Mango Varieties and Causes of Post-Harvest Losses in Kwande Local Government Area, of Benue State, Nigeria

Sambe, Ngutor

Department of Sociology, University of Mkar, Mkar-Nigeria

Abstract

Post-harvest losses of mango fruits are a major challenge to mango farmers who incur huge financial losses and the economy of Benue state which loses much in terms of revenue. The main objective of the study is to investigate the causes of post-harvest losses of mango fruits among farmers in Kwande Local Government Area. Specifically, the study was aimed at exploring mango varieties produced by the farmers; determine causes of post-harvest losses of mango fruits among the farmers and recommend how postharvest losses of mangoes can be controlled for increased profitability. The study used a cross sectional survey design while questionnaires and Key informant interview were used to collect data. Data analysis involved the use of percentages and transcription of opinions. The study found that most (32.1%) of the mango farmers in the study area were aged from 50-59 and majority (60.4%) of the farmers were males and married (82.8%). Also, most of the mango farmers had Senior Secondary Certificate Examination (SSCE) qualification. The study also found that over fifteen (15) varieties of mango fruits were cultivated in the study area. The varieties include Local mango, Julie, Peter, Hindi, Dausha, Broken, Kpan-Peter, Kpan-Julie and Ihorzwa and Ikyekpev, John, Mummy and Ambrose, German, Kotonu and Kerosene. The major causes of postharvest losses of mango fruits in the study area include weather (heat or rain), livestock, bats and rodents, disease, poor handling techniques, sap, insects such as wasp and ants, poor harvesting techniques and lack of preservation infrastructure, handling of the fruits especially during transportation. The study therefore recommends for provision of preservation infrastructure for mango farmers which could keep the fruits in safe environment that will protect the fruits from attacks from animals, insects, rodents and adverse weather; processing of mango fruits into semi finished foods and provision of specialized air-conditioned vehicles for transporting mango fruits for sale.

Key words: Post-harvest losses, Mango fruits, Farmers, Kwande Local Government Area

Introduction

Mango (*Mangifera indica L.*) is the second most grown fruit in the world. It is grown in commercial quantities in more than 90 countries worldwide. Worldwide production of mango fruits was forecasted to reach a volume share of 51 percent of total global major tropical fruit production in 2017 and is one of the two tropical fruits that have witnessed the strongest growth in popularity. Among the producing countries, India is the main global producer with 18.8 million Metric Tonnes (MT), followed by China (4.8 million MT), Thailand (3.4 million MT), Mexico (2.2 million MT) and Pakistan (1.6 million MT), Brazil (1.4 million MT) are placed 5th and 7th respectively in the world. Nigeria is the largest producer (917617MT) of mango fruits in Africa and 10th largest producers of mango fruits in the world. In Nigeria, the main producing states include Benue, Jigawa, Plateau, Yobe, Kebbi, Niger, Kaduna, Kano, Bauchi, Sokoto, Adamawa, Taraba and FCT. However, Benue state is a top producer in the country (Avav and Uza 2002: Yusuf and Salau, 2007; Altendorf, 2017; FAOSTAT, 2016).

Globally, mango is one of the tropical fruits with biggest increase in demand, especially in developed countries. It has been revealed that between 1990 and 2017, the demand for mango fruits grew at about an estimated annual growth rate of 10 percent. Global exports of mango fruits were estimated to reach 1.7 million tonnes in 2017. This represented a 6.3 percent increase from 2016, considerably faster than the 4.6 percent average annual growth registered between 2007 and 2016 (Huang, 2010; Iyango, et al 2012; Altendorf, 2017). Large markets for fresh

mango fruits are Europe, North-America and Asia. The major countries which are leading exporters of fresh mango fruits in the world are Mexico, followed by Brazil, and Thailand respectively (Altendorf, 2017: Evans et al, 2017). Nigeria however is not even among the leading exporters of the fruits despite being one of the major producers in the world (Altendorf, 2017; FAOSTAT, 2016).

Mango fruits are prone to high post-harvest losses in developing countries such as Nigeria. These amounts of losses are approximated at about 30 percent in developing countries. In Benue state a report by the State Ministry of Agriculture in 2010 showed massive postharvest losses of mango fruits as 20 to 80 percent of mangoes are subjected to post-harvest losses. These losses are witnessed during harvesting, packaging, storage, transportation, retailing and consumption. This situation seems to have huge impact on mango production and the nutritional quality of the fruits and the economic significance in terms of increasing farmers' income and Gross Domestic Product (GDP) of Benue state and Nigeria. This appears to explain in part why Nigeria is the 10th largest producer of mango fruits in the world but is not listed among the top exporters of the fruits. It also seems to indicate why Benue state is the top producer of the fruits in Nigeria and yet farmers in Benue state do not earn much financially from production of the fruits (Ugese et al, 2012; Altendorf, 2017; Sambe et al, 2019).

There seems to be dearth of empirical studies on causes of post-harvest losses of mango fruits in Nigeria and Benue state specifically. This appears to be related to the undermining of importance of mango fruits and their nutritional and economic potential by government and researchers in Nigeria. Most of the discussion about mango and postharvest losses in Nigeria seems to be conjectural. This also applies to Benue state which is highest producer of mangoes but no attention from either government or researchers is given to causes of post-harvest losses

There have been studies conducted on causes of post-harvest losses of mango fruits in some parts of the world. Msogoya and Kimaro (2011) study was conducted to assess postharvest losses of fresh mangoes incurred under different handling and transportation practices by small-scale business in Morogoro, Tanzania. Sarkar, Alam, Rahman and Bhuiyan (2011) study identified the post-harvest losses occurring at different stages of value chain of mangoes in Bangladesh. This study studies however ignored the causes of post-harvest losses of mango fruits by farmers which becomes a weakness this study seeks to exploit. Furthermore, the studies seem to completely ignore the study area which is a top producer of mangoes in Nigeria. This study will also take the study area into consideration thereby filling the gap in literature concerning causes of post-harvest losses of mango fruits in Kwande Local Government Area.

The main objective of the study is therefore to investigate factors determining post-harvest losses of mango fruits among farmers in Kwande Local Government Area. The specific objectives of the study were:
1. To explore the major mango varieties produced by the farmers in Kwande Local Government Area.
2. To determine the major determinants of post-harvest losses of mango fruits among the farmers in the study area.
3. To suggest how postharvest losses of mangoes can be controlled for increased profitability in the study area.

Methodology

Kwande Local Government Area was created in 1976 with the Head quarters situated in Adikpo town. The local government area has an estimated population of 335, 600 (NBS, 2016). It is also bounded by several local governments in Benue state including Cross River state and Taraba state and Republic of

Cameroun. On the west, it is bordered by Vandeikya Local Government, Ushongo Local Government Area on the north. In northwest it bordered by Katsina-Ala Local Government Area. In the south, it is bordered by Cross River State and in the southeast by the Republic of Cameroon. Kwande LGA also shares a common border with Takum LGA of Taraba State on the east. Kwande Local government has fifteen council wards but sixteen traditional districts. The local government has diverse climate and weather. As a result of its mountainous nature and proximity to the Cameroonian range of mountains, communities close the mountains usually have cold weather which makes it very conducive to traders and investors. The local government also has very big rivers which usually take care of agricultural and industrial needs. The inhabitants of the area are predominantly farmers who are known for production of crops such as rice, yams, cassava, sweet potatoes and mangoes.

Population of the study encompasses all mango farmers who currently inhabit in Kwande Local Government Area, Benue state. The study employed a cluster sampling technique to select 134 mango farmers. The process began with the researcher purposively selecting four council wards- Usar, Kumakwagh, Tondov II and Liev I where huge amount of mangoes are produced. In each of the council wards, the researcher used convenient sampling technique to select the respondents. In Usar, 39 respondents were selected, 41 in Kumakwagh, 24 in Tondov II and 30 in Liev I.

The selection procedure involved the researchers and his research assistants holding focus group discussions with the mango farmers, traders and mango consumers in the area. The meetings were held in the farm, market or home of the respondents. The researcher also used purposive sampling technique to select four (4) Key informants who were leaders of mango farmers associations in Usar, Kumakwagh, Tondov II and Liev I council wards in Kwande Local Government Area as part of the respondents.

Method of data collection was questionnaire and Key Informant Interviews. In the process of data collection through questionnaire, the researchers engaged and trained four (4) research assistants who assisted him in the administration of the questionnaires to the respondents in their farms, market places or homes. For Key informant interviews, the researcher visited the key informants in their homes, market and farm and conducted the interview with them. The interviews were recorded using Android phones and writing materials such as pen and paper. Analysis of data involved the use of percentages. For Key Informant Interviews, analysis involved transcribing the opinions of the key informants.

Results and Discussion

Table 1 presents socio-demographic characteristics the respondents. In relation to age distribution, the Table showed that majority (32.1%) of the farmers aged from 50-59 while those from the ages of 20-29 were the least (5.2%). Respondents between age ranges of 40-49 were 23.9% with second highest percentage; those aged from 60 years and above came third (22.4%). In the fourth position were farmers who were in the age range of 30-39 with 16.4%.

In the sex distribution section, the table revealed that majority of the respondents was males 60.4% (81) while females were the least with just 39.6% (53).

In relation to marital status, the table showed that most of the respondents were married with (82.8%), 14.2% of them was single while 3.0% were widowed.

In relation to educational qualification, majority (62.7%) of the respondents had Senior Secondary Certificate Examination (SSCE) qualification while those who had no educational qualification were the least (9.7%). This was followed by 16.4% who had First School Leaving

Certificate (FSLC) in second position and 11.2% who acquired either National Certificate of Education (NCE) or Diploma certificate.

Table 1: Socio-Demographic Data of Respondents

Variable	Frequency	Percentage
(a) Age (Years)		
20-29	7	5.2
30-39	22	16.4
40-49	32	23.9
50-59	43	32.1
60 and above	30	22.4
Total	**134**	**100**
(b) Sex		
Male	81	60.4
Female	53	39.6
Total	**134**	**100**
(c) Marital Status		
Single	19	14.2
Married	111	82.8
Widowed	4	3.0
Total	**134**	**100**
(d) Educational Qualification		
None	13	9.7
FSLC	22	16.4
SSCE	84	62.7
NCE/Diploma	15	11.2
Total	**134**	**100**

Source: Field Survey, 2019

.

Table 2: Major mango varieties produced by farmers in Kwande Local Government Area

Varieties	Frequency	Percentage	Rank
Local variety	28	20.9	1st
Julie	25	18.7	2nd
Peter	24	17.9	3rd
Hindi	17	12.7	4th
Dausha	11	8.2	5th
Broken	11	8.2	5th
John	9	6.7	6th
Kpan-Peter	4	3.0	7th
Kpan-Julie	3	2.2	8th
Ihorzwa	1	0.7	9th
Ikyekpev	1	0.7	9th
Total	**134**	**100**	

Source: Field survey, 2019

Table 2 presents the different varieties of mango fruits cultivated in the study area. In the Table, it was revealed that varieties such as Local mango was the most common cultivated by

the respondents in the area with percentage of 20.9% while varieties such Ihorzwa and Ikyekpev were the least with (0.7%) each. The second most popular variety cultivated by the farmers was Julie with 18.7% of the respondents. The third popular variety was Peter with 17.9% while Hindi variety came fourth with 12.7% (17). The fifth most cultivated mango variety was Dausha and Broken with 8.2% respectively. John variety ranked sixth with 6.7%; Kpan-Peter ranked seventh with 3.0% and Kpan-Julie ranked 8th with 2.2% .

Key Informant Interview noted:

"…I cultivate many varieties of mangoes such as Julie, Broken, Dausha, Hindi, Peter, John, Local mango, Mummy and Kpan-Julie and Ambrose. The Ambrose variety was acquired in Cameroon and is one of the best varieties I have…I also have other varieties that germinated on their own from the seeds of the existing mangoes that were dropping on the ground like two of the varieties at the back of my house here…As you see this Julie, if you eat the fruit and drop the seed, it will not grow as Julie but another different variety, unless you cross breed…"

Another Key informant aptly said:

 "…common varieties produced by women in our forum are Peter, Local Mango, Julie, and Hindi. We have other mango fruits we just grow on their own and are not cross bred…some may look more like Peter, Julie or Local mango. If that is the case, then we normally add a word like "*kpan*" (slave) to such varieties…hence Kpan-Peter, Kpan Julie, Kpan-Local mango…other varieties like Angbira also exist which people don't like it compared to other varieties…we also have varieties like German, Kotonu and Kerosene"

The findings suggest that dominant varieties produced in the study area include Local variety, Julie, Peter and Hindi. Though there was host of other varieties that are cultivated by farmers in the area such as Dausha, John, Kpan-Julie, Kpan-Peter, Mummy, Ambrose, German, Kotonu, Kerosene and host of other wild varieties that grow on their own. These findings appear to agree with Ugese, Iyango and Swem (2012) who found that most common and most preferred varieties produced by farmers in Gboko Local Government Area, Benue state included Peter, Julie and Hindi and Local mango, though other varieties such as Dausha and Broken were produced the local government area. Ugese et al (2012) also listed some varieties produced by the farmers such as Zill, John-Peter and John-Bull varieties.

Table 3: Major Causes of Postharvest Losses of Mango Fruits among Farmers in Kwande Local Government Area

Cause of Postharvest Loss	Frequency	Percentage	Rank
Insects	14	10.4	5th
Weather	33	24.6	1st
Poor harvesting	8	6.0	6th
Poor Handling	18	13.4	4th
Livestock/Bats/Rodents	24	17.9	2nd
Disease	19	14.2	3rd
Mango sap	18	13.4	4th
Total	**134**	**100**	

Source: Field survey, 2019

Table 3 presents major causes of postharvest losses of mango fruits in the study area. The Table has shown that the major cause of postharvest losses is weather with 24.6% of the respondents while poor harvesting was the least with 6.0%. Other causes of post-harvest losses included animals, bats and rodents with 17.9% (24) with second highest percentage. This was followed by disease with 14.2% (19) in the third position and poor handling techniques and sap came fourth with 13.4% (18) respectively. Furthermore, in fifth position were insects with 10.4% (14).

According to a key informant Area:

"… Heat is one of the major factors that make mangoes to spoil so fast…most of the time when we pluck the mangoes, we don't have place to keep it…so when the fruits stay in the sun or where there is no air for so long, it can spoil…there are also insects that attack mango fruits and cause them to spoil after been plucked like the wasp…the insects can feed on the mangoes when it is unplucked…when plucked, the openings caused by the wasp sting makes the mango to decay no matter what you do to it…"

Another key informant also reiterated:

"…weather is very important in determining how fast mangoes will decay…in my case during rainy seasons, some mango fruits will get spoilt because they bitten by rain…if you heap mangoes and they are beaten by rain, the ones on the ground will start to spoil…some ants may also attack them…also rats may eat parts of the fruits when they are on the ground and subject to decay fast…thieves may also steal mangoes when they are spread on the floor in a open place…that is, lack of preservation infrastructure results to all these issues…"

A key informant aptly noted:

"…postharvest losses in mangoes may begin from the point of harvesting…when mangoes are plucked without using an aid like a long stick fitted with net, leather or bag, some of them hit on the ground and soften on the spots may start decaying the next day. Such fruits have already began spoiling…sap is also dangerous to mango fruits and some varieties such Julie contain much sap…the fruits touched by sap show signs of burns and if the sap is not washed, the mango fruits can spoil in less than 24 hours…the way we handle mangoes during transportation also makes it vulnerable to decay…some varieties like Local mango, Peter and Hindi will also spoil if they are washed as washing could make the mangoes become blackened the following day and start shrinking…"

The findings suggest that major causes of post-harvest losses of mangoes were mostly due to natural factors such as heat, rain, disease, insects, animals and mango sap, which is a fluid that comes from the mango tree or fruits. Mechanical factors such as bruises and harvesting techniques were found to have contributed less to post-harvest losses of mango fruits in the study area. This finding appears to be inconsistent with a study by Yahia (1998a), which suggest that in developing countries mango postharvest losses are primarily due to factors such as mechanical damage in form of injuries caused to the fruits during harvesting like unsafe harvesting methods which cause mangoes to hit on the ground, or improper field handling. This could be due the years of experience in dealing with the fruits as most of the farmers were from 50-59 years (see

table 1). This indicates that the farmers may have perfected ways of harvesting and handling the fruits due to their years of experience with fruits. The study was however consistent with Sivakumar et al (2011) investigation which found that sap burn, chilling injury, and disease and pest damage were factors responsible for post-harvest losses of mango fruits. He also found that postharvest `losses often occur due to tight fruit packing, using improper transport and inadequate field handling. Other study further show that sap can significantly influence losses of mango fruits as sap burns are associated browning in the fruit skin (Robinson et al., 1993).

Conclusion

The study also concludes that over fifteen (15) varieties of mango fruits cultivated in the study area. However, the major varieties in the study area includes Local mango, Julie, Peter, Hindi, Dausha, Broken, Kpan-Peter, Kpan-Julie and Ihorzwa and Ikyekpev. The major causes of postharvest losses of mango fruits in the study area are weather (heat or rain), animals such as bats and rodents, disease, sap, insects such as wasp and ants and poor harvesting techniques and storage infrastructures. Handling of the fruits during transportation and washing of some varieties like Local mango, Peter and Hindi with water could blacken the fruits and start deterioration process by shrinking.

Recommendations

Based on the findings, the study recommends the following:

    a. Provision of preservation infrastructure for mango farmers which could keep the fruits in safe environment that will protect the fruits from attacks from animals, insects, rodents and adverse weather. This can be provided by government state and local government authorities if it is interested in maximizing economic opportunities that are available to mango production.

    b. Indigenous methods of preservation such as sun drying methods used by Khonda tribes of Rayagada district in Odisha, India (Baul et al 2015). The methods was used to process and preserve mangoes into chips, powder and cakes

    c. of the fruits through processing into some finished products like cakes should be evolved and diffused to farmers through extension workers.

    d. Specialized vehicles for transporting mango fruits can be acquired. These vehicles can be fitted with Air-conditioners that may control heat that contributes to post-harvest looses during transportation. This vehicles can be provided by Government, farmers' cooperatives and International donors in agricultural sector through credit facilities, lease or donations

References

Aguoru, C.U., Okoli, B.E. and Olasan, J.O. (2016). Taxonomic investigation of four cultivars of Mangifera using micro-anatomical features. *International Research Journal of Natural Sciences*, 3(5): 21-32.

Agyepong , M. (2013) *Evaluation Of The Post Harvest Handling Of Mango Fruit (Mangifera indica L.) IN The Akwapim-South, Dangme-West, Lower Manya And The Yilo Krobo Districts Of Ghana. Unpublished* Thesis. Institute of Distance Learning, Department of Horticulture, Kwame Nkrumah University of Science and Technology

Altendorf, S (2016) Global Prospects For Major Tropical Fruits: Short-term outlook, challenges and opportunities in a vibrant global marketplace, Food Outlook: Special Feature, November, 2017

Avav T. and Uza D. V. (2002). Agriculture. In: Pigeonniere, A. L. (Ed) *Africa Atlases: Nigeria*, Les Editions J. A., Paris, pp 92-95

Baul, A., Dhal, N.K, & Mukherjee, S.M. (2015) Indigenous Techniques of Mango (Mangifera Indica L.) Processing and Preservation in By the Khonda Tribes of Rayagada District, Odisha, *Indian Journal of Tropical Medicine Plants. Vol 15 (Dec, 2015)*

Benue State Government (2015) Our Collective Vision For A New Benue-"In God We Trust" Makurdi: Benue State Government.

Bourne, M.C. (1977). Post-harvest Food Losses - The neglected dimension in increasing the world food supply. Cornell University International Agriculture Mimeograph, 53, 49.

Brecht J. K. ; Sargent, S.A; Kader, A.A ; Mitcham, E.J. and Maul, F. (2010). *Mango . Postharvest Best Management Practices Manual*. National Mango Board. Davis.UC. USA. pp.59.

Dharini Sivakumar, Yuming Jiang, Elhadi M. Yahia (2011) Quality During the Export Chain. *Food Research International* 44 (2011) 1254–1263

FAOSTAT. (2016). *FAO Statistics, Food and Agriculture Organization of the United Nations,* Rome, Italy. http://faostat.fao.org/

Huang, Sophia (2010), "Global Trade of Fruits and Vegetables and the Role of Consumer Demand", in Hawkes et al., Trade, Food, Diet and Health: Perspectives and Policy Options, Wiley Blackwell.

Igbari, A. D., Nodza, G. I., Adeusi, A. D. and Ogundipe, O. T. (2019) Morphological Characterization of Mango (Mangifera indica L.) Cultivars from South-West Nigeria. *Ife Journal of Science* vol. 21, no. 1 (2019)

Illoh, H.C., and Olorode. O., (1991). Numerica Taxonomic Studies of Mango (Mangifera indica L.) varieties in Nigeria, Uephytica 51, 197-205

Kader, A. A. (2002). Quality and safety factors: Definition and evaluation for fresh horticultural crops. Postharvest technology of horticultural crops (pp. 279−285). : University of California.

Kitinoja, L. and Gorny, J.R. (1999). Postharvest technology for small-scale produce marketers: economic opportunities, quality and food safety. Univ. Calif. Postharvest Hort. Series No. 21

Mrema, C. G. and Rolle, S. R. (2002). Status of the postharvest sector and its contribution to agricultural development and economic growth. 9th JIRCAS International Symposium – Value Addition to Agricultural Product, pp. 13-20.

Msogoya, T.J. and Kimaro, E.S. (2011) Assessment and management of post harvest losses of fresh mango under small-scale business in Morogoro, Tanzania. Journal of Animal & Plant Sciences, 2011. Vol. 11, Issue 1:

Ploetz, R. C., Zentmyer, G. A., Nishijima, W. T., Rohrbach, K. G., & Ohr, H. D. (Eds.). (1994). Compendium of tropical fruit diseases (pp. 88). APS Press

Robinson, S. P., Loveys, B. R., & Chacko, E. K. (1993). Polyphenol Oxidase Enzymes in the Sap and Skin of Mango Fruit. *Australian Journal of Plant Physiology, 20, 99−107*

Sarkar, K.M.A, Alam, M.M, Rahman, A., and Bhuiyan, M.G.K (2011) POST-HARVEST LOSSES IN MANGO VALUE CHAIN, Intl. j. Bio.Res. L0(5):25-31 May,2011Sambe, N.; Ikwuba, A.A., Sugh, E.T., (2019) Utilization and Challenges of Indigenous Methods of Mango Fruits Preservation by Farmers in Tivland, Benue state. *Production and Agricultural Technology (PAT)* Vol. 15 (2) pp.91-101

Sivakumar, D; Jiang Y, & Yahia, E.M (2011) Maintaining mango (Mangifera indica L.) fruit quality during the export chain, *Food Research International* 44 (2011) 1254–1263. Elsevier.

Talcott, Moore, Lounds-Singleton, & Percival (2005). Ripening associated phytochmical changes in mangoes (Mangifera indica) following thermal quarantine and low temperature storage. Journal of Food Science, 70, 337−341.

Ugese, F. D., Iyango P. O. and Swem T. J. (2012) Mango (*Mangifera Indica* L.) Fruit Production and Production Constraints In Gboko Local Government Area of Benue State**.** *PAT June, 2012; 8 (1): 164 -174; ISSN: 0794-5213*

UNIDO Farmer's Training Manual on Post Harvest Management of Sorghum, Groundnut and Rice, Project on Enhanced Value Addition and Strengthening Value Chains in the Greater Bahr el Ghazal Region. UNIDOs

Yahia, E. M. (1998a). Postharvest handling of mangoes. Technical Report. Agricultural Technology Utilization and Transfer Project, Giza, Egypt. http://www.atut.gov.eg. Accessed 04.12.2019.

Yusuf, S., and Salau, A.S. (2007) Forecasting Mango and Citrus Production in Nigeria, MPRA Paper No. 2691, November, 2007