



ASSESSMENT OF POST-HARVEST LOSSES OF TOMATO IN ZOBE IRRIGATION PROJECT DUTSINMA LOCAL GOVERNMENT AREA OF KATSINA STATE

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ABSTRACT

The study assessed post-harvest losses of tomato in Zobe Irrigation Project, Dutsinma Local government Area of Katsina State, extent of vegetables losses, causes of post-harvest losses and response by the farmers in minimizing the losses were assessed. A total of 254 out of 765 registered farmers with Sokoto Rima River Basin Development Authority were sampled for the study. Investigative survey approach by means of structured questionnaire was used to collect the vital information. Descriptive statistics of frequency and percentage were used for the analysis of data. The results obtained revealed that 92% of the respondents were male while 8% were women. The study also revealed that 35% of the farmers were between the ages of 41-50. The mean values of post-harvest losses were 32.3% in Garhi, 29.4% in Makera, 28.7% in Ardawa and 26.75% in Salihawa. The farmers were using traditional method of sun drying, sorting, and storing in a cool places to preserve their tomato. The study recommended that government through Sokoto Rima River Basin Development Authority should provide the farmers with more proper packaging materials, tomato market, and suitable mode of transportation and establishment of private companies such as tomato processing industry that will minimize the unnecessary and avoidable wasting of the vegetable.

KEYWORDS: Tomato, Post-harvest losses, Irrigation farming, Zobe dam, Dutsinma.

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1.1 INTRODUCTION

Despite the remarkable progress made in increasing world food production at the global level, approximately half of the population in the third world does not have access to adequate food supplies. There are many reasons for this; one of which is food loss occurring in the post-harvest and marketing systems. Evidence suggests that these losses tend to be highest in countries where the need for food is greatest [1]. It is estimated that as much as 25% fruits, 40% vegetables and 15-20% grains are wasted harvest, post-harvest losses can be caused by a wide variety of factors, ranging from growing conditions to handling to retail level. Hence, the elimination of post-harvest losses of agricultural products is important to boost food security and availability in these countries [2]. The most important goals of postharvest handling are to keep the produce cool, thereby avoiding moisture loss and slowing down undesirable chemical changes and to avoid physical damage such as bruising to delay spoilage. This in turn will help ensure increased food security as food security goes beyond food production to include distribution and marketing, adequate and stable supply, and accessibility to food. Usually, losses occur from poor storage conditions in the markets and poor packaging during transportation. Due to the physiological form of fruits and vegetables, they deteriorate easily in transit and storage, especially under conditions of high temperature and humidity and as a result, heavy losses occur in these crops [3]. Post-harvest losses represent more than just losses of food. When 20 percent of a harvest is lost, the actual crop loss is just part of the problem. Also wasted are 20 percent of all the factors that contributed to producing the crop, 20 percent of the land used to grow the food and 20 percent of the water used to irrigate it, along with the human labor, seeds, fertilizer, and everything else. In other words, post-harvest food loss translates not just into human hunger and financial loss to farmers but into tremendous environmental waste as well [4].

In developing countries postharvest losses of fruits and vegetables are more serious than those in developed countries. In most developing countries the number of scientists concerned with postharvest handling research is significantly lower than those involved in production research. The handling procedures used in technologically advanced countries to reduce post-harvest losses are not fully recognised in developing countries [5]. It is estimated that about 50% of perishable food commodities including fruits, vegetables, roots and tubers and about 30% of food grains including maize, sorghum, millet, rice and cowpeas are lost after harvest in West Africa [6].

It is a fact that Nigeria is blessed with rich farmlands and subsequent good harvest each year. The country is one of the leading producer of tomatoes and other vegetables that are grown in its diverse agro-ecological zones that range from humid in the south to sub-humid in the middle belt and semiarid/arid in the north yet, produce are lost at an alarming rate of 30-50% yearly due to poor pre and post-harvest practices [7]. Agricultural losses are one of the greatest problems facing agricultural production in Nigeria and concern everyone from the research scientists to the extension workers/ marketers in the field to the farmers on the farm and to the government policy formulators. The post-harvest technological scenario in cereals, grain, legumes, oilseeds, fruits, vegetables, tubers, roots, of Nigerians present a dismal picture and are mostly comprised of traditional techniques practiced by growers, traders and the processor resulting in considerable deterioration of physical and nutritional qualities of harvested crop [8].

Tomato (*Lycopersicon esculentus*) is a staple fruit vegetable that is highly sensitive to frost. It thrives well in within a temperature range of 25 – 34 °C in Nigeria [9]. The domestic consumption and demand for tomato is growing due to increase in population. It is very important vegetable with substantial nutritional value. Tomato may be eaten fresh as salad or they may be pressed into pastes or purees, which are used for cooking in soups or stews and producing fruit drinks. Moreover, it is available at low price as compared to other vegetables. Unfortunately, they are not only seasonal but highly perishable and deteriorate few days after harvest, losing almost all their required quality attributes and some could likely result to total waste. In developing countries like Nigeria, storage, packaging, transport and handling techniques are practically non-existent with perishable crops, so this allows for considerable losses of produce. Furthermore, improper postharvest sanitation, poor packaging practices and mechanical damage during harvesting, handling and transportation resulting from vibration by undulation and irregularities on the road can enhance wastages [3].

The tomato plant is very versatile and the crop can be divided into two categories; fresh market tomatoes, which we are concerned with and processing tomatoes, which are grown only outdoors for the canning industry and mechanically harvested. World production and consumption have grown quite rapidly over the past 25 years. Tomato is one of the most important vegetables worldwide. World Tomato production in 2001 was about 105 million tons of fresh fruit from an estimated 3.9 million hectare [10].

The deterioration of the tomato starts during the harvesting operations, because fresh fruits are

inherently perishable. The more carefully a product is handled, the slower the deterioration process during subsequent handling operations. The causes of tomato losses included physical damage during handling, and transport, physiological decay, water loss, or sometimes simply because there is a surplus or glut in the market and no buyer can be found [11]. It is distressing to note that much is being devoted to planting crop, so many resources are spent on irrigation, fertilizer application and crop protection measures only to be wasted in few days after harvest [12].

The aim of the study therefore is to assess the post-harvest losses of tomato among tomato farmers in Zobe Irrigation Project Dutsinma Local Government while the specific objectives were to investigate the causes of post-harvest losses of tomato, extent of post-harvest losses of tomato and the farmer's response in minimizing the post-harvest losses of tomato in the study area.

2.1 MATERIALS & METHODS

2.2 Study area

Zobe irrigation project under Zobe Dam is located in Makera, a rural settlement 75km south of Dutsinma headquarters of Dutsinma LGA, Katsina State. The dam has rivers Karaduwa and Gada as its tributaries and stores up to 177 million cubic meters of water during rainy season. The reservoir formed by the Dam covers 4,500 hectares of rocky land and it is about 2.7 kilometers long flowing north-westward to the Sokoto Basin. The study area is located between latitudes 120°20'34.62" and 120°23'27.48" North of the Equator and longitudes 70°27'57.12" and 70°34'4.68" east of the Greenwich Meridian. Dutsinma LGA is bounded by Kurfi and Charanchi LGAs in the North, Dan-Musa and Matazu in the South, and Kankia and Safana LGAs in the East and West respectively [13]. The people of the area are farmers, but some rear animals and engage in fishing. The Hausa-Fulani are the largest and dominant group that occupies the area. Other ethnic groups such as the Igbo and Beriberi are also found [14].

2.3 Methodology

The target population of this study constitutes 765 farmers from 4 villages registered with Zobe irrigation project, under Sokoto River-Rima River Basin Development. The villages comprise of Makera, Garhi, Salihawa and Ardawa. (Table 1) Sample size was 254 based on Krejcie and Morgan (1970). The samples were proportionately allocated base of the number of registered farmers from each village. The study also adopted simple random sampling method to draw the respondents from each village.

The survey was conducted using investigative survey research approach (ISRA). Information was collected using structured questionnaire which sought for the following information: personal information like gender, age, level of education, marital status, and years of experience. Farm size, packaging materials, mode of transport, causes of losses, extent of losses and measures to minimize them.

Table 1: Registered farmers and samples

Villages	Registered Farmers	Samples
Makera	270	90
Garhi	220	73
Salihawa	155	51
Ardawa	120	40
Total	765	254

2.4 Statistical Analysis

The descriptive statistics such as frequency mean and percentages were used.

3.1 RESULTS & DISCUSSION

3.2 Socioeconomic Characteristics of the Respondents

Table 2 shows tomato farming which is dominated by male (92%), this implies that tomato farming is dominated by male farmers and could be attributed to the cultural setting of the people of the area in which land is allocated to males while female are deprived of direct land ownership. This is contrary to the finding of [15] that women are known to be more involved in agricultural activities than men sub-Saharan African countries, Nigeria inclusive. As much as 73% were involved in cash crops, arable and vegetable gardening, while post-harvest activities had 16% and agro forestry 15%. The study also revealed that, higher proportions (35%) of the sampled farmers are within the age range of 41-50, while farmers that are in youthful age had the least frequency (17%), this shows that most young people are not into farming and migrate to the cities looking for more lucrative jobs, [16] reported that Majority (94%) of the yam farmers in Wukari local government area of Taraba state were less than 60 years of age, and only 6% of the respondents were above 60 years.

The marital status as presented on Table 2 shows that with 66% tomato farming is dominated by married people, this is due to the cultural setting of the people in the study area that any capable person get married in order to have more children that will assist them with their farming activities. [11] Reported that majority of the tomato farmers in Imeko-Afon Local Government Area of Ogun State, Nigeria are married (86.4%) while 13.64% are either single or divorced.

Table 2: Socio-economic Characteristics of the Respondents (n = 254)

Sex	Frequency	Percentage
Male	234	92
Female	20	8
Age	Frequency	Percentage
30 and below	43	17
31-40	74	29
41-50	89	35
51 and above	48	19
Marital status	Frequency	Percentage
Married	168	66
Single	53	21
window	33	13
Level of education	Frequency	Percentage
Did not go to school	74	29
Primary	112	44
Secondary	53	21
Tertiary	15	6
Farm size	Frequency	Percentage
1 and below acre	109	43
1-2 acre	97	38
2 and above acre	48	19
Farming experience (years)	Frequency	Percentage
5 and below	38	14
6-10	63	25
11-15	99	39
Above 15	56	22

Source: Fieldwork, 2019

The level of education shows that tomato farmers with only primary certificate are the highest with (44%) while only (6%) where manage to make it up to tertiary institution, this shows that the education level of the farmers is very low. [17]Reported that only very few farmers in Awgu local government area of Enugu state have tertiary education (3.2%) and secondary education (5%)

The result revealed that tomato farmers with one and below acre are the highest with (43%) and those that have more than two acre are the least with (19%) this shows that majority of the irrigation farmers in the study area are small scale farmers, this is due individual land tenure system and as result of inheritance and increased in population led to the sub division and fragmentation of the farmland.

The findings shows that at those farmers with farming experience between 11-15 years are the dominant with (39%) this shows that the tomato farmers were experienced and are into farming for relatively long period of farming. Experience is very important in farming business especially when dealing with fruits and vegetables which are perishable agricultural produce. An experience farmer would be aware of when

to plant his crops, when to harvest, most agronomic practices required for quality yield [12].

3.3 Causes of Post-harvest Losses of Tomato

Table 3 presented different causes of post-harvest losses from harvest to the market; the causes of the losses include microbiological, mechanical and environmental factors, however with (37%) environmental factors are the highest this is as result of excessive heat and change in wind velocity which makes the tomato more prone to deterioration more especially in tropical areas. Also Animals attack (34%), this is because animals attack such as bird, rodents and bigger ones like goat and sheep eat up and destroyed some of the tomato. Mechanical factor (29%), tomatoes are squashed on the ground by the feet of the pickers because of insufficient spacing. Tomatoes are also harvested in baskets and plastic buckets that are stacked one on top of the other his causes crushing and bruising of the fruit during head load transportation from the field. When fruit crops are harvested from the parent plant it begins to deteriorate, every year there is 16-36% post-harvest losses in fruit crops by mechanical, microbial and physiological losses[18].

Table 3: Causes of Post-harvest Losses of Tomato (n=254)

Causes of Tomato Losses at Harvest	Frequency	Percentage
Microbiological & Animals attack	86	34
Mechanical factors	74	29
Environmental factors	94	37
Causes of Tomato Losses during Transport	Frequency	Percentage
Inappropriate packaging	46	18
Poor transport network	112	44
Inappropriate mode of transport	74	29
Inadequate loading vehicles	22	9
Causes of Tomato Losses at Storage	Frequency	Percentage
Microbiological & Animals attack	58	23
Inappropriate storage facilities	122	48
Inadequate storage facilities	74	29
Causes of Tomato Losses at the Market	Frequency	Percentage
Low patronage	104	41
Inappropriate packaging	43	17
Poor hygiene	20	8
Ambient temperature	87	34

Sources: Fieldwork, 2019

Causes of losses during transportation comprised; inappropriate packaging, poor transport network, inappropriate mode of transport and inadequate loading vehicles, however, However, poor transport network is the dominant factor with (44%), this is

because most of the roads in the area are in bad condition which make it difficult for some vehicles to use causing unnecessary shaking and delay in transporting the tomato to the market and in turn making some of the tomato to spoiled along the way. Inappropriate mode of transport (29%), most of the vehicles used for transporting the tomato to the point of sale are not suitable and often being overloaded there by making some of the vegetables to damage on the road. Lack of access roads to production fields in many African countries is a major challenge hampering the success of the tomato industry. Majority of the production fields are located in remote areas, which are far from improved roads making access to competitive markets difficult and costly. In cases where there are roads linking these farming sites, these roads are in a very deplorable condition [19]. The use of appropriate transportation is another factor to consider in postharvest handling of tomatoes. During transportation, the produce should be immobilized by proper packaging and stacking to avoid excessive movement or vibration. Vibration and impact during transportation as a result of undulations on roads is one of the major causes of post-harvest losses to most fruits and vegetables especially tomatoes [3].

The causes of post-harvest losses of tomato during storage include: Inappropriate storage facilities, inadequate storage facilities, microbiological and animals attack, however, inappropriate storage facilities is the highest with (48%), the farmers use local storages which are not suitable for storing the perishable tomato, hence microbiological, ambient temperature and bigger animals can easily spoiled some of the tomato before selling them. Also inadequate storage facilities (29%) shows even the local storage facilities used by the farmers are not enough to store their tomato, the storage used by the farmer are often not enough to store large amount of tomato at a time as a result some of the farmers have to keep their tomato under the shade of trees which change directions as hours pass there by exposing the vegetables to excessive heat of the sun light [20]. High temperatures during post-harvest storage are commonly associated with high transpiration rates and subsequent degradation of quality traits. The causes of tomato losses at the market comprise; low patronage, ambient temperature, inappropriate packaging materials and poor hygiene, however, low patronage is the dominant factor with (41%), and this normally occurs during the peak time of harvest when most of the tomato farmers brought their tomato to the market which makes it difficult for some of the farmers to sale their tomato and in turn start spoiling. Ambient temperature (34%), heat is causing serious damage to the tomato most especially during midday when there is scorching sun. [21] Reported that

in Africa, there is no information on reliable market availability, here is lack of communication between producers and consumers and also lack of market information. This has been the main reason for the mismatch between production and available markets. Producers therefore have to sell their harvest at very low cost to prevent total loss. Marketing cooperatives are needed by producers in African countries in major tomatoes producing areas to create market for producers. The inefficiencies in using the wooden crate lies in the inadequate ventilations provided for cooling, sharp surfaces and edges and depth of the package. The depth of the crate is not appropriate as there is always crushing of fruits near the base as compression pressure increases with depth [22].

3.4 EXTENTS OF TOMATO LOSSES

3.4.1 Spatial variation of tomato losses across the villages

Result presented in (Table 4) shows that, some villages experience tomato losses more than others. Garhi is the highest which experienced (32.3%) followed Makera with (29.4%) than Ardawa and Salihawa with (28.7%) and (26.75%) respectively. This can be attributed to that fact that causal factors and measures taken by the farmers in minimizing the losses can be slightly different from one village to another. This is in line with the study by [8 & 19], which said that the magnitude of losses varies greatly from place to place and agrees with them that losses are often difficult to calculate since losses are related to improper temperature management, and other factors and that 40% to 50% of agricultural crops produced in developing countries are lost before they are consumed, mainly because of high rate of bruising, water loss, and subsequent decay during handling.

Table 4: Spatial variation of tomato losses across the villages

Villages	Losses in Percentage (%)
Makera	29.4
Garhi	32.3
Salihawa	26.75
Ardawa	28.7

Sources: Fieldwork, 2019

3.4.2 Percentage of Tomato Losses at different stage

The overall post-harvest losses of the tomato in the entire villages is 29.55%, however, there are losses at every stage from harvest to the market, the losses occur at harvest, during transport, storage and during sale. As presented in (Table 5) the finding shows that only 2.6% of the tomato losses occur at harvest, this is because the tomato does not take much time at the field; majority of

the farmers harvest and transport their tomato to the market early in the morning or late evening in order to avoid excessive heat. In the same manner, the finding shows that 9.35 % of the tomato get spoiled during transportation, this because of the poor transport network and inappropriate mode of transportation which most of the farmers use in transporting the vegetables to the market. With 3.7% losses of tomato incurred at storage, the losses are relatively low due to the fact that most of the farmers do not allow their tomato to take long time due to its perishability nature. Also the highest tomato losses 13.9% occur during sale this is because there is sufficient supply of tomato during peak time of harvest when most of the farmers brought their tomato to the markets coupled with fact that most of the packaging materials use are not suitable which make some of the vegetables to spoiled before selling them. [18] Reported that the postharvest losses of fruit in India are farmers field (15-20%) packaging (15-20%) transportation (30-40%) marketing (30-4-%). (24) Reported that majority (55.0%) of tomatoes in Gboko Local Government Area of Benue state get loss during harvesting season. This is due to non-availability of storage facilities and the high water content of the fruit which make them spoil easily after harvest.

Table 5: Percentage of tomato losses at different stages

Stages	Losses in Percentage (%)
At Harvest	2.6
Transport	9.35
Storage	3.7
Selling Point	13.9

Sources: Fieldwork, 2019

4.1 Farmers response to tomato post-harvest losses

The finding presented in (Table 6) shows the response and action taken by the farmers in reducing losses during harvesting which include harvesting before it fully ripe and harvesting in the morning and evening. However, early morning and late evening harvesting is the highest with (74%), farmers resort to harvesting tomato at morning and evening when the temperature is relatively cool in order to avoid the excessive heat that may damage the tomato. Also (26%) of the farmers harvest their tomato before it fully ripe this is the possibility of spoilage and damage during transport and market will be minimal. A study by [25] revealed that, although about 46% of Nigerian farmers harvest their tomatoes in the morning and 12% in the evening, most of them store the harvested tomatoes under tree shades until buyers arrive. Tree shades are not reliable as they

are likely to shift away from the produce when the sun changes its position. The fruits are therefore exposed to the scorching sun causing a buildup of field heat in the produce.

The measures adopted by farmers during transportation include, transporting the tomato to nearby markets, using car and pick up van as means of transportation and early morning transport. However, transporting the tomato to the nearest market is the highest with (65%), because transporting the tomato to relatively shorter distance minimizes the damage that may occur as a result shaking and vibration of the tomato. Also, Using car and lorry as mode of transport (26%) car and lorry are faster and more efficient than other mode of transportation such as bicycle and animals. Morning transportation (9%), morning transportation when there is relatively cool temperature reduces damage causes by heat. [26] Reported that majority (70.00%) of the tomato farmers in Abeokuta north local government area of Ogun state always transported their product to markets by pick-up van. [27] Reported that transportation of tomatoes should be done in a well-ventilated vehicle, which should be covered at the top to prevent direct sunlight, protection from rainfall other hazards.

Table 6: Farmers Response to tomato Losses (n=254)

Response at Harvest	Frequency	Percentage
Early morning & late evening harvest	189	74
Harvesting before it fully ripe	65	26
Response at Transport	Frequency	Percentage
Transporting to Nearby Markets	166	65
Using Car and pick up van as mode of transportation	65	26
Morning Transportation	23	9
Response at Storage	Frequency	Percentage
Sun drying	117	46
Storing in cool dry places	76	30
Sorting	61	24
Response at the Market	Frequency	Percentage
Selling the tomato at cheaper price	163	64
Targeting another Market	91	36

Sources: Fieldwork, 2019

The measures adopted by the farmers during storage comprise storing in cool places, sun drying and sorting. However, Sun drying is high with (46%); this method is adopted to put the tomato under the sun to dry-off the moisture content from the tomato and can then be stored for a long period of time. Storing in cool dry

places (30%), storing the tomato in a cool places slows down the activities of the microorganisms that destroyed the tomato and in turn the quality of the tomato will be reserve for sometimes. Also, sorting (24%) is done by the farmers to remove injured, decayed, misshapen tomato in order to limit the spread of infection to other healthy tomato. Drying is the oldest and cheapest method of preservation of horticultural produce. Drying involves the removal of water with minimum damage to the food. Evaporators will concentrate the food 2-3 folds or more while driers take the foods very close to total dryness that is to 97-98% solids [18]. Pre-cooling is the first step in good temperature management. The field heat of a freshly harvested crop that heat the product holds from the sun and ambient temperature is usually high, and should be removed as quickly as possible before shipping, processing, or storage [28].

Response by the farmers at the market, selling the tomato at cheaper price is the dominant (64%), majority of the farmers prefer to sale their tomato at relatively cheaper price to avoid further deterioration which mostly happens at late evening when buyers are leaving the market. Targeting another (36%), some of the farmers prefer take the risk and wait for another market most especially those that harvested their tomato before they fully ripe.

CONCLUSION

Base on the finding the following conclusion are made: It can be concluded that since most of the tomato farmers have low level of education, they will find it difficult to adopt modern method of harvesting crops, by implication the post-harvest losses of tomato will be higher. In the same manner, the tomato farmers use packaging materials like wooden basket with sharp and irregular edge and transported with inappropriate mode of transport, the implication is that the most of the tomato will be spoiled before reaching the point of sale. Use of traditional methods for minimizing post-harvest losses is inefficient and inadequate for preserving large quantity of tomato which led to spoilage of tomato after harvesting.

Based on the findings of the study, the following recommendations were made:

1. The tomatoes farmers should be organized in to cooperate societies which will enable them to acquire improve quality seeds that will be resistance to the microbial attack.
2. Government through Sokoto Rima River Basin Development Authority should provide the farmers

with more proper packaging materials and suitable mode of transportation that will minimize the losses.

3. Establishment of private companies such as tomato processing industry and Provision of modern processing and storage facilities will minimize the unnecessary and avoidable wasting of the tomato.
4. Village farm produce markets should be set up by the government which will be close to the farmers, so as to reduce the burden of transportation.

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