ASSESSMENT OF POST HARVEST LOSSES OF LEAFY VEGETABLES AMONG RURAL FARMERS IN KANO AND JIGAWA STATE, NIGERIA

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Abstract

This study focused on the assessment of post-harvest losses of leafy vegetables among rural farmers in Kano and Jigawa State, Nigeria. Three (3) research questions and one (1) hypothesis guided the study. Survey research design was adopted for the study. The population for the study comprises of Leafy vegetable farmers, marketers and extension agents in Kano and Jigawa States. Purposive sampling method was used in selecting 120 respondents for the study. Three sets of questionnaires were developed from the reviewed literature and were used for data collection from the respondents. The questionnaires were face-validated by three experts. Cronbach Alpha reliability method was used to determine the internal consistency of the instruments and a reliability coefficient of 0.71, 0.73, and 0.89 were obtained for the three sets of questionnaire respectively. 120 copies of the questionnaires were administered to the respondents by the researcher with the help of five research assistants and all the copies were retrieved. The data collected were analyzed using frequency distribution table and simple percentage to answer the research questions while t-test statistics was used to test the hypotheses of no Significance difference at the probability of 0.05 at relevant degree of freedom. It was found out that inadequate pre-harvest production practices, poor planning of harvesting time, inadequate storage and processing facilities causes post-harvest loss of leafy vegetables, On the use of technology, majority of the farmers and marketers lack skills for effective re-use of the vegetables for other purposes and it has affected socio-economic status of the rural farmers in the area of income generation, high cost of food items and farm input leading to diversification in production activities. The study recommended improvement in the periodic training of farmers, and extension agents, subsidizing farm inputs and storage and processing facilities towards minimizing post-harvest losses and wastages of leafy vegetables in the study area.

Keywords: Assessment, post-harvest, losses, wastages, rural farmers.

1.0 Introduction

Green leafy vegetables have generated interest worldwide as they exhibit multiple benefits for health of human beings, as it has developed in parallel with the evolution of humanity to ensure steady provision, safety and varieties as well as improved nutritional composition for the benefit of mankind. According to Deepak, Satendra, and Chandra (2020) green leafy vegetables occupy an important place among the food crops as it provides adequate amount of many vitamins and minerals for humans. Food and Agricultural Organization (FAO, 2019) estimated that more than 15% of the food produced including vegetables globally is lost during the post-harvest production stage before reaching the retail stage of the food system. Food losses and wastages according to FAO (2019) could be described as the decrease in quantity or quality of food along the food supply chain. It also refers to all the crop, livestock and fish, human-edible commodity quantities that, directly or indirectly, completely exit the post-harvest supply chain during storage, transportation and processing by being discarded and do not re-enter in any other utilization (such as animal feed, industrial use, etc. Agriculture as one of the mainstays of the economy of developing countries (DCs) like Nigeria, underpin-

ning their food security, export earnings and rural development. Yet, their agricultural production for the domestic and export markets have continuously lagged behind with growth in per capital output declining. Nigeria is a country endowed with variety of food, but most of her agricultural products are lost to insect attack, rodents, micro-organisms and losses during harvesting handling; packaging, processing and storage. According to Bolarin, and Bosa, (2015) survey carried out on post-harvest food losses in some communities in Nigeria revealed that as much as 20 – 30% of total grain production, 30 – 50% of root and tuber crops and usually high percentage of fruits and vegetables are lost with a substantial amount recorded during storage.

Leafy vegetables are considered very important part of human diet not only in developing countries like Nigeria but all over the world. Nigeria, which is the most densely populated country in African continent, is still struggling to achieve self-sufficiency to feed its over 200 million people. For this purpose, vegetables have got their specific importance to provide balanced and healthy diets to its citizenry. Alao (2000) observed that practically all leafy vegetables such as amaranthus, cabbage, lettuce among others grown are consumed in Nigeria and production is seasonal resulting in glut during the rainy season and scarcity at off seasons. Due to their soft texture, they are easily bruised or wounded as a result of harvesting, and other post-harvest handling operations such as packaging, transportation and storage. In Northern part of Nigeria, especially in Kano and Jigawa State where production of leafy vegetables is all year round among those that farm using irrigation system. Despite producing adequate quantities of leafy vegetables, they become inadequate on account of losses and wastages in the field as well as along the value chain before reaching the final consumers.

The causes of food losses vary greatly by regions. Accurate and time-wise estimates of wastes and losses in the food system are unavailable. However, evidence to date indicated that, every year, about 670 million tonnes of food is lost or wasted in high-income countries, and 630 million tonnes in low- and middle-income countries – a total of 1.3 billion tonnes, or one-third of the edible part of food originally intended for human consumption (FAO, 2019). Food losses are caused by different factors at different levels. High Level Panel of Experts, (2011).stated that in low-income countries such as Nigeria, significant levels of leafy vegetable losses occur upstream, at harvest and during post-harvest handling, owing to poor infrastructure, low levels of technology, a limited knowledge base and lack of investment in production. Leafy vegetable losses also tend to be caused by managerial and technical constraints in harvesting, storage, transportation, processing, packaging and marketing. Weinberger and Acedo as cited in Antonio and Warwick (2015) stated that leafy vegetable post-harvest losses vary considerably with maximum average losses of up to 50 per cent or higher occurring in developing countries. This could also arise due to the feature of supply chains in these countries which are often typified by hot and humid tropical climates, where there is a lack of knowledge, techniques and facilities in produce handling and processing. Adverse climates and poor management combined with the perishable nature of leafy vegetables have a large impact on reducing the profitability and efficiency of supply chains. The greatest losses occur in small- and medium-scale agricultural production and processing sectors. Uncertainty about weather and market conditions, and weak institutional frameworks, also contribute to losses. Mustapha and Yahaya (2006) reported that the complex and long chain of marketing system of leafy vegetables between the rural farmers and consumers makes it difficult to assess the level of damage in leafy vegetable crops in Nigeria. However, generally about 30 % fruits and vegetables are rendered unfit for consumption due to spoilage after harvesting.

Food losses are not acceptable anywhere in the world considering resources required for producing and processing foods. Post-harvest losses of leafy vegetables could be described as a disservice to humanity in a world where millions, if not billions of people, are either suffering from outright or hidden hunger (malnutrition). Nigeria is, according to the World Bank record, home to over 87 million extremely poor people, and one of the criteria for this classifica-

tion is lack of access to quality foods. Professor Gloria as cited in Femi (2018) stated that the economic value of post-harvest losses in Nigeria was $9 billion from vegetables, fruits and food crops; A large percentage of farm products are either wasted on the farm, in transit or at commodity markets. Also, Ogiamien as cited in Gabriel (2021), stated that Nigeria's business environment for the leafy vegetable producers is currently witnessing a lot of activities as a result of the efforts of National Agricultural Seed Council,(NASC), but more importantly, the doggedness of the producers themselves are faced with many of the same challenges businesses in Nigeria face which include funding, investment, staffing and infrastructure deficit. However, chief of these challenges is the high waste of produce in every season. This single activity has multiplier effects on the sector as well as on the socio economic life of the rural farmers. Ahmed as cited in Mada, Hussaini, Medugu, and Adams (2014) reported that post-harvest losses of leafy vegetables are making Nigeria rural farmers poorer. For a very long time, Nigerian rural farmers have lamented the situation without getting meaningful assistance. Most products are seasonal and because we have a barely developed post-harvest industry, a large percentage of our harvest goes to waste. Therefore reducing leafy vegetable losses could increase production, increase farmers income as well as the supply of available leafy vegetables and hence improve socio-economic status of the end users in Nigeria. It could also go a long way in strengthening food security in Nigeria and beyond.

1.2 Statement of the Problem

The importance of leafy vegetables in improving the nutritional and economy needs of rural farmers cannot be underestimated. Leafy vegetables are essential part of human diets, but they are perishable by nature. Losses between farms and consumers are common in Nigeria where there is inadequate knowledge; skills, technologies, techniques, and facilities for produce handling and processing. These losses of leafy vegetables and economic opportunities have contributed to poverty, unemployment and malnutrition. The varied agro-climatic conditions prevailing in Nigeria are conducive for the cultivation of leafy vegetables in different stages round the year. Nigeria is a country that is rich in the supply of agricultural products including leafy vegetables but post-harvest losses continue to reduce it impact on the socio-economic life of the rural farmers and to some extent Nigerians thereby creating food insecurity as being witness presently. These leafy vegetables due to their soft texture easily get bruised or wounded as a result of harvesting, and other post-harvest handling operations such as packaging, transportation and storage. In Northern part of Nigeria, despite producing adequate quantities of leafy vegetables, they become inadequate on account of losses in the field as well as in storage. This situation has compelled leafy vegetable farmers in the rural setting in Kano and Jigawa State to sell their produce at give-away prices on several occasions because there are no temperature regulated facilities where they could be stored. This situation has over the years affected the rural farmers as many often time find it difficult to meet their family needs and to reinvest in leafy vegetable production. This study, therefore, is intended to focus on the usage of technology and it implications on reducing post-harvest losses and wastages of leafy vegetables among the rural farmers in Kano and Jigawa States. Nigeria.

1.3 Purpose of the Study

The main purpose of this study is to assess the effect of post-harvest losses of leafy vegetables such as amaranthus, cabbage and lettuce on the rural farmers in Kano and Jigawa States, Specifically, the study will**:**

1. Find out the causes of post-harvest losses of leafy vegetables that occur at producers level and along the supply chain in Kano and Jigawa States,
2. Find out the level of farmers' uses of post-harvest technologies in handling leafy vegetables in Kano and Jigawa States,
3. Find out implications of the post-harvest losses and wastages of leafy vegetables on the rural farmers in Kano and Jigawa States

1.4 Research Questions

This study will be guided by the following research questions:

1. What are the causes of post-harvest loss and wastages of leafy vegetables that occur at producers and along the supply chain level in Kano and Jigawa States?
2. What is the level of farmers use of post-harvest technologies in handling leafy vegetables in Kano and Jigawa States?
3. What are the Implications of post-harvest losses and wastages of leafy vegetables on the rural farmers in Kano and Jigawa States?

1.5 Research Hypotheses (If any):

Ho_1: There is no significant difference in the mean response of leafy vegetable farmers and leafy vegetable marketers on the use of post-harvest technologies towards reducing wastages and losses in Kano and Jigawa States.

1.6 Significance of the Study

The study is of significant value to the people of Kano and Jigawa State and the nation at large as it explores the implication of post-harvest losses of leafy vegetables on the rural farmers. The study also assisted in identifying the appropriate technologies that can be deploy by leafy vegetable farmers in handling post-harvest processing of the vegetables to minimize wastages and losses. Its success adds value to the nutritional needs and requirements of the people. It also leads to improvement in income generation and socio-economic life of the rural farmers when the finding and recommendations of the study are fully implemented

3.0 Methodology

A. Research Design

Descriptive survey research design was adopted for the study. Descriptive survey research design according to Ali (2006) is one in which a group of people or items is studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group using questionnaire, interview or observation. This design is suitable for the study because it make use of questionnaires developed from the literature reviewed to collect data from the respondents on post-harvest losses and wastages of leafy vegetables such as amaranthus, cabbage and lettuce, its implications on the rural farmers in Kano and Jigawa States.

B. Sample and Sampling Technique

The population comprises of Leafy vegetable farmers and marketers producing and selling along these major Dam in Kano and Jigawa States. Purposive sampling method was used in selecting extension agents, leafy vegetable farmers as well as wholesalers and retailers based on pre-census that was conducted to answer the questionnaires. A sample size of 120 were involved in the study. It comprises of 40 extension agents made up of 20 from each of the State, 40 leafy vegetable farmers with 20 from each of the State, 40 wholesalers and retailers with 20 from each of the State respectively. This is consistent with the Central Limit Theorem which assumes that random samples of size equal to or larger than 30 have sample mean which approaches a normal distribution and is representative of the population (Islam, 2018).

C. Instrumentation

The instrument for data collection was a structured questionnaire titled: Assessment of the Post-Harvest Losses of Leafy Vegetables and its implication among the Rural Farmers in Kano and Jigawa State. The questionnaire items is made up of section A which is meant to elicit information on personal data of the respondents and section B which was used to obtained data on post-harvest losses at producers level, post-harvest losses at supply chain level, interest in the utilization of post-harvest technologies and effect/ implications on the socio-economic life of the rural farmers. The questionnaire has response options as follows: Section B (a and b) Yes/No generated data on the courses of post-harvest losses and wastages of leafy vegetables both at producers and marketers level, c, has four (4) point response scale options

of Highly Utilized (HU), Average Utilized (AU) Partially Utilized (PU) and Not Utilized (NU) and Strongly Agreed (SA), Agreed (A), Disagreed (D) and Strongly Disagreed (SD) for the level of farmers use of post-harvest technology component and the implications of post-harvest loss of leafy vegetables on the socio economic life of the rural farmers and have a four (4) point response scale each with corresponding value of 4, 3, 2, and 1 respectively.

The instrument were face validated by three experts: one from the Agricultural Extension unit, Kano State Ministry of Agriculture and Natural Resources, one from Department of Crop Science, (Vegetable production unit) College of Agriculture Danbatta, Kano State and one from Marketing Education Department, Federal College of Education (Technical) Bichi respectively. Their corrections and suggestions were utilized to improve the questionnaire before producing the final copies. A pre-test of the questionnaires was carried out prior to its administration. Twenty (20) Extension Agents, Ten (10) leafy vegetable producers and Ten (10) wholesalers and retailers were purposively selected from Kaduna State for the pre-test. The results of the pre-test were analyzed using Cronbach Alpha Reliability method to determine the internal consistency of the questionnaire items and a reliability coefficient of 0.71, 0.73, and 0.89 were obtained.

The data for the study were collected with the help of seven (7) research assistants hired for administration and retrieval of the instrument in Kano and Jigawa States. Copies of the questionnaire were retrieved from the research assistants after three (3) weeks at an agreed time and location for data analysis. The data generated by the study were analyzed using descriptive statistic such as frequency count and simple percentage.

D. Scope of the Study

The study was restricted to assessment of post-harvest losses of leafy vegetables among rural farmers in Kano and Jigawa State, Nigeria. It covers the causes of post-harvest loss and wastages of leafy vegetables that occur at producers and along the supply chain, level of farmers use of post-harvest technologies in handling leafy vegetables and the implications of post-harvest losses and wastages of leafy vegetables on the rural farmers in Kano and Jigawa States, Nigeria. The study was also restricted to collection of data from Agricultural extension agents, Vegetable producers and marketers in Kano and Jigawa state, Nigeria.

The study was carried out in some selected communities based on their consistency in the production of leafy vegetables along Watari Dam, Hadeija Ja'amare Dam, Thumos Dam in Kano and Jigawa States. The communities are Bagwai, Kura, Danbatta in Kano State and Eabi, Auyo, Ringim and Hadejia in Jigawa State. These communities are utilizing the advantage of regular water supply through these Dam for leafy vegetable production. Also, rural market such as Badume, Bichi, Kunchi, Kura and Ringim, Auyo respectively serve as outlet for contact between the producers and wholesalers and retailers along the supply chain. These communities because of the availability of water and conducive environment are constantly producing roots, bulb and leafy vegetables.

4.0 Results/Findings

The results of the analysis were presented in the tables below:

Research Question 1: What are the causes of post-harvest loss and wastages of leafy vegetables that occur at producers and along the supply chain level in Kano and Jigawa States?

Responses of Agricultural Extension Agents and Vegetable Producers on the causes of post-harvest loss and wastages of leafy vegetables that occur at producers and along the supply chain level in Kano and Jigawa States

Table 1a (AEA (40), VP (40) =80)

What are the causes of post-harvest losses of leafy vegetables such as cabbage, lettuce and ammaranthus at producer's level?

S/No	**Item Statements**	AEA Yes (%)	AEA No (%)	VP Yes (%)	VP No (%)
01	Pre-harvest production practices.	36, 90%	04, 10%	38, 95%	02, 5%
02	Improper management of pest and diseases in the leafy vegetable farm	37, 92.5%	03, 7.5%	35, 87.5%	05, 12.5%
03	Poor planning of harvesting time	28, 70%	12, 30%	33, 82.5%	07, 17.5%
04	Delay in the harvesting of leafy vegetable	31, 77.5%	09, 22.5%	30, 75%	10, 25%
05	Lack of equipment for harvesting leafy vegetable	32, 80%	08, 20%	34, 85%	06, 15%
06	Poor treatment of harvested leafy vegetables	29, 72.5%	11, 27.5%	30, 75%	10, 25%
07	Lack of storage facilities	36, 90%	04, 10%	33, 82.5%	07, 17.5%
08	Physical injuries resulting from poor handling	29, 72.5%	11, 27.5%	28, 70%	12, 30%
09	Poor ventilation of leafy vegetables	27, 67.5%	13, 32.5%	31, 77.5%	09, 22.5%

The result in table 1a above revealed that 36 agricultural extension agents and 38 vegetable producers represented by 90% and 95% respectively are of the view that inadequate pre-harvest production practices causes post-harvest losses of leafy vegetables at production level. This is greater than the number of those with contrary view that is 04 and 02 responses represented by 10% and 5% respectively. Also, 37 agricultural extension agents and 35 vegetable producers represented by 92.5% and 87.5% are of the view that improper management of pest and diseases in the leafy vegetable farm brings about post-harvest loss of leafy vegetables while those with contrary view are 03 and 05 represented by 7.5% and 12.5% respectively.

Additionally, 28 extension agents' and 33 vegetable producers represented by 70% and 82.5% respectively stated that poor planning of harvesting time causes loss of leafy vegetables. This also is greater than 12 and 07 respondents who disagree with this statement and are represented by 30% and17.5% respectively. The results on the table further indicated that 31 extension agents' and 30 vegetable producers represented by 77.5% and 75% respectively are of the opinion that delay in the harvesting of leafy vegetable could lead to loss of leafy vegetables. This also is greater than 09 and 10 respondents who are of contrary view and are represented by 22.5% and 25% respectively.

Furthermore, the results on the table further indicated that 32extension agents' and 34 vegetable producers represented by 80% and 85% respectively are of the view that lack of equipment for harvesting leafy vegetable causes damages and hence lead to loss of leafy vegetables while 08 and 06 respondents are of contrary view and are represented by 20% and 15% respectively.

Also, the data in table 1a shows that 29 and 30 respondents represented by 72.5% and 75 % believed that poor treatment and handling of harvested leafy vegetables causes wastage and loss of leafy vegetables at the farm level while 11 and 10 respondents represented by 27.5%

and 25% respectively are of contrary view. The result in table 1a above also revealed that 36 agricultural extension agents and 33 vegetable producers represented by 90% and 82.5% respectively are of the view that lack of adequate storage facilities for preserving harvested leafy vegetables causes post-harvest wastage and losses of leafy vegetables at production level. This is greater than the number of those with contrary view that is 04 and 07 respondents represented by 10% and 17.5% respectively. 29 agricultural extension agents and 28 vegetable producers represented by 72.5% and 70% respectively are of the view that physical injuries resulting from poor handing of vegetables lead to wastage and losses at production level.

Lastly, 27 and 31 agricultural extension agents and vegetable producers respectively represented by 67.5% and 77.5% are of the view that poor ventilation of leafy vegetables at farm level could initiate deterioration at farm level leading to wastage and losses. This is greater that the number of those with contrary view represented by13 (32.5% and 07 (17.5%) respectively.

Responses of Agricultural Extension Agents and Vegetable Marketers on the causes of post-harvest loss and wastages of leafy vegetables that occur at producers and along the supply chain level in Kano and Jigawa States.

Table 1b (AEA (40), VP (40) =80)

What are the causes of leafy vegetable losses that occur along the supply chain level?					
S/No	**Item Statements**	AEA Yes (%)	AEA No (%)	VM Yes (%)	VM No (%)
01	Poor arrangement of leafy vegetables at collation centre.	38, 95%	02, 5%	36, 90%	04, 10%
02	Lack/ poor storage facility at the distribution centre.	40, 100%	00, 0%	35, 87.5%	05, 12.5%
03	Delay in the distribution of products by whole sellers to the retailers	36, 90%	04, 10%	26, 65%	14, 35%
04	Unsuitable packaging materials	35, 87.5%	05, 12.5%	33, 82.5%	07, 17.5%
05	Poor coordination and lack of ready market for leafy vegetables	30, 75%	10, 25%	33, 82.5%	07, 17.5%
06	Pest infestations carried from the farm	35, 87.5%	05, 12.5%	37, 92.5%	03 ,7.5%
07	Over loading of containers with leafy vegetables during transportation	35, 87.5%	05, 12.5%	32, 80%	08, 20%
08	Exposure of produce to extremes temperature along the supply chain.	33, 82.5%	07, 17.5%	30, 75%	10, 25%
09	Susceptibility to contaminants especially when dirty water is used for washing the products	38, 95%	02, 5%	37, 92.5%	03, 7.5%
10	Rejected produce lying around packaging houses and unhealthy produce	29, 72.5%	11, 27.5%	32, 80%	08, 20%
11	Breakdowns of vehicles along the supply chain	34, 85%	06, 15%	36, 90%	04, 10%
12	High weight loss resulting from the trimming of leafy vegetables	27, 67.5%	13, 32.5%	22, 55%	18, 45%

13	Arrival of fresh supplies in a market	30, 75%	10, 25%	34, 85%	06, 15%

The result in table 1b above revealed that 38 agricultural extension agents and 36 vegetable producers represented by 95% and 90% respectively are of the view that poor arrangement of leafy vegetables at collation centre before transportation to the sale point causes post-harvest losses of leafy vegetables along the supply chain. This is greater than the number of those with contrary view that is 02 and 04 responses represented by 5% and 10% respectively. Also, 40 agricultural extension agents and 35 vegetable producers represented by 100% and 87.5% are of the view that lack/ poor storage facility at the distribution centre in the leafy vegetable farm brings about post-harvest losses while those with contrary view are 0 and 05 represented by 0% and 12.5% respectively. Item 3 in the above table 1b also shows that 36 and 26 respondents representing 90% and 65% respectively are of the view that delay in the distribution of products by whole sellers to the retailers cause post- harvest losses and wastages of leafy vegetables along the supply chain. This is greater than 04 and 14 respondents represented by 10% and 35% respectively with contrary view. Furthermore, Item 4 in the table revealed that 35 and 33 respondents representing 87.5% and 82.5% respectively are of the believed that the use of unsuitable packaging materials facilitate losses and wastages of leafy vegetables along the supply chain. This is also greater than 05 and 7 respondents represented by 12.5% and 17.5% respectively with differed opinion.

The result in table 1b above revealed that item 5 had 30 agricultural extension agents and 33 vegetable producers represented by 75% and 82.5% respectively are of the view that poor coordination and lack of ready market for leafy vegetables lead to post-harvest losses along the supply chain. While 10 and 07 respondents represented with 25% and 17.5% are of contrary view respectively. Also, 35 and 37 respondents represented by 87.5% and 92.5% are of the view that pest infestations carried from the farm encourages post-harvest losses while those with contrary view are 05 and 03 represented by 12.5% and 7.5% respectively. Item 7 in the above table 1b also shows that 35 and 32 respondents representing 87.5% and 80% respectively are of the view that over loading of containers with leafy vegetables during transportation encourages post- harvest losses and wastages of leafy vegetables along the supply chain, while 5 and 8 respondents representing 12.5% and 20% respectively are of contrary view.

Also, item 8 in table 1b shows that 33 and 30 respondents represented by 82.5% and 75 % believed that exposure of produce to extremes temperature along the supply chain causes wastage and loss of leafy vegetables along the supply chain, while 07 and 10 respondents represented by 17.5% and 25% respectively are of contrary view. The result in table 1a above on item 9 revealed that 38 agricultural extension agents and 37 vegetable producers represented by 95% and 92.5% respectively are of the view that contamination of leafy vegetables especially when dirty water used for washing the products facilitates facilities deterioration leading to post-harvest wastage and of losses of leafy vegetables along supply chain level. This is greater than the number of those with contrary view that is 02 and 03 respondents represented by 5% and 7.5% respectively. 29 agricultural extension agents and 32 vegetable producers represented by 72.5% and 80% respectively are of the view that rejected produce lying around packaging houses lead to wastage and losses along the supply chain level, while 11 and 08 respondents representing 27.5% and 20% respectively are of contrary opinion.

Item 11 in the above table 1b also shows that 34 and 36 respondents representing 85% and 90% respectively are of the view that breakdowns of vehicles along the supply chain expose leafy vegetables to post-harvest losses and wastages along the supply chain. This is greater than 06 and 04 respondents represented by 15% and 10% respectively are of contrary view. Furthermore, Item 12 in the table revealed that 27 and 22 respondents representing 67.5% and 55% respectively are of the believed that high weight loss resulting from the trimming of leafy vegetables facilitate losses and wastages of leafy vegetables along the supply chain.

This is also greater than 13 and 18 respondents represented by 32.5% and 45% respectively with differed opinion. Finally, item 13 in table 1b shows that 30 and 34 respondents represented by 75% and 8% indicated that arrival of excess supplies of leafy vegetables in the market can lead to losses and wastages of leafy vegetables along the supply chain, while 10 and 06 respondents represented by 25% and 15% respectively are of contrary opinion

Responses of Vegetable Producers and Vegetable Marketers on the Level of farmers' use of post-harvest technologies in handling leafy vegetables in Kano and Jigawa States.

Table 2 (VP (40), VM (40) =80)

Level of farmers' use of post-harvest technologies in handling leafy vegetables						
S/NO	Items	HU	AU	PU	NU	Total
01	Using vegetable harvesters for cutting (Knife, cutlass)	51, 63.5%	19, 24%	04, 5%	06, 7.5%	80 100%
02	Curing of harvested leafy vegetables before transporting to the market	08, 10%	10, 12.5%	04, 5%	58, 72.5%	80, 100%
03	Covering leafy vegetables with cellophane bags to reduce moisture loss before reaching the markets	35, 43.75%	20, 25%	05, 6.25%	20, 25%	80, 100%
04	Keeping harvested produce in a shady place, proper cleaning or washing before marketing	43, 53.75%	25, 31.25%	4, 5%	8 10%	80, 100%
05	Applying ice block or sprinkling of water on leafy vegetables before and during distribution along the supply chain	47, 58.75%	15, 18.75%	4, 5%	14, 17.5%	80, 100%
06	Using local pots filled with water for cooling temperature of the leafy vegetables after harvesting or while in the markets	48, 60%	14, 17.5%	12, 15%	06, 7.5%	80, 100%
07	Using drying and milling method for processing excess leafy vegetables into powdery form for preservation	02, 2.5%	04, 5%	02 2.5%	72, 90%	80, 100%
08	Using excess and wasted leafy vegetables for silage preparation as livestock feeds	14, 17.5%	20, 25%	08, 10%	38, 47.5%	80, 100%

Key: HU-Highly Utilized, AU-Averagely Utilized, PU-Partially Utilized and NU-Not Utilized

The result in table 2 shows that 74 Vegetable Producers and Marketers representing 92.5% agreed to be using vegetable harvesting tools such as Knife and cutlass for harvesting leafy vegetables while 06 respondents representing 7.5% are of contrary view. Also, result in table 2 revealed that 22 respondents representing 27.5% of Vegetable Producers and Marketers are of the view that they have being curing and treating the cut portion of leafy vegetables before transporting to the market. This is less than the numbers of those that is 58 represented by 72.5 % who strongly disagree to have being treating and curing vegetables before marketing. Additionally, 60 Vegetable Producers and Marketers representing 75% indicated that they usually cover leafy vegetables with cellophane bags to reduce moisture loss before reaching the markets while 20 respondents representing 25% agree not to be covering their vegetables with cellophane materials.72 respondents representing 90% of Vegetable Producers and Marketers are keeping harvested produce in a shady place, proper cleaning or washing before marketing while 8 representing 10% are of contrary opinion. Furthermore, 66 Vegetable Producers and Marketers representing 82.5% agreed to be applying ice block or water on leafy vegetables before and during distribution along the supply chain. This also is greater than 14 representing 17.5% of Vegetable Producers and Marketers who are of contrary view.. On the other hand, 74 Vegetable Producers and Marketers representing 92.5% strongly agreed using local pots filled with water for cooling temperature of the leafy vegetables after harvesting or while in the markets while 6 respondents representing 7.5% disagreed. Also, 8 Vegetable

Producers and Marketers representing 10% agreed to be drying and milling excess leafy vegetables especially ammaranthus into powdery form for preservation while 62 of the respondents representing 90% are of contrary view. Lastly, 42 Vegetable Producers and Marketers representing 52.5% are of the view that they are using excess and wasted leafy vegetables for silage preparation as livestock feeds while 28 respondents representing 47.5% disagreed and do not convert excess leafy vegetable into hay for livestock feedings.

Responses of Vegetable Producers and Vegetable Marketers on the Implication of post-harvest loss of leafy vegetables on the socio-economics life of the rural farmers in Kano and Jigawa States

Table 3 (VP (40), VM (40) =80)

Implications of PHL of leafy vegetables on the socio economic life of the rural farmers						
S/NO	Items	SA	A	D	SD	Total
01	Educated farmers are conscious of post-harvest loss and always try to avert it occurrence.	38 47.5%	30 37.5%	08 10%	04 5%	80 100%
02	Both educated and un educated farmers are willing to accept guide by extension officers on how to avert post-harvest losses.	32 40%	36 45%	07 8.75%	05 6.25%	80 100%
03	Post- harvest losses usually discourage farmers from increasing production of leafy vegetables.	32 40%	34 42.5%	02 2.5%	12 15%	80 100%
04	Post- harvest losses at time could push farmers into financial deficit	40 50%	32 40%	02 2.5%	06 7.5%	80 100%
05	Post- harvest losses recorded often could reduce or affect farmers commitment to meeting family needs	70 87.5%	10 12.5%	00 0%	00 0%	80 100%
06	Post- harvest losses of leafy vegetables could encourage diversification by farmers in crop production	29 36.25%	24 30%	10 12.5%	17 21.25%	80 100%
07	Post- harvest losses could impact negatively on both farmers and distributors income	46 57.5%	25 31.25%	04 5%	05 6.25%	80 100%
08	Post- harvest losses of leafy vegetable could lead to food insecurity.	36 45%	18 22.5%	12 15%	14 17.5%	80 100%
09	Post- harvest losses of leafy vegetables could lead to increase in the price of the vegetables	45 56.25%	28 35%	02 2.5%	05 6.25%	80 100%
10	Post- harvest losses at time could push framers into psychological trauma and health challenges	32 40%	22 27.5%	08 10%	18 22.5%	80 100%

Keywords: SA=Strongly Agree, A=Agree, D=Disagree and SD=Strongly Disagree.

From the Table 4 above, item 1 shows the consciousness of educated farmers in averting post-harvest loss and it implication on the Socio-Economic life of the rural farmers, where 38 respondents representing 47.5% Strongly Agreed, 30 respondents representing 37.5% Agree, 08 respondents representing 10% disagree and 4 respondents representing 5% strongly disagree. This shows that socioeconomic life of educated rural farmers who are conscious of post- harvest losses is better than those farmers who are not conscious of post-harvest losses as majority of the respondents fall among strongly agree and agree. Item 2 shows the willingness of farmers to accept guide by extension officers on how to avert post-harvest losses where 32 respondents representing 40% Strongly Agreed, 36 respondents representing 45%

Agree, 07 respondents representing 8.75% disagree and 5 respondents representing 6.25% strongly disagree. This indicates that majority of the respondents are of the view that accepting guide from the extension agents will enhance effective management of leafy vegetable and thus improve on their socio economics life. Item 3 shows that post-harvest losses of leafy vegetable usually discourage farmers from increasing production where 32 respondents representing 40% strongly agreed, 34 respondents representing 42.5% agreed, 02 respondents representing 2.5% disagree and 12 respondents representing 15% strongly disagree. This indicates that framers are usually discouraged from increasing production of leafy vegetable as a result of post-harvest losses. In addition, item 4 revealed the implication of post-harvest losses of leafy vegetable on pushing farmers into financial deficit where 40 respondents representing 50% strongly agree, 32 respondents representing 40% agreed, 02 respondents representing 2.5% disagree and 06 respondents representing 7.5% strongly disagree. This shows that post-harvest losses of leafy vegetable create financial difficulties for farmers. Also, item 5 indicated that 70 respondents representing 87.5% and 10 respondents representing 12.5% who choose strongly agree and agree respectively are of the opinion that post-harvest losses of leafy vegetables makes it difficult for rural farmers in meeting their family needs.

Furthermore, item 6 revealed the implication of post-harvest losses of leafy vegetable could encourage diversification by farmers in crop production where 29 respondents representing 36.25% strongly agree, 24 respondents representing 30% agreed, 10 respondents representing 12.5% disagree and 19 respondents representing 21.25% strongly disagree. This shows that post-harvest losses of leafy vegetable could encourage farmers to diversify in crop production. Item 7shows that 46 respondents representing 57.5% strongly agree, 25 respondents representing 31.25% agree, 04 respondents representing 5% disagree and 05respondents representing 6.25% respectively. This indicates that majority of the respondents are of the view that post-harvest losses and wastage could impact negatively on both farmers and distributors income which translate to wastage of energy and resources deployed during production and marketing activities. Also, item 9and 10 indicates that 36,45 respondents representing 45% and 56.25% strongly agree, 18,28 respondents representing 22.5% and 35% agree, 12,02 respondents representing 15% and 2.5% disagree and 14,05 respondents representing 17.5% and 6.25% respectively. This indicates that majority of the respondents are of the opinion that post-harvest losses and wastage could lead to increase in the price of leafy vegetables and as well promote food insecurity. Finally, item 11shows that 32 respondents representing 40% strongly agree 22 respondents representing 27.5% agreed, 08 respondents representing 10% disagree and 18 respondents representing 22.5% strongly disagree. This also revealed that post-harvest losses of leafy vegetable could at time push framers into psychological trauma and health challenges thereby impacting negatively on their socio-economic life. Given the summary outcome of the aforementioned results, it can be deduced that, post-harvest losses and wastage of leafy vegetables could negatively affects the socio-economic life of the rural farmers within the study area.

Hypothesis Testing

In this study, t-test is used to test the hypothesis of no significant difference between the responses of leafy vegetable producers and marketers. (see Table 4). The test is used to compare the differences between two independent groups towards one dependent variable.

Table 4

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Leafy veg. Producers	42.967	39	.000	2.56563	2.4448	2.6864
Leafy Veg. Marketers	34.968	39	.000	2.45313	2.3112	2.5950

The results in table 4 above at 95% confidence interval and greater than 0.05 level of significance at 39 degree of freedom revealed that there is no significant difference in the mean responses of leafy vegetable farmers and leafy vegetable marketers on the use of post-harvest technologies towards reducing wastages and losses in Kano and Jigawa States. Therefore, the null hypothesis of no significant difference was upheld for the study.

5.0 Discussion of Results

The results of this study revealed several causes of post-harvest loss and wastages of leafy vegetables that occur at producers and along the supply chain level. Such factors includes; poor arrangement of leafy vegetables at collation centre, Lack/ poor storage facility, delay in the distribution of products by whole sellers to the retailers, poor coordination of marketing activities, unsuitable packaging materials among others. The finding of this study is in agreement with the findings of Yahaya and Mardiyya (2019) in a study carried out on the review of post-harvest losses of fruits and vegetables. It was reported that mechanical damage of fruits and vegetables caused by careless handling during harvesting, packing, transportation, storage etc. the author stated further that the mechanical injuries like bruising and cracking of fruits and vegetables result in favourable conditions causing secondary loss and wastage of leafy vegetables and fruits. Also, inadequate harvesting equipment, extended time taken for harvesting and grading in field exposes the fruits and vegetables with field heat for longer period of time which, may subsequently causes faster senescence and reduce shelf life. The findings of this study are also in line with the findings of Chetna, Amandeep.and Manzoor.,(2021)) in a study carried out on food loss and waste in food supply chains. It indicated that the major factors responsible for food loss and wastage include the poor management of perishable food items, stakeholder attitudes, buyer−supplier agreements and supply chain interruptions. *Bolarin and Bosa,(2015)* in a study conducted on Post Harvest Losses: A Dilemma in Ensuring Food Security in Nigeria; It was reported that the major problems cursing food loss and wastages are improper handling, lack of proper storage and packaging,

The findings of this study also shows that majority of the farmers and marketers have being using some of the simple technologies in managing leafy vegetables at post-harvest level. It revealed that92. 5% of the respondents uses simple harvesting tools for harvesting, 72.% agreed not curing and treating vegetables after harvesting, 75% also, agreed covering vegetables with cellphone papers to reduce moisture, 82.5% agreed applying ice block, cold and cold water while selling and along the supply chain. The findings of this study are also in line with the findings of Taiwo., Komolafe, Fapojuwo, and Martins,.(2022) in a study on the utilization of improved post-harvest techniques of leafy vegetables among farmers in Ojo Local Government Area of Lagos state, Nigeria. It was revealed that assembling harvested vegetables under tree shade (85.3%) and frequent sprinkling of water on harvested vegetables (75.3%) were the mostly used storage postharvest techniques among farmers.

The results of this study further revealed the impact of post-harvest loss and wastages of leafy vegetables that occur at producers and along the supply chain level on the life of the rural farmers; It shows that 93.5% of vegetable producers and marketers agreed that they are willing to accept guide from agricultural extension agents that could assist in averting post-harvest losses and wastages of leafy vegetables,85% agreed that it discourages farmers from increasing production and encourage diversification, 100% believes that it reduces farmers commitment in meeting family needs, 82% and 93.5% respectively are of the view that it could lead to increase in the price of food items and as well food insecurity in the study area. The findings of this study are also in agreement with the findings of Abdulganiyu (2017) in a study carried out on the Socio-Economic Analysis of Food Security Status of Smallholder Farmers in Land Degradation Prone Communities of Jigawa State, Nigeria. The results showed that 88% of the smallholder farmers were food insecured, 85% feed twice a day,70% doesn't eats to satisfaction, 52% produced food that last for <= 6 months and 98% doesn't access food at affordable prices.

6.0 Recommendations

There should be regular training of farmers by extension agents on the use of post-harvest technologies for effective management of pre-harvest and post- harvest period to minimize losses and wastage of leafy vegetables.

The government should subsidize farm inputs, storage and processing facilities for utilization by farmers towards minimizing post-harvest losses and wastages of leafy vegetables in the study area.

7.0 Conclusion

Based on the findings of this study, post-harvest losses and wastages is impacting negatively on the livelihood of the rural farmers and by extension food insecurity in the nation, Therefore, minimizing post-harvest losses of food is a very effective way of increasing food availability and ensuring food security in Nigeria. Having identified various factors that lead to or encourage food losses and wastages, there is need for effective communication among agricultural researchers, extension agents, farmers and marketers on the need to implement research findings towards reducing the impact of post-harvest losses and wastages of leafy vegetables on the producers and marketers and the entire society at large.

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