			
	- Bags			
Storage	- Sun drying			
	- Keep under shade			
i. Transportation	- Head load			
	- Truck			
	- Use of animal			
i. Postharvest treatment	- Use of hot water			

(b) Modern Postharvest Technologies

i. Harvesting	- Harvesters			
ii. Packing house operation	- Use of chlorine solution			
	- Automatic grading			
iii. Package container	- Wooden crate			
	- Plastic crate			
iv. Storage	- Refrigerator			
v. Transportation method	- Automobile			
	- Motorcycle			
	- Railway			
vi. Postharvest treatment	- Use of chemical (chlorine solution)			

SECTION C: Levels of Awareness of Postharvest Management technologies.

1. Are you aware of the modern postharvest management practices of horticultural crops?

(a) Very much aware [ ](b) Sparingly aware [ ](c) Completely unaware [ ]

SECTION E: Challenges of postharvest management technology

1. What are the challenges you face on the use of these management technologies?

S/N	Challenges	Very Serious	Serious	Not Serious
1	Inadequate storage infrastructure such as refrigerator,			
2	Inadequate level of skills			
3	Low income/capital			
4	Low level of awareness			
5	Poor access to credit facilities			
6	Lack of extension services			
7	Low level of education			
8	Poor transportation system			
9	Poor package containers			
10	High cost of transportation			
11	High cost of labour			
	Climatic problems such as			
12	Temperature			
13	Wind			
14	Humidity			
15	Altitude			