

## **POST-HARVEST CHALLENGES OF FOOD CROPS IN JAKAIRI SUB-DIVISION, CAMEROON. A THREAT TO FOOD SECURITY**

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### **ABSTRACT**

In Less Economically advanced nations, more than half of their populations live in rural areas and majority depend on agriculture for survival. Post-harvest food loss in Africa represents a multi-faceted challenge that reduces the income of approximately 470 million farmers. Agriculture plays a key role in the overall economic performance of Jakiri Sub Division, in terms of its contribution to food, source of livelihood and in providing employment. Using secondary and primary data, participatory approaches through field observation, questionnaires and interviews, this study investigates post-harvest options of farmers in Jakiri Sub-Division. Results revealed that agricultural production techniques have evolved and improved over the years, however very little has been done to improve post-harvest management. Findings equally showed that Post-harvest options of farmers are inadequate due to a complexity of reasons such as the absence of sufficient technologies/infrastructures, inadequate capital and technical knowhow and above all refusal to adopt appropriate techniques. Consequently this results in large quantities of harvested food produce being lost thereby representing a waste of time, effort and resources. Overcoming these socio-economic constraints through the development of infrastructures, increased training and sensitisation of the local population is an important step in achieving food security and also it would go a long way to increase the efficiency of resources used in food production.

**Keywords:** Post-harvest, Food security, production techniques, Jakiri

### **INTRODUCTION**

Over the past decades, significant focus and resources have been allocated to increase food production in different parts of the world. About 95% of these research investments are all in a bid to improve on agricultural productivity. Food production equally is critical for ensuring global food security but this is not sufficient if proper management technics of food crops after

harvest are not employed, (Kader and Roller 2004; WFLO 2010). In addition, agriculture is constantly being challenged by climatic variability which has had a great impact on crop produce in terms of quality and quantity of crops produced (Gustavasson et al 2011) Effective postharvest management therefore maintains the quality of food crops from when they are harvested to when they reach the consumer. Each year massive quantities of world's food harvest are lost to spoilage and infestations on the journey to consumers. According to the Food and Agriculture Organisation (FAO 2004) of the United Nations, 1.3 billion tons of food are globally lost per year. Reduction in these losses would increase the amount of food available for human consumption and enhance global food security. Coupled with this is the global increase in food prices due to growing consumer demand, increase demand for biofuel, industrial uses and increased weather variability (Mundial, 2008; Trostle, 2010).

Post-harvest food loss in Africa represents a multi-faceted challenge that reduces the income of approximately 470 million farmers and other value chain actors by as much as 15% (The Rockefeller Foundation 2013). Over the past 40 years, 40-50% of food crops produced in developing countries are lost before they can be consumed mainly because of high rates of bruising water loss and subsequent decay during posts harvest handling (Kitinoja, 2002; Ray and Ravi, 2005). The magnitude of these losses and their impact on farm income varies from place to place. The importance of postharvest management lies in its capacity to meet the food requirements of growing populations most especially that of Sub Saharan Africa by reducing losses and increasing the production of nutritive food items. Postharvest technologies such as quality maintenance, conservation, processing, packaging, distribution and marketing of agricultural produce are necessary. These technologies stimulate agricultural production, reduce losses, improve nutrition and add value to products, thereby generating employment, reducing poverty and stimulating growth within other related economic sectors.

About a third of food produced in Cameroon is wasted due to poor postharvest management. This post-harvest food loss greatly has devastating consequences on farmer's food security, nutrition, health, and livelihoods as a whole. With this huge postharvest losses efforts are needed to reduce these losses if we are to enhance global food security in Cameroon. A great variety of food crops (Maze, beans, soya beans, potato, groundnuts cassava, sweet potato, cocoyam, and yam), vegetables (cabbage, tomato, onion, spinach, green spices, okra, and pepper) and fruits (banana, mango, pineapple, jackfruit, papaya, melon, mandarin, guava, citrus fruits; oranges lemon and lime) are cultivated in Jakiri Sub-Division. In Jakiri Sub Division, food crops are harvested seasonally and prices increase as the new harvest approaches. Farmers sometimes benefit from these increases by storing for long periods and then selling out of season. However, these benefits hardly last as long-term storage increases the crops' susceptibility to deterioration especially by pests and diseases as the storing facilities are poor, inadequate or

completely absent. Post-harvest management in Jakiri Sub Division, like in most developing countries is far from satisfactory. Appropriate post-harvest management technologies are not available. Based on the above therefore, this paper seeks to examine food crop management and causes of post-harvest food losses in Jakiri Sub-Division.

## **METHOD AND STUDY AREA**

Field survey was undertaken in two phases; the 1<sup>st</sup> phase, which was mainly field observation, discussions and snap shorts, ran from September to October 2014. From this first part, the study area was delimited with focus on the various postharvest management strategies and the challenges faced by farmers in preserving crops, vegetables and fruits within the area. The 2<sup>nd</sup> phase, which comprise of interviews and the administering of questionnaires ran from December to May (2015). Interviews were conducted with some officials of the Department of Agriculture and Economic Development of the area. This included interviews with the Sub Divisional Delegate of Agriculture and Rural Development, Mayor of Jakiri, 2<sup>nd</sup> Deputy Mayor of Jakiri council, some members of the Hard Labour Mixed Farming group in Jakiri. From these discussions, information was collected on the various post-harvest management strategies and challenges farmers face such as transportation, sorting/threshing, processing to storage and marketing of food crops. Some warehouses in this area were visited and this enable us to collect quantitative data, post-harvest management options. Discussions with resource persons from NGOs such as Agricultural Competitive Improvement Project (PACA) helped to identify their activities which included sensitisation and granting of subsidies to farmers in order to encourage them carryout appropriate farming techniques and above all adopt best post-harvest management options. Furthermore, interviews and discussions were granted to farmer groups most especially women since they are more involved in postharvest management.

A total of one hundred and twenty (120) questionnaires were designed and administered to some sampled village population of Jakiri Sub Division to acquire information on postharvest management techniques, the various processes involved and the challenges they face. A systematic random sampling of households was used to ensure that each villages had a chance to be chosen without bias. From this sampling technique 8 villages were selected and these villages included Jakiri, Sop, Ber, Vekovi, Wainamah, Mantum, Shiy and Nkar. Questionnaires were distributed to each village base on its population size (Table 1)

**Table 1: Sample size obtained for questionnaire distribution**

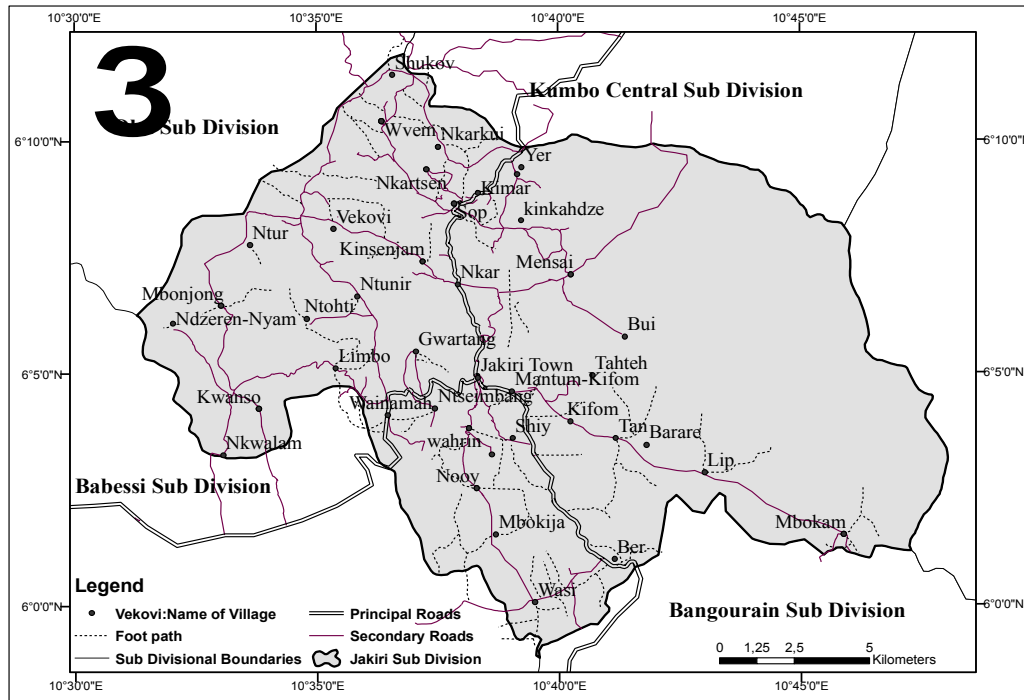
Number of Villages	Name of Village	Population of Village	Number of Questionnaires Administered	Number of Questionnaires Retrieved
1	Jakiri	3500	30	30
2	Mantum	1500	10	10
3	Sop	881	8	8
4	Wainamah	2350	20	15
5	Nkar	1880	12	12
6	Vekovi	900	5	5
7	Ber	3000	20	15
8	Shiy	2300	15	15
Total	8	16311	120	110

Source: Field Work 2015

Data on types of food crops and post-harvest management activities was also collected from reports of the Regional, Divisional and Sub Divisional Delegations of the Ministry of Agriculture and Rural development (MINADER). Policy documents on Jakiri Sub Division were also concerted from the council such as the Council Development Plan (CDP), the Master Plan for Jakiri Sub Division and the Council Monographic Studies. This source provided information on the population of each village, various socio-economic activities carried out in each village.

Descriptive analyses were employed to analyse information on post-harvest management techniques of food crops. It was then transformed into qualitative data by sorting out the percentages of responses and computed using the Microsoft Excel and this information was displayed in form of tables, charts, bar charts, histograms. The Chi Square statistical method was used to analyze post-harvest management activities. Jakiri Sub-Division is located between latitude  $6^{\circ}00'$  and  $6^{\circ}10'$  North of the Equator and longitude  $10^{\circ}31'$  and  $10^{\circ}48'$  East of the Greenwich Meridian (Figure 1)

Figure 1: The Layout of Jakiri Sub Division



Source: Geospatial Information Services Yaoundé, (2013)

The climate of Jakiri Sub-Division is characterized by two major seasons, the dry and wet seasons. The wet season lasts for 8 months (from mid-March to mid-October) while the dry season lasts for four months (from mid-October to mid-March). The short dry season is often characterized by windy, dusty and foggy weather conditions. The main form of precipitation is rainfall, during which ground water recharge takes place to ensure perennial flow of rivers. Average annual rainfall ranges between 1500mm – 2000mm, while mean monthly rainfall varies between 0-500. During the wet season most of the roads here become slippery and muddy, since they are untarred consequently rendering the transportation almost impossible. The average temperature is about 20°C in the wet season and 27°C in the dry season. During the wet season the atmosphere is usually warm and moist, with relative humidity averaging 91%, contrary to the hot dry conditions in the dry season where relative humidity figures are barely above 52.25% (Sakah, 2008).

The relief of Jakiri Sub Division forms part of the Western Highlands and Bamenda highlands in particular. The highest altitude (2,084m above sea level) occurs in the North in Vekovi area, while the lowest is found in Ber in the south (approximately 1,406m above sea level). Elsewhere the topography is generally undulating punctuated by forest galleries and interlocked spurs.

Jakiri Sub- Division consist of plutonic and volcanic rocks. The dominant rock which forms the basement complex is basalt which are of volcanic origin. These serve both as aquifers for the development of streams and parent materials for the development of soils in the region. (Tata 2008). The lowland regions are characterized by black alluvial soils and these soils are better suited for the cultivation of crops like rice, groundnuts, maize, beans, soya beans, white yam.

The natural vegetation is predominantly grassland. There are equally patches of man-made and natural forest dotted over the area which the population exploits for timber and fuelwood. Raffia palms and cola nut trees can be seen in valleys and around settlements whereby the population exploit to sustain their livelihood. From the National census published by BUCREP in 2005, the population of Jakiri Sub-Division was estimated at 85,500 with an annual growth rate of about 2.6% distributed across 33 villages. Generally the female population (51%) in the municipality was higher than the male population (49%). The active population (18 to 60 years) was considerably high and constituted 59% of the total population as opposed to the very elderly and depended group below 18 years of age who constituted 39% of the population (BUCREP 2005).

More than 90% of the people are engaged in agriculture as it is the main economic activity of the people (Jakiri Council Plan 2006). The main type of agriculture practiced in Jakiri is subsistence farming and pastoral nomadism. The products derived from this practice range from cereals and pulses such as maize, beans, soya beans, groundnuts to tubers and root crops such as; yams, Irish and sweet potatoes, yams and vegetables/fruits and dairy products. These produce are sold in the main market of the area and other towns in Cameroon and also to neighbouring countries, such as Gabon, Central African Republic and Equatorial Guinea. Furthermore, sand and stones quarrying are other primary activity that is practiced in the area. The main tertiary activities in Jakiri are services rendered in schools, Banks and hospitals.

### **FOOD CROPS CULTIVATED AND FARMING TECHNICS**

Major food crops cultivated in Jakiri Sub Division range from Maize, Beans, Cassava Colocassia (macabo), Solanum, Potatoes, Tomatoes, Rice, Onions, Cabbage, Carrots, Yam, Groundnuts, Garlic and vegetables. It was observed here that the cultivation of food crops in any given location is a function of soil type, relief and climatic conditions This explains the disparity in the production of food crops in Jakiri Sub-Division. The low lands have alluvial soils which favour the cultivation of grains and pulses such as rice, groundnuts and beans. Whereas high lands such as Tarshem, Mvem and Vekovi are are characterised by cold climatic conditions together with organic deep soils that favour the cultivation of market gardening crops such as tomatoes, garlic, cabbage and carrots.

Consequently the methods and techniques of cultivation differ from one crop to the other. Analyses of questionnaire revealed that mixed cropping or inter-cropping is the highest technique that is used by most farmers across the study area (Table 2). According to most respondents, this method helps to minimise the risk of losses. This is a situation whereby farmers cultivate several crops on the same piece of land such as maize, beans, Irish potatoes. Irrigation of food crops most especially vegetables and tomatoes is usually done during the dry season. Based on a sample survey carried out in the field, crop rotation and multiple cropping registered 19% and 18% respectively, most farmers practice this method in order to improve on soil fertility, monoculture 13% and irrigation 9% (usually during the dry season when there is little or no rainfall).

**Table 2: Response on Farming Techniques/Cultivation methods.**

Responses	Frequency	Percentage %
Mixed cropping	45	40
Monoculture	15	13
Irrigation	10	9
Crop rotation	21	19
Multiple cropping	20	18
Total	111	100

Source: Field Work, 2015.

In the past, shifting cultivation was the main form of farming with the use of crude methods and with very minimal use of farm inputs. These techniques could guarantee soil fertility for a short period of time as nutrients are destroyed in the process. However with population evolution in this area, some of the farmlands have been taken over for other activities. Today, the Government of Cameroon through the Ministry of Agriculture, MIDENO and NGOs have sensitised and created an awareness on the importance of adopting proper ecological behaviours. Many farmers now try as much as possible to adopt those techniques that guarantee soil fertility and above all high yields.

Ridge formation is the most popular technique of ploughing in the Jakiri Sub-Division as compared to the past where the “slash and burn” method of cultivation was widely used. The “Slash and burn” method of farming is gradually being replaced by the “slash and mulch” method. With this method the cleared grass is arranged in furrows and covered by soil in aligned stretches to form ridges without burning. Farmers here use chemical fertilizer like 20 10 10



5.5(NPKCaO<sub>3</sub><sup>1</sup>), UREE for the cultivation of food grains such as maize, beans and rice. Organic manure gathered from animal droppings such as fowl dropping and cow dung and compost manure are mostly used for the cultivation of market gardening crops such as vegetables, onions, carrots and this is highly dominant around Vekovi. Herbicides commonly used in the study area include; Labada 480, Plantop 360, Quielear 360, plantoxone super and glyphosate. .Based on survey carried out on a sample population in the field, it was revealed that 40% of respondents use compost manure 30% uses organic manure since it is cheap and above all ensures soil fertility for the cultivation of most especially market gardening products, 20% of farmers use chemical fertilizers most especially for the cultivation of food grains, while herbicides occupy 10% as they help to keep the farm weed free and equally minimises the manual work of clearing.

### CAUSES OF POST-HARVEST FOOD LOSSES

Post-harvest food loss is a major challenge to post-harvest management in Jakiri Sub-Division. Post-harvest Food Loss (PHL) is defined as measurable qualitative and quantitative food loss along the supply chain, starting at the time of harvest to consumption or other end uses (Hodges et al 2011). Most Subsistence household farmers do not get real value for their produce due to losses. Losses are waste of food, but also represent a similar waste of human effort, farm inputs, livelihoods, investments and scarce resources. Field survey reveals that food is wasted throughout the Food Supply Chain from initial agricultural production down to final household consumption. These losses vary between perishable and durable food crops. Significant food losses in the study area are mostly experienced at the early stages in the food supply chain (Table 3).

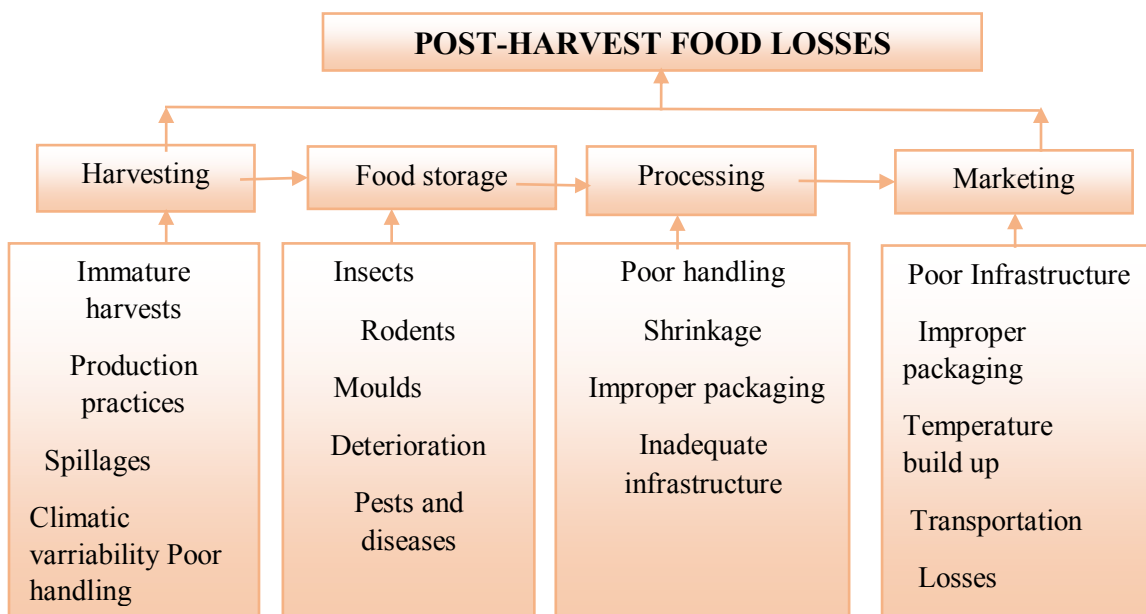
**Table 3: Food losses at various stages of the post-harvest management chain.**

Crop	At harvest	Processing	Transportation	Storage	Marketing
Maize	X	X	-	X	-
Beans	X	-	-	X	-
Irish potatoes	X	-	X	X	-
Yams	X	-	X	X	-
Rice	X	X	X	X	-
Plantains	X	-	-	-	-
Cassava	X	X	-	-	-
Tomatoes	X	-	X	X	X

Source: Field work 2015



Cassava, yam, Irish potatoes, tomatoes and plantains are the dominant food crops and are very perishable. These products are easily damaged during harvest, transportation and storage. At harvest huge quantities of food grains such as rice, maize and beans are lost due to spillages, or even abandonment in the farms if labour is insufficient. In as much as field results reveals that most farmers experienced huge losses as a result of biological and environmental reasons and above all fluctuating climatic conditions, the major causes are socio-economic reasons such as attack from pests and diseases due to poor quality of storage facilities, limited technology, poor road networks, and inadequate training and information (Figure 2)



**Figure 2: Causes of Losses at the various post-harvest stages.**

**Source: Field work 2015**

Food crops such as tomatoes, carrots, onions contain much water. When food and water reserves are exhausted, produce dies or decays. Increases in normal physiological changes can be caused by high temperatures. Most perishable food crops such as tomatoes are damaged when exposed to extremes of temperature. Equally there are losses due to and physical injury. With the recent variations in climatic conditions and a shifts in weather patterns, and extreme weather events, smallholder farmers in the study area face increasing risks associated with crop losses.

Pests and diseases are also major challenges to post-harvest management as 50% of farmers here perceived an imminent risk of losses due to attack by pests and diseases if they store their crops for longer periods of time. Attacks from weevils and rodents, and growth of molds are among the

agents contributing to the losses. Common crop pests and diseases prevalent in the study area are shown on table 4 below.

**Table 4: Common crop pests and diseases in the study area.**

CROP	PESTS AND DISEASES
Cassava	Mosaic, Tuber rots
Cocoyam	Nematode infestation
Irish Potato	Mildew, Blight aphids
Maize	Maize Weevil, Sitophilus
Plantain	Nematode infestation
Tomatoes and Vegetables	Mildew, Blight aphids
Yams	Tuber rot, Tuber yam beetle
Beans	Prostephanus truncatus

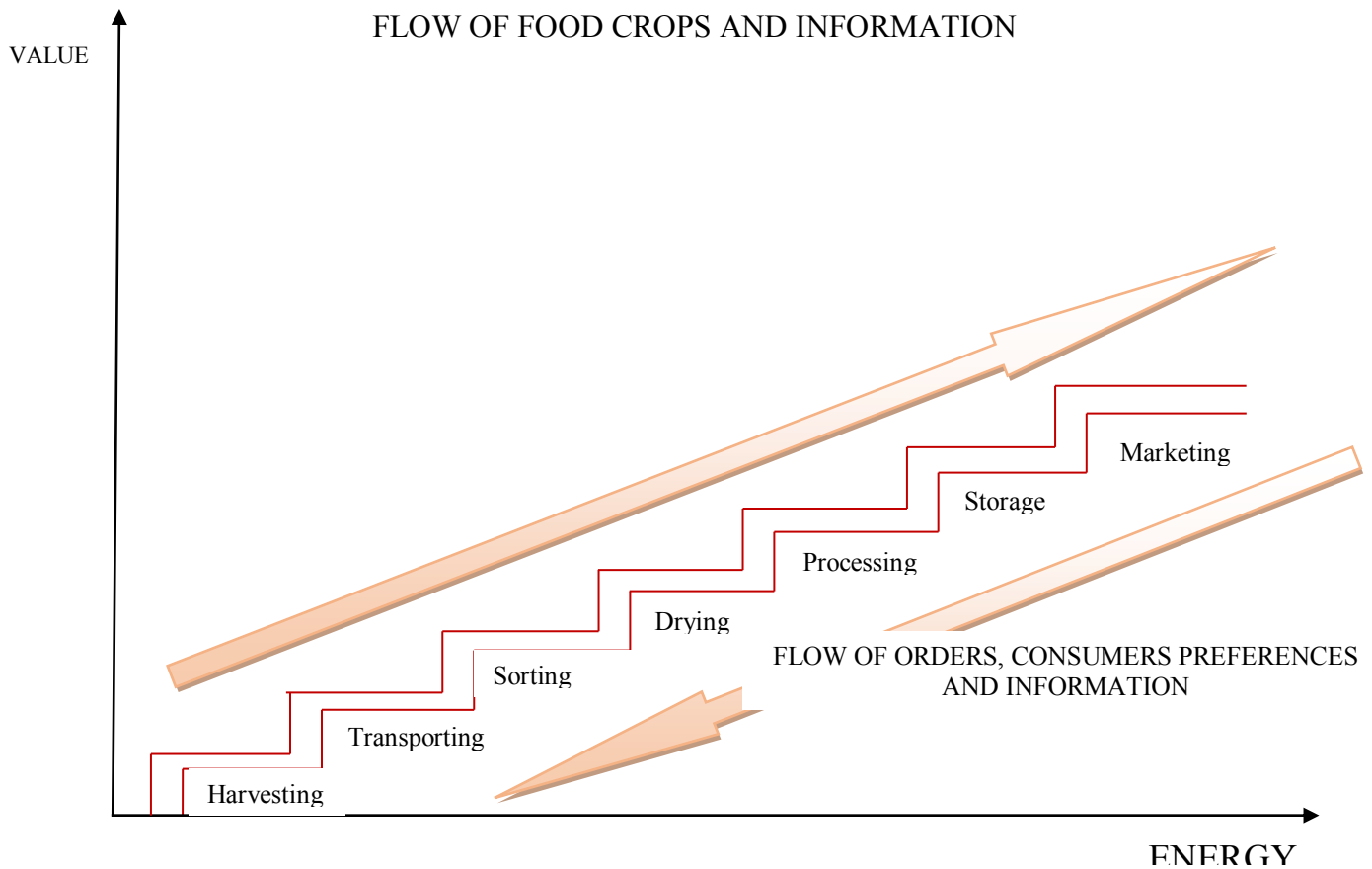
Source: MINADER Jakiri and Fieldwork 2015.

In Jakiri-Sub-Division, roads network are important in the evacuation of produce from the farms. Damage occurs as a result of careless handling of packed produce during loading and unloading as some food grains which end up spilling on the way as a result of vibration (shaking) of the vehicle, especially on bad roads. Losses also result from using closed vehicles with no ventilation; stacking patterns that block the movement of air; and using vehicles that provide no protection from the sun. Fresh products like fruits and vegetables spoil in hot climates due to lack of storage and cooling facilities. The few cooling facilities for those who can afford cannot serve their purpose due to constant power failure. Indiscriminate use of pesticides has equally increased pesticide resistance of insects; high humidity and moisture content of grains during storage. Climate variability has caused the time of harvest and drying to be largely unpredictable thus increasing food losses. Majority of the farmers in the study area depend on their household for every farming operation due to financial constraints. This affect production and consequently lost. They have limited access to loan or credit and information.

### **POST-HARVEST MANAGEMENT**

The post-harvest period is that part in the food life cycle which covers all stages after harvest and includes: transportation, processing, packaging, sorting, storage, and marketing (Figure 3). Post-harvest encompasses a sequence of activities and operations depending on the type of crop whether perishable or durable. The primary objective of post-harvest operations is to maintain quality and quantity of food in order to sustain livelihood. The challenge of maintaining food security not only lies in producing sufficient quantities of safe food for our fast growing populations, but also to cater for what has been produced. All food produce cannot be consumed

at the time it is produced. Part must be stored for further consumption and some for seedlings to be planted during the next farming season. This pressure is not only felt in Jakiri Sub Division but less developed nations as a whole as food availability and accessibility are constantly affected by increasing populations and rising food prices.



Source: Field Work 2015

**Fig: 3: Flow Of Food Crops And Information Along The Post-Harvest Chain**

The time of harvesting is determined by the degree of maturity of any given crop. There are two harvesting seasons in Jakiri Sub-Division firstly from late August to late September and the second harvest in October. Food crops such as cereals and pulses require extended pre-harvest field drying. They are usually left in the field to eventually become dry. However extended pre-harvest field drying ensures good preservation but also heightens the risk of losses due to attack from birds, rodents, insects and moulds. As a result most farmers transport such food crops to the homestead for further drying. The length of time needed for full drying depends considerably on weather and atmospheric conditions. Vegetables such as bitter leaf, cabbage, huckle berry, and cowpeas are also dried and preserved for consumption since they are scarce in the dry season. Drying of food grains such as maize, beans, and groundnuts is to reduce moisture and to kill pests and insects within the grains. These crops are spread on mats or bags. This method is good but it is still not effective to combat moulds, pests and diseases.

Treatment is equally an important post-harvest activity that can help maintain the quality and quantity of food crops mostly grains following harvest. This activity is characterised by the use of insecticides to treat stored cereals and pulses in order to offer long-term protection against insect and pest attack. An example is the atelic powder that is mostly used by some respondents to prevent weevil attack on beans and maize. However, inadequate capital to purchase some of these chemicals is the major obstacle and above all inadequate knowledge on how to use them. Consequently, most farmers used wood ash and dust (table 5) in the preservation of tubers and root crops such as Irish potatoes. These are traditional methods which have been proven effective in this area.

**Table 5: Pre-treatment of food crops before storage.**

Pre-treatment	Frequency	Percentage
Agro-chemicals	14	15.9
Traditional	39	39.8
None	35	44.3
Total	88	100.0

Source: Field work 2015.

However, a greater proportion of the people interviewed donnot see the need to treat their food crops especially food grains before storage (44.3%), while just 15.9% treat their crops. This is due to the fact that many donnot know their importance nor how to use some of the chemicals available in the local markets. The refusal to adopt some of these technological methods by most respondents and the desire to only stick to their traditional methods can be explain the fear of the unknown. Whereas 39.8% make good use of traditional methods because they are affordable.

Traditional methods of storage have evolved over long periods and many generations are usually well suited to the climatic and social environment in which they are used.

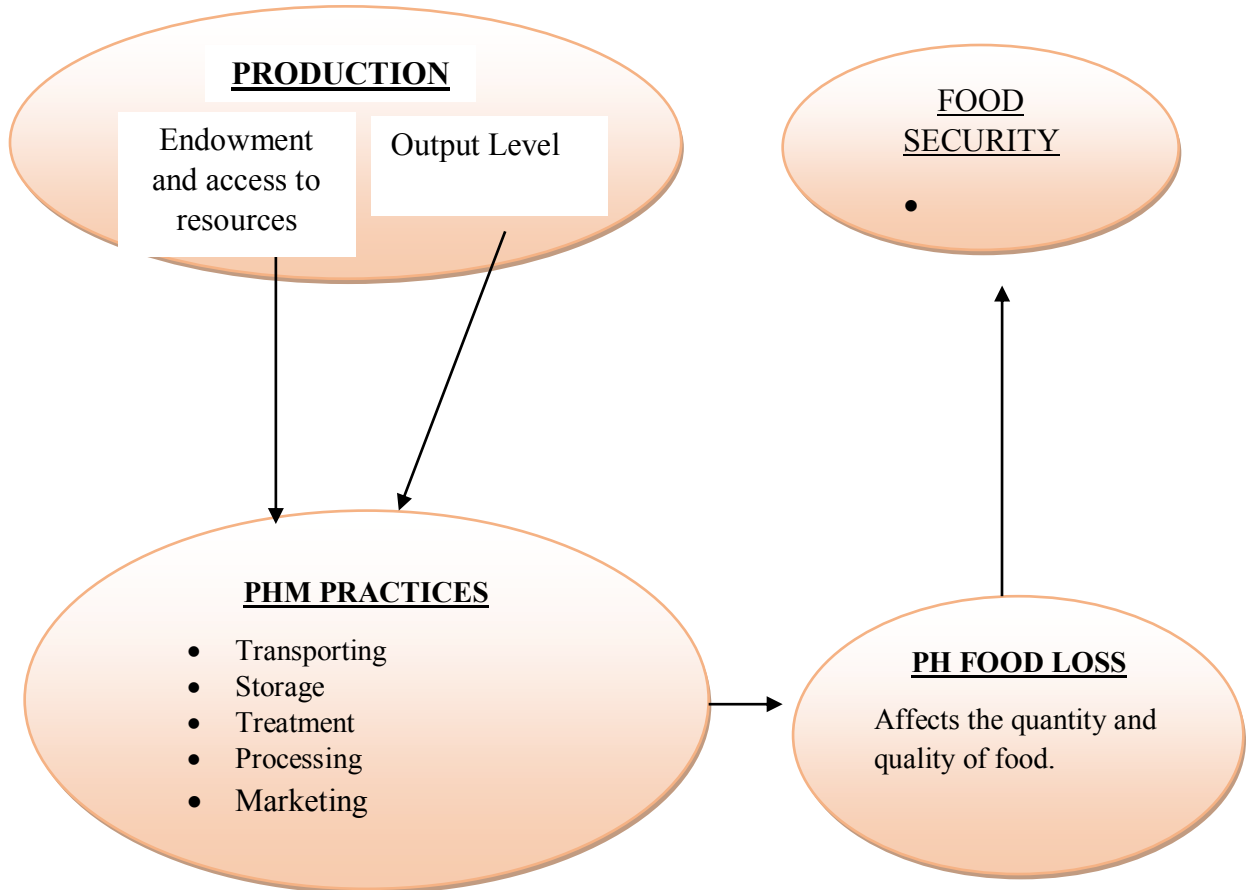
Field survey revealed that 41.7% of farmers use local bans for storage, 33.3% on the one hand hang the maize and beans below the eaves of the roofs of their houses most especially in the kitchen because of constant heat to help in the drying process, 16.7% use drums, pots and bags most especially for easy retrieval and transportation, while just 8.3% use cribs because the material required for their construction is expensive as such most farmers cannot afford. Above 80% of crops in the study area are stored inside houses to avoid theft. Perishable food items such as tomatoes have a very short duration of storage as many local indigenes do not have refrigerators. After harvesting, cleaning and sorting they are spread on the ground before they are finally taken to the market or consumed. Tubers such as yam are kept in bans while their seedlings are mostly buried in the ground to be used during the next planting season. Food grains such as maize and beans are preserved for long in the warmer areas. On the other hand high temperatures in the warmer areas easily affect the storage of perishable food crops whereas they are easily preserved in the colder areas. Food Processing is also of great importance because it adds value to the crop. This activity is absent or very limited in the study area due to low levels of technology. However there are small scale corn and cassava mills for the processing of maize and cassava. Cassava is mainly processed to obtain garri, flour and “water fufu” while maize is processed to obtain corn bear, and flour.

Proper handling during transportation is essential if losses are to be minimised and quantity maintained. Therefore a lot of care is needed in transporting most especially perishable food crops in order to prevent deterioration, as well as preventing detached grain from falling on the road before reaching the storage or threshing site. Despite Jakiri’s accessibility to other areas, most of her farm-to-market roads are not in good conditions, they are highly seasonal. Analysis from the questionnaire responses revealed that 45% of farmers mostly transport farm produce with the use of motor bikes since they are better adapted to poor road conditions, 30% carry most of the produce on their heads, 20% on the one hand hire trucks or vehicles and only 5% own personal cars or trucks. Marketing is the final and decisive element in the post-harvest system, although it can occur at various points in the agro-food chain. Moreover, it cannot be separated from transport, which is an essential link in the system. The marketing of food crops within the study area is governed by the forces of demand and supply. Individually farmers sell their farm produce most especially after harvest in markets within the Sub-Division such as Nkar, Sop, and Jakiri main market.

The aspect of gender was highly noted as women (65%) are highly involved in the marketing of food crops than the men (35%). These figures are so given the fact that women are more

involved in the cultivation of food crops whereas men are involved in other activities such as cattle rearing. Crops such as Irish Potatoes are highly exported and thus is usually facilitated by middle men generally called the “buyam sellam”. Notwithstanding, some farmers organise themselves into farmer groups and own collectively storage facilities and above all collectively market their farm produce. Another significant aspect of post-harvest marketing in the study area is the fact that most farmers market a greater proportion of their food crops immediately following harvest. This is due to either the perishability of some crops or risks of pests and diseases and the’ immediate cash needs to meet of households. Conclusively, Post-harvest management is of great importance sine it help improve the quality of food crops following harvest, reduce post-harvest food losses, ensure food self-sufficiency, thus food security and improve farmer’s livelihood. The relationships between post-harvest management practices and food security are depicted in Figure Y below.

Looking at the different post-harvest options of farmers in the study area, findings showed that there are persistent post-harvest losses and these losses vary from one household to the other. Significant quantities of food crops are lost every year indicating that the techniques adopted by most farmers are inadequate. Using the data derived from the respondents, the Chi Square Value was computed as illustrated in Table 6 below



**Figure 4: The Importance of Post-Harvest Management On Household Food Security**

Source: Field Work 2015



**Table 6: Reasons for the inadequacy of post-harvest options**

	<b>Reasons</b>	<b>Observed Distribution (O)</b>	<b>Expected Distribution (E)</b>
1	Limited access to information.	15	27.5
2	Lack of cultural acceptability	45	27.5
3	Refusal to adopt modern techniques.	40	27.5
4	Limited Government incentives	10	27.5
	<b>TOTAL</b>	<b>110</b>	<b>110</b>

Source: Field work, 2014

The Chi Square formula is given as  $X^2 = \sum (O-E)^2/E$   
 $X^2 = (15-27.5)^2 + (45-27.5)^2 + (40-27.5)^2 + (10-27.5)^2 / 27.5$

$$X^2 = (156.25 + 306.25 + 156.25 + 306.25) / 27.5$$

$$X^2 = 925 / 27.5$$

$$X^2_{cal} = \mathbf{33.6}$$

Degree of Freedom (Df) = n-1, where n = 4

$$Df = 4-1 = \mathbf{3}$$

At 5% level of significance and Df of 3, the tabulated or critical value  $X^2$  is **7.81**. The calculated  $X^2$  value (33.6) is greater than the tabulated or critical  $X^2$  value of 7.81.

From the above analysis it is clear that the adoption of improved post-harvest practices and technologies needs to be better understood from an economic, technical and socio-cultural perspective. It was discovered that challenges to post-harvest activities in Jakiri Sub-Division cannot only be attributed to limit access to information and reluctant by the local population to innovations. The importance of providing appropriate infrastructures for appropriate post-harvest options is important. Similarly providing the necessary infrastructures without training and dissemination of information on the importance of adopting such technologies is of little significance.

Public awareness through education and political initiatives are possible starting points to change people's attitudes towards the current massive food losses. Demonstrations of appropriate

postharvest technologies in markets and villages could also be helpful to pass information across to the local inhabitants of the study area. When introducing new technologies, it is essential to include food handling, storage, and conservation in the process. Agricultural Development Programmes should be decentralised so that farmers can have access to such programmes while taking into consideration the educational levels, farm size, and land ownership of farmers. The governments of Cameroon should create a better 'enabling environment' and investment climate, to stimulate the private sector to invest in the food industry and to work more closely with farmers to address supply issues. The Government should empower Common Initiative Groups, to produce and market improved qualities of food crops. Women are more involved than the men in post-harvest operations. A gender sensitive strategy is needed to drive change in post-harvest practices and investment in new technologies. Encouraging post-harvest research is a great step as this can help minimise post-harvest food losses. Promote more participatory action research methods that are compatible with farmers' needs and which could be easily disseminated by researchers or lead farmers rather than empirical research whose results end up with the researchers. Improved processing and storage techniques should be introduced especially in the rural areas where the poor road network does not allow for fast evacuation of perishable foodstuffs and other agricultural produce.

## **CONCLUSION**

Food security is defined both by availability and sustained access to adequate food. It is equally determined by the amount of output produced which is itself a function of resource endowment. Maintaining the availability of food following harvest greatly depends on adequate post-harvest management practices that is, storage, handling, processing, transporting, and marketing. These post-harvest options equally depend on farmer's access to information and resources. Hence, the level of household food security is highly affected directly by the magnitude of post-harvest losses. Given the challenges posed by climate variability and limited resources, food security cannot be achieved only through increases in agricultural productivity. Attention also needs to be given to measures to reduce losses along the farm-to-consumer chain. Reducing waste of already produced food is more sustainable than increasing production to compensate for post-harvest losses. Reduced losses not only reflect an increase in food availability for human consumption, but also reflect an increase in farmer's incomes, a source of employment, more judicious use of our limited natural resources and above all stimulates agro economic development as a whole.

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