Post-Harvest Loss and Management Practices of Agriculture Produces under Shifting Cultivation in Mizoram

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For partial fulfilment of the requirement for the award of

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Submitted By

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CERTIFICATE

This is to certify that H.Lalhmangaihchhungi has worked under my supervision and guidance on a research topic entitled**, "POST HARVEST LOSS AND MANAGEMENT PRACTICES OF AGRICULTURE PRODUCES UNDER SHIFTING CULTIVATION"** for the degree of Master of Philosophy in Economics, Mizoram University, Aizawl. The work embodies a record of original investigations and no part of it has been submitted for any other degree in other universities.

Date:……

(DR. JAMES L.T. THANGA)
Supervisor

DECLARATION

I, H. Lalhmangaihchhungi, declare that the work done in this dissertation is the original work done by me, and the contents inside this work did not form basis of the award of any previous degree to me and the dissertation has not been submitted by me for awarding of any degree in any other University or Institution.

This is being submitted to the Mizoram University for the degree of Master of Philosophy in Economics.

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Head of Department

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Supervisor

LIST OF ABBREVIATIONS

AAY	Antyodaya Anna Yojana
AIDS	Acquired Immuno Deficiency Syndrome
APL	Above Poverty Line
CIPHET	Central Institute of Post Harvest Engineering and Technology
FAO	Food and Agriculture Organisation
IARI	The Indian Agricultural Research Institute
IFPRO	The International Food Policy Research Institute
IWDP	Integrated Wasteland Development Programme
JICA	Japanese International Corporation Agency
NFSA	National Food Security Act
NLUP	New Land Use Policy
PHH	Priority Household
WFLO	World Food Logistics Organization
ZECC	Zero Energy Cool Chamber

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(H.LALHMANGAIHCHHUNGI)

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INTRODUCTION

1.1. Introduction

With increasing world population, the demand for food is also increasing. World population is expected to reach 10.5 Billion by 2050 (United Nations, 2013) which pose a serious concern for food security. The challenge is to provide the world's growing population with food self sufficiency. Many people die each year from hunger and malnutrition more than AIDS, tuberculosis and malaria combined. To ensure food security for its growing population every nation needs to produce more and manage its production efficiently. Billion of tons of food are wasted globally every year. The issue of food losses is a serious challenge in the efforts of combating hunger and poverty across the world. Reduction in the losses of this food waste will help tremendously in ensuring food security which is crucial for survival of the nation.

Over the past decades, significant focus and resources have been allocated to increase food production. During the past 30yr, 95% of the research investments were reported to have focused on increasing productivity and only 5% directed towards reducing losses(WFLO,2010).

India is second largest food producer in the world next only to China. Due to its ever growing population the domestic food production is not sufficient, so the country has to import huge amount of foodgrains every year. The problem of food insufficiency is aggravated by huge loss of the food every year due to poor arrangement and technology for post harvest management. Study conducted by

Indian Institute of Management, Kolkata found that as much as 40% of the total food production in India is lost every year. According to the Ministry of Food Processing Industries (2016), the total annual loss of agriculture produce in India is estimated to be $13 billion. Thus, reduction of food losses through introduction of proper and appropriate postharvest management practices vis-a-vis introduction of modern post harvest technology should be the key thrust areas for any initiative for self-sufficiency in food production.

Out of more than 6 billion people living in the world, The United Nation estimates that close to 1 billion suffered from chronic hunger. India is a home of 1.3Billion people (based on UN estimates) and second most populous countries in the world next to China. In terms of percentage,17% of the world population are living in India. If it continuously grow at the same current rate,it will surpass China in 2050.This population explosion is one of the major causes of hunger in the country. India ranked 97th of 118 in Global Hunger Index prepared by The International Food Policy Research Institute(IFPRO).India ranked behind most of the Asian developing countries.

India is second biggest food producer country in the world next only to China. India and China produce more than US but US exports are higher than the two countries. This is mainly due to the population of the two countries which are the two most populous countries in the world. India produce an enormous amount of foodgrain every year, but still it imports a huge amount of food grains every year. According to Alexandratos and Brunisma (2012), food supplies would need to increase by 60% (estimated at 2005 food production level) in order to meet the food demand in India.

Land is becoming scarce for food production to feed the growing population. Food production is being challenged by limited land, water and increased weather variability due to climate change. Focus and and resources have been concentrated to food production. Increasing agricultural productivity is critical for ensuring food security, but this may not be sufficient to feed every people. Proper management and efficiency right from harvesting to consumption will help tremendously in ensuring food security. In India, Agriculture produce to the tune of 40% of the total produce go wasted every year. The main reason behind is inappropriate supply chain management from harvesting to consumption. As per a survey conducted by IIM Kolkata, only 10% foods get cold storage.

1.2. Post-Harvest Management – Meaning and Significance

In agriculture, post-harvest management/handling is the stage of crop production immediately following harvest, including cooling, cleaning, sorting and packing. The instant a crop is removed from the ground, or separated from its parent plant, it begins to deteriorate. Post-harvest treatment largely determines final quality, whether a crop is sold for fresh consumption, or used as an ingredient in a processed food product.

The most important goals of post-harvest handling are keeping the product cool, to avoid moisture loss and slow down undesirable chemical changes, and avoiding physical damage such as bruising, to delay spoilage. Sanitation is also an important factor, to reduce the possibility of pathogens that could be carried by fresh produce, for example, as residue from contaminated washing water.

After the field, post-harvest processing is usually continued in a packing house. This can be a simple shed, providing shade and running water, or a large-scale, sophisticated, mechanised facility, with conveyor belts, automated sorting and packing stations, walk-in coolers and the like. In mechanised harvesting, processing may also begin as part of the actual harvest process, with initial cleaning and sorting performed by the harvesting machinery.

Initial post-harvest storage conditions are critical to maintaining quality. Each crop has an optimum range for storage temperature and humidity. Also, certain crops cannot be effectively stored together, as unwanted chemical interactions can result. Various methods of high-speed cooling, and sophisticated refrigerated and atmosphere-controlled environments, are employed to prolong freshness, particularly in large-scale operations.

Regardless of the scale of harvest, from domestic garden to industrialised farm, the basic principles of post-harvest handling for most crops are the same: handle with care to avoid damage (cutting, crushing, bruising), cool immediately and maintain in cool conditions, and cull (remove damaged items).

Therefore, the post-harvest sector includes all points in the value chain from production in the field to the food being placed on a plate for consumption. Post-harvest activities thus include harvesting, handling, storage, processing, packaging, transportation and marketing.

1.3. Post-Harvest Loss – Definition and Causes

Post-harvest loss of fruits and vegetables is defined as “that weight of wholesome edible product (exclusive of moisture content) that is normally consumed by human and that has been separated from the medium and sited of its immediate growth and production by deliberate human action with intention of using it for human feeding but which for any reasons fails to be consumed by human” (Sudheer and Indira, 2007). Not only quantity and quality but even appearance of fruits and vegetables are affected and their market values are reduced.

The nature in which post-harvest losses occur is given in brief below:

(i) economic loss, which refers to reduction in monetary value as a result of physical loss,

(ii) quantitative loss which includes reduction in weight by moisture loss and loss of dry matter by respiration,

(iii) pilferage and other incidental loss in terms of quality of food, accepted standards of quality leading to loss of consumers appeal, and

(v) nutritive loss which includes loss in vitamins, minerals, sugars, etc. Proper post-harvest handling of these perishables reduces post harvest losses and helps in preserving nutritional qualities.

Moreover, causes of post-harvest loss of agricultural products can be classified into two. They are:-

a) Primary causes: Primary factors of post-harvest losses are those for which certain mechanical, physiological, pathological or environmental factors are directly

responsible. Mechanical losses are caused by careless handling during harvesting, packaging, transportation and storage. Insects and birds are also responsible for mechanical injury in fruits and vegetables. Many a times, mechanical injury received by agriculture products due to pressure thrust during transportation, though sometimes invisible, leads to rupturing of inner tissues and cells. Such produce degrades faster during natural ageing process.

A significant portion of losses during post-harvest period is attributed to diseases caused by fungi and bacteria. Besides attacking fresh produce, these organisms also cause damage to canned and processed products. Moreover, among environmental factors, temperature, humidity, composition and proportion of gases in controlled atmospheric storage play an important role in post-harvest loss of agriculture.

b) Secondary causes: Inadequate harvesting, transportation, storage and marketing facilities and legislation lead to conditions favourable for secondary causes of loss. Inadequate harvesting facilities and rough handling during harvesting result in bruising and increased possibilities of contact of produce of soil which leads to contamination with organisms. A prolonged period taken for harvesting and grading in field, leaves the produce with field heat for longer time which subsequently causes faster senescence. Besides, use of improper machinery and equipments in mechanical harvesting causes serious losses.

Inadequate storage facilities at producing and marketing centres leave the produce at natural causes of losses. Transportation and distribution are important areas of post-harvest loss. Physical and mechanical injuries occur during

transportation and distribution. Longer shipment and distribution periods eventually cause heavy losses.

1.4. Scenario of Post-Harvest Management and Losses

Though Indian government is working actively to increase its food production to feed its population ,it is still a huge challenge for a country like India to waste so much of food when many people is spending days in poverty and hunger. The total loss in agricultural produce is estimated at $13 billion according to data published by the Ministry of Food Processing Industries on August,2016. Reducing food losses by proper and appropriate postharvest management should be an important goal to follow by the government.

Apart from other problems, food security in a country is an important issue in agriculture. One of the major problems faced by developing countries today is to adequately feed the rapidly growing population and combating the malnutrition and under nutrition among the poor section of its society. Vegetables are closely associated with determining health standards of the people by preventing disease, and contributing to the nation's development and prosperity. Vegetables are not only rich and cheap source of carbohydrates but also of minerals and vitamins which are essential for building resistance against diseases. In order to have a balanced diet, a certain amount of vegetables is needed to consume per daily. In order to feed population of over a billion, there are so much to be done as average farm yield is still quite low and post harvest losses are high.

Diversified climate of India helps to produce almost all varieties of fruits and vegetables, while unavailability of appropriate cold storage, refrigerated transportation facilities, led to spoilage of fruits and vegetables worth Rs.133300 crores every year. Nearly 20-30% of fruits and vegetables were spoiled in the process of post harvest handling which further reduces food availability from 100g per capita to 80g (Singh, 2014).

The cold storage facilities available in the country are inadequate. The plants are capital intensive, non-efficient in terms of energy consumption and yield low returns on investment. The non-availabilty of uninterrupted power supply further worsens the situations. As against a total annual output of 100 million tones of fruits and vegetables, the existing cold storage facilities in the country have the capacity to handle only 5.7 million tones of farm products at a time. Almost 90% of these capacities are used for storage of potatoes alone. About 88% of the units are in private sector. Further, the private investment in this sector is not coming up due to low returns.

In India, mostly small farmers carry out the cultivation of vegetables without any knowledge of post harvest management activities like packaging, storing, transport and marketing. It is reported that more than one-thirds of the total harvest of vegetables produced annually lost due to lack of adequate technologies of post harvest treatment. The main reason for this lost is a result of low priority accorded to these issues in general.

The growing importance of vegetables in India’s economy can be well appreciated in terms of rising domestic demand and their increasing export potential, the need to feed the ever growing population, the need for providing large

employment opportunities in rural area and vegetable being relatively more remunerative crops. The production of most of the vegetables is seasonal and highly localized in favour of agro climatic conditions in the country.

The vegetables crops because of their moisture content are inherently more liable for deterioration in quality and quantity especially under tropical conditions. Post harvest losses in vegetable during post harvest operations due to improper handling and storage are enormous. Most of the vegetables are grown without the knowledge of of post harvest management activities like packaging, storage, transport and marketing. The country also suffers from poor infrastructure, inaccessibility of technology, poor irrigation, small and fragmented land holding and low investment capacity of farmers. The distance between the production area and the market also contributes to the loss of vegetables at various stages of post harvest activities. Non-availabilty of vegetables friendly infrastructure also contributes to the problem. Perishable crops like fruit and vegetables needs proper and scientific method for storage and packaging. Transport and proper handling techniques are also inadequate and hence considerable amount of produce go wasted.

Though India is the second largest producer of vegetables, only a small amount of the total production is processed. There is under utitilization of processing capacity and value addition has been meagre. Moreover, it is facing many constraints in terms of non-availability of adequate infrastructural facilities like post harvest-harvest storage facilities, cold chain systems, refrigerated transport and cold storage cabinet, etc. Export of processed vegetables has registered a compounded annual growth rate of 16% in volume and 25% in value. Food production has recorded an annual growth rate of 3.9% while processing sector has grown a arate of 20% p.a. Within the processing sector, the most significant growth

has taken place in the production of frozen fruits and vegetables (121%). And dehydrated fruits and vegetables (24%).Over 4,000 fruit processing unit exist in India. With an aggregate capacity of more than 1.2 million MT. This capacity however accounts for less than 4% of the total fruits produced. Approximately 20% of processed fruits are exported(Chikkasubbana,2006).

The annual value of post-harvest losses of major agricultural produce was Rs 92651 crore at wholesale price of 2014 for the year 2012-13(Jha, et. al, 2014).This huge amount was lost during the different stages of post harvest treatment. If we could save this loss by introducing a better post harvest technology, it will contribute a lot in bettering our economy as a whole. It will increase the income of the producer and more food will be available for the masses.

Table 1.1. Estimate of the Monitory value of post-harvest losses in India for the year 2012-13 at wholesale price of 2014

Crop/commodity	Production (million tones)	Price(Rs/tone)	Overall total loss	Monitory value of the losses (Rs.crore)
Paddy	104.40	17918	5.53	10344
Mustard	7.82	34820	5.54	1508
Soyabean	14.68	36984	9.96	5405
Mango	17.29	453555	9.16	7186
Grapes	2.52	44564	8.63	969
Cabbage	8.53	10928	9.37	874
Cauliflower	7.79	16321	9.56	1214
Potato	41.09	16649	7.32	5008
Tomato	17.85	16510	12.44	3666
Arecanut	0.53	182865	4.91	475
Sugarcane	338.96	2100	7.89	5614
Turmeric	0.93	24845	4.44	108
Chilli	1.93	64411	6.51	547

Source: Jha, et. al, 2015

1.5. Significance of the Study

As noted earlier, shifting cultivation has been the main agricultural practice of the people of Mizoram where modern post-harvest management practices are hardly adopted by the people. With the onset of economic development and increasing urbanisation, the people undertaking shifting cultivation has started cultivating cash crops. Accordingly, the agriculture of there has been commercialised to a great extent. The people select crops in view of their marketing prospects. Large quantity of the agriculture produces from shifting cultivation arrived at the urban market stations. Meanwhile, limited use of sufficient post-harvest management technology vis-à-vis inadequate storage facilities have resulted in huge loss at different stages in the agriculture market chains. As a result, a study of the post-harvest management practices and losses of the crops would be of great significance for agriculture development of the state as well as to protect the producer farmers from loss.

1.6. Scope of the Study

It is understood that large number of crops are cultivated in the shifting cultivation which could not be easily covered in one study. So, it is decided to select 10 major crops cultivated under shifting cultivation as a representative of all these crops. Thus, this study covered 10 selected jhum crops as follows: paddy, ginger, chilli, pumpkin, brinjal, mock tomato, mustard, maize, cumcumber, and cowpea. As the leafs of pumpkin, mustard and cowpea are the widely consumed vegetables in the state, only the leafs of these crops are considered in the study.

1.7. Trends of Existing Literature - Overview

Ramchandra, et al (2015) found that on an average the maximum loss was estimated in potato (45.08%) and minimum loss in pumpkin (2.11%). The loss of vegetables at the grower level resulted from lack of knowledge about proper post-harvest management. Devi and Singh (2015) stated that due to lack of sufficient storage and processing and processing facilities in north east region, huge amount of fruits and vegetables are being spoiled after harvest. Singh, et al. (2014) stated that harvested fruits and vegetables require adequate and advanced post-harvest processing technologies for minimizing the qualitative as well as quantitative losses after harvesting. Nearly 40% fruits and vegetables are wasted every year due to improper handling, storage and packaging, and transportation.

Mitravanavar and Yeledalli (2014) showed that inadequate transportation facilities is one of the major post-harvest factor of post-harvest loss followed by inadequate storage facilities. Sharma and Singh (2011) stated that one of the most important causes of post-harvest losses is harvest the inappropriate maturity, resulting in erratic ripening and poor quality. Patil, et al. (2010) revealed that among the farmers who practice organic cultivation, post-harvest management were found to be given less importance. Most of the post-harvest management practices found were a simple methods like packing the produce in a bamboo basket and gunny bags, cleaning the produce by water and cloth was noticed among majority of the respondents.

Lakra, et al (2010) observed that tribals population uses 25 indigenous practices post-harvest management. Some of the common practices were leaving harvested rice bundles in the field 2-3 days for sun drying as well as sun exposure of

paddy before storage. Satapathy (2007) stated that The North Eastern Region experiences hot and humid climate which is highly harmful from postharvest management point of view. Traditional post- harvest technologies prevalent in the region are cruder compared to other parts of the country.

Based on the observations and findings of the various studies undertaken in the post-harvest management and losses, general conclusions and literature gap may be highlighted as follows:

1) Several studies attempted to examine the extent of post-harvest losses and tried to identify the factors responsible for it. Majority of the studies focused on vegetables, fruits and other horticulture crops (potato, tomato, etc).
2) Significantly large portion of the agriculture produces go wasted after harvest before it reached the final consumer due poor post-harvest handling and inadequate storage and transportation facilities.
3) Inadequate storage facilities and means of transportations have been the main factors for the post-harvest losses of the agricultural produces. Thus, all the suggestions to reduce post-harvest losses revolve around the provisions of storages and transportations for these produces.

1.8. Research Gap

It may be noted that the main livelihood sources of the hill people, especially in the North Eastern India, is Shifting Cultivation (i.e. Jhumming). As the farmers shift their place of cultivation every year or two under shifting cultivation, it is not possible provide proper communication facilities to these places unlike settled cultivation. So, the produces has to be carried by head load to the nearest motor road

or market. The situation is significantly different from what is happening under settled cultivation. Studies highlighted above do not cover the situation of post-harvest loss and managements under shifting cultivation. This may be considered as research gap in which this study would find its significance clearly.

1.9. Objectives of the Study

1. To study the existing status of post-harvest management practices among the people who are engaged in shifting cultivation.
2. To estimate the post-harvest losses of agricultural produces in Mizoram and examine the extent of losses in each stage of post-harvest handling activities.
3. To study the relationship between the extent of post-harvest management and losses of crops.

1.10. Hypothesis

The research hypothesis of this study is "Post-harvest management practices has reduced post-harvest loss for agriculture produces under shifting cultivation".

1.11. Methodology

a) Selection of Study Areas: Since the methods and activities undertaken are more or less similar in most of the villages, it is considered necessary to randomly select *three* villages representing Mizoram to capture varying nature of farming and post-harvest activities across the state. The main criteria for village selection are the intensity of jhumming practices in terms of areas and production as per the available official data. The villages selected for this study are Tachhip, Mualpheng and

Rawpuichhip. Due weightage was given on the intensity of jhumming practice and accessibility to the major vegetable markets in Mizoram.

b) Collection of Primary Data: From each of the selected villages, households are selected randomly. This study adopted equal sample size for all villages. The sample size for one village is determined at 25 households, and thus, a total of 75 households were covered by this study. The pre structured questionnaire was canvassed to obtained the required information from the respondents.

c) Sources of Secondary Data. Secondary data are collected from the various publications and unpublished resources of the state government departments like Directorates of Economics & Statistics, Agriculture Department, Horticulture Department, Population Census 2011,Statistical Abstract Mizoram 2015, various issues of Economic Survey Mizoram, etc.

d) Analytical Tools. To describe the general patterns and nature of the field conditions and existing secondary data, simple statistical tools like percent, average, standard deviation and charts are adopted in this study. In addition, to generate concrete conclusion, this study also conducted hypothesis testing using t-statistic for difference of means.

1.12. Scheme of Chapterisation

The study is organised in five chapters as follows:

Chapter 1: Introduction

Chapter 2: Review of Literature

Chapter 3: General Status of Shifting Cultivation in Mizoram

Chapter 4: Post Harvest Loss and Management Practices: An Analysis

Chapter 5: Summary of Findings, Conclusion, and Recommendations

Bibliography

Chapter 2

REVIEW OF LITERATURE

This chapter presents a brief review of literature on post harvest loss and management activities of different agricultural produces. Most of the studies examined here are conducted within the country while a few international studies in other countries are also presented. The main purpose of this exercise to understand the trends of existing literature on the study of post harvest loss and management practices undertaken in different parts of the world. This will help in better understanding of the context, methodology, and observations presented in the subsequent chapters of this study. While there are plethora of works on the dynamics of production and marketing of vegetable crops, only few studies were found on the aspect of post harvest loss and its causes, processing and value addition of agriculture produces.

Ramchandra, et al (2015) has examined the nature and extent of post-harvest losses of major vegetables supply chain in Allahabad District of Uttar Pradesh. Hundred and twenty major vegetables grower has been selected for the study including eighteen market functionaries. Among the vegetables grown in the region, ten were selected for the purpose. And the selection was done on the basis of the total annual production of the major vegetables in the state. Primary data were collected from the selected farmers, wholesalers and retailers involved in the marketing using the pre-structured schedule personal interview method during the year 2013-2014.The losses were estimated to find out which vegetables incurred the maximum loss, as well as at which stage. The post harvest losses were estimated at different levels

which include the producer level as the first level which comprises of harvesting, grading, packing and handling, etc., and the next is trader level which comprises loading-unloading, transportation, grading and selling stages. The extent of losses varied from vegetable to vegetable as well as at different stages.

The study found that on an average the maximum loss was estimated in potato(45.08%) and minimum loss in pumpkin(2.11%).Heavy rainfall during the month of October and November during the study period caused huge losses of tomato, onion, potato, chilly, cauliflower, etc. Among the vegetables selected for the study, tomato recorded the highest post harvest loss of 43.77% followed by chilly (23.42%),onion(17.69%),okra(13.67%),etc. Tomato and chilly registered maximum losses during the harvesting and marketing stage, while tomato and okra had maximum losses during harvesting stage. It was also observed that major losses have been found at the grower level in all the vegetables except pumpkin. The loss of vegetables at the grower level resulted from lack of knowledge about proper post harvest management. Improper grading, packing, lack of storage and inadequate transportation facilities, harvesting at appropriate maturity added more to postharvest losses. The study mentioned that there is an urgent need of training the vegetable growers on scientific post harvest techniques if the vegetable production is to be sustained on a profitable basis.

Devi and Singh (2015) stated that due to lack of sufficient storage and processing and processing facilities in north east region, huge amount of fruits and vegetables are being spoiled after harvest. According to FAO report the global food losses and wastage is 30-40% in the year 2012 and the losses are more noticed in developing countries. In developing countries more than 40% of the food losses at postharvest losses and processing levels. They stated that farmers in the north east

region have poor resource availability particularly where the vegetables are grown as subsistence crop. The farmers usually sell their vegetables in the local market soon after the harvest due to absence of proper storage and upkeep of the produce are the common postharvest activities of the region.

The study mainly revolved around the introduction of Zero Energy Cool Chamber designed by IARI Pusa, New Delhi. On the principle of evaporative cooling i.e., cooling created due to evaporation of water. The ZECC can be constructed easily with locally available materials which is very convenient for local farmers. The shelf life of cucumber was 18days in ZECC condition and 13days in room condition. The study mentioned that north east region have sufficient potential to produce enough quantity and quality of fruits and vegetables. But postharvest management activities are still neglected at large. Due to lack of proper storage and processing facilities considerable amount of horticultural produces goes waste. Farmers have to sell their produce immediately after harvest which led to glut in the market and resulting into lower return of their produce.

Singh, et al. (2014) stated that harvested fruits and vegetables require adequate and advanced post harvest processing technologies for minimizing the qualitative as well as quantitative losses after harvesting. Nearly 40% fruits and vegetables are wasted every year due to improper handling, storage and packaging, and transportation. In the different steps of post harvest handling nearly 20-30% of the produced fruits of the total produced vegetables were spoiled and decreased the 100g (based on total produced fruits) to 80g per capita per day (based on consumable produces after losses reduction).In the case of vegetables 30-35% of the total produce vegetables were lost and only 2% of the total produced vegetable undergone for processing.

Gangwar, et al. (2014) focused on production and losses of agricultural produce in India. They observed that on an average 15-30% of the country's food gets damaged on its way from the farm to the fork. The loss accounts for 80,000 crores rupees every year which is sufficient for free meals to below poverty line (BPL) population in the country. The foodgrains loss accounts for 10% of the total production which are about 20Mt, which is equivalent to the total food grains produced by Australia annually. If food wastage and post harvest losses is reduced the present production is enough to provide food for the population.

Mitravanavar and Yeledalli (2014) conducted a case study in Karnataka and aimed at estimation of post harvest losses in major vegetables. A study was conducted on five major vegetables i.e., potato, tomato, brinjal, beans and onion. The study showed that inadequate transportation facilities were viewed as one of the major post harvest problem by 80% of fruit growers. About 78.33% of farmers considered inadequate storage facilities as problem. About 76.67% growers viewed adverse weather condition as a major problem. About 60.3% expressed the problem of inadequate labour facilities and about 16.67% of farmer did not have full knowledge of post harvest management.

Kalidas and Akila(2014) conducted a study on Micro Level Investiagtion of Marketing and Post-Harvest Losses of Tomato in Coimbatore District of Tamil Nadu.The study stated that the quantum of loss is governed by factors such as perishable nature,method of harvesting and packaging,transportation,etc.It has been observed that a majority of tomato producers sell their produce to the wholesalers facilitated by commission agents at different stages.The study revealed that aggregate post0harvest losses from farm gate to consumers in tomato ranges from 13-26%.It has indicated the necessity of reducing the market intermediaries for minimizing post-

harvest losses and providing remunerative prices to the producers.Conventional wholesale marketing was prevalent in tomato.The post harvest loss was found to be highest in marketing channel which involves more intermediaries.Post-harvest losses of tomato in each marketing was due to lack of storage facilities and improper handling.The overall post-harvest losses were estimated to be 26%.Since tomato is perishable crop the post harvest loss is also high.The study also suggested necessary steps should be taken by the government to sell the farmers produce directly to the consumers which raises the farmer income level.It was concluded that the marketing loss is inversely proportional to the marketing efficiency.Plastic crates are found to be best packaging material as it incurs minimum loss.

Peer et al (2014) studied the post harvest management of potato sub tropical zone of Jammu Division.The study estimated loss due to poor handling and storage are between 40 and 50%.The physiological and pathological causes of loss observed before and during the storage of potato crop reveald that 51.51 of respondents observed bruises on tubera followed by rooting(48.00)%,chilling injury(44.89),enlarged lenticels(42.67%) and sprouting up to 40.89%

Sharma and Singh (2011) examined the nature and extent of post harvest losses in vegetable supply chain in the Kumaon Division of Uttarakhand. The sample was taken from 80 vegetable growers, 40 farmers from hilly region and 40 farmers from the bhabhar region. It has also includes 25 market functionaries. Post harvest losses in vegetables have been estimated at different stages. It was first estimated at producer level and then at the trader level at the producer level, the post harvest losses have been found maximum in case tomato followed by French bean, brinjal, pea and minimum in radish. At the retail level also, tomato recorded maximum loss, followed by Okra, chilly and pea. The maximum aggregate post harvest losses have been found

in tomato followed by potato, chilly, pea and minimum radish. The study stated that one of the most important causes of post harvest losses is harvest at inappropriate maturity, resulting in erratic ripening and poor quality. Therefore, they suggested training for vegetables growers on scientific post harvest techniques. And the one possible solution suggested also is the establishment of producer cooperatives to handle various activities relating to production and marketing of vegetables.

Changule et al(2011) reported that the post harvest losses occurred during collection,sorting,packing and transportation.At the farm level,due to lack of storage and improper handling losses were occurred.Storage of tomato was practiced neither at farm level nor at the trader level over aperiod of time.The overall post harvest losses were estimated to 35kg per quintal of tomato.The post harvest losses in the market were observed in each and every stage of handling.Plastic crates were used for long distant transportation and opacking losses were found minimum in the packing material like crates.

Patil, et al. (2010) conducted a research study in Belgaum District of Karnataka state during the year 2007-2008 with a sample size of 140 respondents. The study revealed that among the farmers who practice organic cultivation, postharvest management were found to be given less importance. Most of the post harvest management practices found were a simple methods like packing the produce in a bamboo basket and gunny bags, cleaning the produce by water and cloth was noticed among majority of the respondents. Grading of the produce based on size and quality noticed among the farmers shows the farmer realization of the market situation and consumer demand for better quality and for getting a good price.

The study reveals that all respondents were found to pack chilly in gunny bags and tomato produce in bamboo baskets. Cleaning of chilly in water and tomatoes was noticed among majority farmers. Grading of the produce based on size and quality was recorded 58.57% and a very low percentage of farmers (2.86%)were found to practice value addition. The low rate of adoption was due to lack of awareness about value addition. The study revealed that farmers had the practice of marketing through commission agents. This is mainly due to the availability of storage facilities with the commission agents and scope for getting good price was the advantage mentioned by the farmers for selling through commission agents. And another reason is also due to the common practice with the farmer of borrowing loans and other services from commission agents also compelled them to sell their produce to commission agents.

Lakra, et al (2010) conducted a study in Jharkhand where bulk of tribals live, constituting 28% of total population in the state. tribals are known to have rich knowledge of indigenous technology pertaining to agricultural practices. Data was collected from 3 Districts covering 9 villages from 225 farmers. Twenty five indigenous practices have been identified and five of them were related to postharvest activities. Some of the common practices were leaving harvested rice bundles in the field 2-3 days for sun drying as well as sun exposure of paddy before storage. The post harvest activities revealed by the study were paddy is threshed by a pair of bullocks. Similarly, pulses like black gram, horse gram, pigeonpe are thrashed by hand beating. Winnowing is done by bamboo made device locally called as soop even today, about 21% respondents still use Dhenki (a wooden device) for husking of paddy.

Gajbhije et al(2008) made an economic analysis of the post harvest losses of vegetables in Nagpur District,Maharastra.It was conducted to estimate the marketing

cost,marketing margin,a price spread in vegetables marketing and also studied post harvest loss incuured during marketing at different levels.Data on marketing cost,marketing margin,price spraed and losses were collected from 15 wholesaler and 15 retailers from Nagpur vegetable market.The highest losses incurred during marketing were 35% in tomato,followed by cabbage,cauliflower and aubergine,and lowest in okra and green chilly between 6-9%

Singh and Ahmad(2008) conducted a Study on Assessment of Post-Harvest Losses and Marketing Risks of Potato crop in comparision to Wheat crop in Allahabad District.The study covered wheat and potato which are the main crops and accounted 36.06% and 2.55% to gross cropped area respectively during 2006-07.The average production per hectare was 17.82quintals and 172.93quintals for wheat and potato respectively,during the study period.Thirty six(36) farmers were selected from two villages of a block of Gangetic Plain of Allahabad District to assess the post harvest losses and marketing risk of potato crops comparision to wheat crop.The study reveals that overall 8.04% and 10.45% post harvest losses occurred in wheat and potato respectively.Thus,loss was higher on potato than wheat on the sample farmers.The analysis also reveals that occurrence of post harvest losses was found maximum at storage level in both the crops.Due to non-availability of cold storages for potato,post-harvest losses were higher in potato than wheat.The sample farmers had kept maximum of production of wheat in their houses,so the attacks of pest,insect,rats,etc.,were responsible for huge wastage in stored grains.Of the total production of potato only 50% was stored in cold storages and 25% was sold right after harvesting.The rest 25% was stored in houses.Due to improper arrangement of storage of potato,there was great price fluctuation which leads to market risk.With a

view to minimize market risk,the inefficient marketing system should be modified into efficient marketing system to develop the infrastructural facilities.

Gauraha and Thakur(2008) conducted a study on Comparative Economic Analysis of Post-Harvest Losses in Vegetables and Foodgrains Crops in Chhatisgarh.The study estimated the post harvest losses in vegetable and foodgrain crops.Data were collected during the year 2005-06 and 45 vegetable growers from the two villages of Mungeli tehsil of Bilaspur district of Chhatisgarh were selected for the purpose of this study.The samples were divided into three categories viz.,small,medium and large farms.To estimate the postharvest losses of vegetables and foodgrains at farm,market and consumer level,appropriate number of market functionaries and consumer were selected.The estimation of post-harvest losses was done on the average bais.The study concluded that the average cultivated area was 3.87ha and cropping intensity was 238.76%.The cost-benefit ratio was maximum for chilly followed by potato in vegetable crops.In the case of foodgrain crop it was maximum in paddy followed by gram.Whole-cum-Commission agents and Primary Agricultura Co-operative Societies(PACs) were the key individual in vegetable in procuring vegetable and foodgrains from the farmers respectively.Overall post-harvest losses for vegetables and foodgrain crops towards consumption and of the post harvest distribution system was around 17.08% and 8.60%% of the total quantity traded respectively.The resultant losses were the current practices used in post harvest handling and the standard of material facilities used for storage.There is a strong need to promote direct and group marketing of vegetables to enhance the producer’s share in rupee and to ensure supply of fresh quality of vegetables to the consumer at reasonable price.

Satapathy (2007) stated that The North Eastern Region experiences hot and humid climate which is highly harmful from postharvest management point of view. Traditional post harvest technology prevalent in the region are more crude compared to other parts of the country. The post harvest operations like drying, threshing and transportation are highly labour intensive. Storage and transportation are the two most important postharvest operations since agriculture is a seasonal activity and the produce has to be kept in reserve for consumption. Drying of grains is also a major problem and it is difficult for the farmer to handle the crop as the region is one of the most heavy rainfall areas in the country.

The indigenous method of drying is to hang the harvested crop on a horizontal bamboo mostly in the field itself. Moisture, humidity, insects and rodents offer major constraints in storage. The study conducted by by Assam Productivity Council and Assam Agricultural University Jorhat indicated that loss during storage of paddy was caused due to infestation of stored grain pests and rodents. The most common method of storing rice for consumption or sale is to have a separate storehouses with raised platform. The post harvest losses are quite significant in the region due to improper cultivation practices, lack of elaborate harvesting machinery, non-availabilty of collection centres in major areas, inadequate transportation system and poor processing facilities. The produce after harvest is hardly graded or packed properly before it goes to transport. Most of the fruits and vegetables harvested are sell directly in local markets or even on the roadsides due to lack of proper marketing facilities. The various intermediaries together appropriated a major portion of profit .Almost 17% of the price of the produce is retained by the retailers followed by agents/village traders and wholesalers who retained 14 and 10 per cent respectively.

Yadav and Yadav (2007) stated due to diverse agro climatic conditions, different soil type and abundance of rainfall the North Eastern Region offers wide scope for cultivation of different types of crops including fruits, vegetables, flowers, plantation crops and crops o f medicinal and aromatic importance. The post harvest losses are estimated to be 5-40% depending upon the crop and variety. The post harvest losses in case of fruits like banana and pine apple are 15-205 and 12-17% respectively.

This study also shown that post harvest losses in case of perishable commodities are higher in comparison to other parts of the country mainly due to lack of mechanization, collection centres in major producing areas, container for storage, poor transportation, unorganized marketing system and processing units. They also stated besides production, the reduction in post harvest will be a complementary means for increasing supply of fruits and vegetables. Therefore, attention has to be given to reducing post harvest losses right from harvesting to processing and marketing. The study also stated different types of practices of postharvest handling and management in the NER. It includes maturity standards, the right time for harvesting, the condition required to increase the shelf life of a fresh produce during transportation and the need and advantages of grading, and the importance of packaging in protecting the produce.

Basavaraja, et. al (2007) estimated post harvest losses of two major foodgrains in Karnataka. A study was conducted in the Shimoga district which topped the list of rice growing district and Dharwad district which stood first for wheat growing in the state. From the selected district, two block area were selected, and five villages were selected again from each block area previously selected. Finally, 10 foodgrains growing farmers in each village were randomly interviewed. It was found that about

75% of the total post harvest losses occur at the farm level and about 25% at the market level. Educational level of the farmers and bad weather conditions also influence the post harvest losses significantly. At the farm level, losses were maximum due to faulty storage like non-availability of separate storage, presence of rodents and insects and improper drainage in storage places. And the transit losses were mainly due to unsuitable transport containers, negligent driving and rough roads.

Liyas and Goyal (2007), stated due to the multitude of postharvest factors, post harvest loss in fruits and vegetables is 4 to 5 times higher than in foodgrains. The post harvest loss is estimated to be 300 billion rupees each year. Hardly 2% of the horticultural produce goes for commercial processing, whereas it is almost 75-80% in developed countries. Due to improper postharvest management and lack of adequate processing facilities, huge quantities of nutritive food are lost in our country. Due to fluctuation in prices of seasonal fruits and vegetables during period of maximum availability, the prices become un-remunerative to the farmer, unscrupulous traders and middlemen get way with most of the profit leaving the producer only 25-30% of the price paid by the consumer. Most of the processed fruits and vegetables are prepared in cottage or small scale sector. The study suggested that with proper postharvest management practices, which include right stage of harvest with maturity and proper harvesting technique followed with sorting, packaging and transporting will ensure the least postharvest losses.

Bassapa et al(2007) conducted a study during 2003-2004 in Karnataka for estimating post-harvest loss in Maize at different stages at farm level.Based on maximum area under maize,two districts,namely Davanagere and Belgaum were selected among the total district of Karnataka.Davanagere and Channagiri Taluks(Blocks) of Channagere district and Gokak and Raibag taluks of Belgaum

district were specifically selected for the study.Five leading villages under in area under maize cultivation were selected from each taluk and a sample of 20 villages were chosen for the study.Five farmers from each village were selected randomly.Thus,50 framers were surveyed from each district and a total sample of 100 farmers were selected for the study.The post-harvest loss in maize at different stages at farm level during harvesting,threshing,cleaning,drying,storage,transportation,packaging were 0.40,0.18,0.05,0.21,0.33,0.20,0.08,respectively out of the total quantity harvested 49.98quintals per farm.And the total loss was 1.51 quintal per farm.The main reason for losses at the harvesting stage were the negligence of the labour employed for harvesting the crop.Majority of the farmers stored the grains in bags and loose.During transportation,most of the farmers transport their their produce by bullock cart and tractor to different places.The losses were more during handling loading and unloading grain at different places.For packaging,gunny bags were commonly used.And the reason for loss during this stage was due to packing of grains by old and torned gunny bags.

According to Garg (2006), post harvest management involves all the activities that occur after the production of agricultural commodities. It includes procurement, packaging, storage, transport, processing and marketing of agricultural products from the farm gate to the distribution and final consumer. The main objectives are to ensure food safety and quality to act as a source of employment and value-addition to products. It also contributes in raising the standard of living of the people engaged in the postharvest activities. Being able to produce and maintain high quality fresh produce from field to the table posed many challenges. A Grower who can meet these challenges will be able to increase its production, expand marketing opportunities and

able to compete in the market. Post harvest management contributes to the quality and efficiency of handling, processing and presentation of the produce. Increase in agricultural production would prove to be useless without proper postharvest management practices.

Choudhury (2006) stated that due to poor infrastructure for storage, processing and marketing in many countries of the Asia Pacific region contribute to a high proportion of agriculture produces go wasted and the average loss ranged between 10-40%. Due to improper harvest operations and lack of processing, considerable amount of food produced in India go wasted. It results in a gap between gross production and net availability of food. Thus, he suggested that efforts should be made to reduce post harvest loss which has direct bearing on food availability, while public awareness campaigns must be implemented in order to increase awareness of the cost and implication of losses after production.

Rolle (2006) reviewed the recent trends across the region, issues and challenges which impact upon horticultural chain management and marketing and discussed the role of government in facilitating horticulture chain management and marketing in the Asia Pacific region. India is grouped under the low income category which struggled to overcome technical, infrastructural and managerial constraint in maintaining quality and safety of its agriculture produce. High levels of postharvest losses occur primarily due to the use of poor quality inputs, poor cultural practices at the production level, lack of knowledge and skill in harvesting, post harvest handling, packing and lack of pre cooling facilities, high transportation costs, poor integration of activities along the supply chain. The study also stated that small farmers generally focus on production activities, and show relatively less interest in post harvest activities which are primarily undertaken by middlemen, traders and assemblers. The

estimated post harvest loss in India was 40%. It was also observed that proper road infrastructure, appropriate transportation as well as proper packaging technologies are critical to minimizing mechanical injury during the transit of produce from rural to urban areas. The government should provide policy as well as incentives for investment in post harvest and value addition to fruits and vegetables.

Hazarika (2006) in his study Post-Harvest Loss and Food Security-A study on Fruits and Vegetables in Assam revealed that horticulture crops occupy a very important role in developing countries in both economic and social spheres in helping improving the income and nutritional status of the rural masses. Assam produces a large number of fruits and vegetables which have a high commercial value. The study attempted to estimate the post harvest losses of the major perishable horticultural crops. Based on area coverage and total production, pineapple, ginger, orange and tomato were selected for the study. The maximum post harvest loss was found to be 22.62 per cent for tomato followed by ginger, orange and pineapple. The study also revealed that the post harvest loss was more during storage and transportation of the product, except tomato, the loss was found to be more in market level than the loss at growers' level. The post harvest losses of these commodities were found to be high and proper post harvest management is the need of the hour to reduce these losses. This will in increasing per capita availability of these crops at the existing level of production.

Kumar et al(2006) attempted to estimate post harvest losses in two major vegetables grown in karnata viz.potato and onion.The total post harvest loss in onion and potato at the field level was estimared to be 6.12Kg/Qtl and 7.34Kg/qtl respectivel.At the wholesale level,1.85Kg/Qtl losses occurred in onion and 2.22kg/Qtl losses occurred in potato accounting.It accounts for 17.75% and 17.12% of the total

losses in all the stages.The loss at the retail level was to the tune of 2.36Kg/Qtl in onion and 3.41Kg/qtl in potato and accounting for 22.65% and 26.29% of the total loss in all the stages respectively.Thus,60% of total post harvsest losses occur at the farm level and 25% losses are observed at retailing level.The per hectre post harvest loss at the farm level was assessed to be 2.88Qtl in the case of onion and 3.64Qtl in the case of potato.The per farm post harvest loss was assessed to be 7.34quintals in the case of onion and 5.72quintals in the case of potato.The storage loss at different stages added was about 38% of the total loss while on farm,harvesting operation accounted for about 17% of total losses.Transit loss contributes about 25% of the total loss.The study revealed that inadequate storage and inadequate transportation activities coupled with bad weather conditions influenced the post harvest losses at the farm level.it suggested the establishment of cold storage units in the production centres would help in reducing the storage losses in vegetables.

Verma et al (2003) assessed the post harvest losses of vegetables in physical and economic terms at different levels during the year 1999-2000 and 2000-2001.the multistage stratified random sampling was used to estimate the losses at wholesale,retailer and farm levels.The estimate were developed to asses losses at transporation and sorting levels.the overall losses were varied up to 20% in vegetables like tomato,cabbage,cauliflower and chilly.The loss was estimated 10%,14% and 20% for tomato crop at wholesale level,retailer and farm level,respectively.During the sorting process,the maximum loss was observed in cabbage and retailer level for tomato.The high moisture content of tomato was responsible for maximum loss during storage.

Based on the observations and findings of the various studies undertaken in the post harvest management and post harvest losses, the following points are worth

noting. Firstly, several studies attempted to examine the extent of post harvest losses and tried to identify the factors responsible for it. Majority of the studies focused on vegetables, fruits and other horticulture crops (potato, tomato, etc). Secondly, significantly large portion of the agriculture produces go wasted after harvest before it reached the final consumer due poor post harvest handling and inadequate storage and transportation facilities. The percentage could be as high as 40% in some crops in certain areas. Thirdly, inadequate storage facilities and means of transportations have been the main factors for the post harvest losses of the agricultural produces. Thus, all the suggestions to reduce post harvest losses revolve around the provisions of storages and transportations for these produces.

It may be noted that the main livelihood sources of the hill people, especially in the North Eastern India, is Shifting Cultivation (i.e. Jhumming). As the farmers shift their place of cultivation every year or two under shifting cultivation, it is not possible provide proper communication facilities to these places unlike settled cultivation. So, the produces has to be carried by head load to the nearest motor road or market. The situation is significantly different from what is happening under settled cultivation. Studies highlighted above do not cover the situation of post harvest loss and managements under shifting cultivation. This may be considered as literature gap in which this study would find its significance clearly.

Chapter 3

GENERAL STATUS OF PRODUCTION UNDER SHIFTING CULTIVATION

3.1. Introduction

Agriculture occupies a very important place in the economy and culture of Mizoram. The aged old method of cultivation known as jhumming or slash and burn is the most prevalent form of cultivation. Agriculture continues to be the main occupation of the people in general till date. The economic life of the people has always been centered around shifting cultivation. In most of the cases, mixed cropping is being practiced under shifting cultivation, and paddy is the most commonly adopted main crops. The number of crops grown in the same jhum plots ranged from 20 to 50. Some of the crops commonly grown under shifting cultivation are maize, ginger, cucumber, beans, pumpkin, mustard, sesame, brinjal, mock tomato, cowpea, French beans, chilly, winter melon, cabbage, bitter gourd, sweet potato, yam, pea, radish, etc.

Although shifting cultivation has been practised in Mizoram from time immemorial and by almost the entire population of the state, its adverse impact on the environment was never felt. Till the mid-1950s, there was no realisation that the damage to the top soil formed by hundreds of years of slow natural process would create any problem to the people. With the establishment of Mizo District Council in 1952 after independence and its subsequent upgradation to Union Territory status in 1972, the need to switch the jhumia families to settled cultivation was seriously felt by the government. Thus, control of jhum cultivation became essential for the economic

development of Mizoram and the other hill areas of North East India. So, the state Government has introduced schemes and project from time to time to abolish the practice of shifting cultivation. Due to these efforts, the areas nder shifting cultivation has declined continuously. In spite of the declining area under shifting cultivation, one could see its significance in the livelihood system of rural population. So, the system is likely to sustain for a long time at least in a lesser intensity.

This chapter attempts to present the area, production, marketing and post harvest management practices of different agricultural crops in Mizoram. Data were obtained from two sources: (1) Official Source which includes the publications of Directorate of Economics & Statistics, Government of Mizoram, and (2) Primary data collected during the field survey of this study.

3.2. Area and Production of Major Agriculture Crops in Mizoram

To study the general trends in cultivation of different crops in Mizoram, the areas under cultivation and production of major agriculture and allied crops in 2005-06 and 2014-15 as per the record of the Directorate of Economics and Statistics, Government of Mizoram is presented in Table 3.1. It may be noted that the crops which are extensively cultivated under shifting cultivation presented in this table are paddy, maize, pulses, oilseeds, cabbage, birdey chilli, turmeric and ginger, while other crops are normally cultivated in settled farming. In terms of the areas and production, one could see the main crops are paddy, maize, pulses, oilseed and ginger. These are all the jhum crops.

Table 3.1: Areas and Production of Major Agriculture Crops in Mizoram

Crops	2005-2006		2014-2015	
	Area (Ha)	Production (MT)	Area (Ha)	Production (MT)
Paddy	56,460	1,07,740	36,930	60,679
Maize	11,742	22,703	5,695	8,624
Pulses	6,861	8,663	4,221	5,971
Oilseeds	5,870	5,560	2,137	2,397
Sugarcane	1,383	15,935	1476	44,257
Potato	953	3,891	207	1,283
Orange	5,258	33,020	14,200	41,200
Bananas	4,520	1,04,818	108,70	1,41,000
Grape	107	1521	2450	22,550
Cabbage	275	4287	3680	48,810
Passion fruit	929	3354	980	2110
Tomato	16	274	1070	10,120
Birdeye Chilly	714	721	9140	9330
Chow-chow	604	21,593	4800	81,930
Turmeric	522	9735	6350	25130
Ginger	4654	45,143	7650	31,200

Source: Statistical Abstract of Mizoram, 2015, Directorate of Economics & Statistics, Government of Mizoram

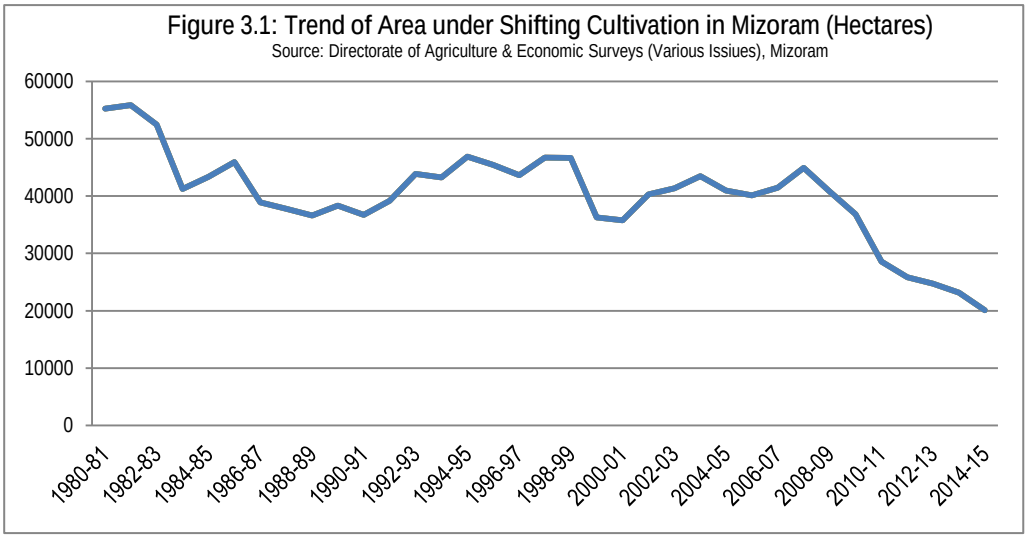
A notable trend from Table 3.1 is that there has been significant decline in the areas under major jhum crops during the 10 years under comparation (2005 and 2015). The area for paddy has declined by 134%, maize 151%, pulses 138%, oilseeds 163%, and ginger 36%. So, it may be concluded that there has been significant decline in the practices of cultivating jhum crops in Mizoram over the years.

3.3. Shifting Cultivation in Mizoram

Table 3.2 and Figure 3.1 present the trend of the area under shifting cultivation in Mizoram since 1980-81 as per the records of the Directorate of Economics & Statistics, Government of Mizoram.

Table 3.2: Areas under Shifting Cultivation in Mizoram

Year	Total Jhum Area(Ha)
1980-1981	55265
1984-1985	43377
1989-1990	38349
1994-1995	46854
1999-2000	36285
2004-2005	40969
2009-2010	36285
2014-2015	20064
Source: Statistical Abstract of Mizoram, 2015 & Economic Survey (Various Issues) of Mizoram	



It would be observed that the practice of shifting cultivation in terms of area cover has decreased significantly during the last 30 years. The area under shifting cultivation has decreased from 55265 hectares in 1980-81 to 20064 in 2014-15. It may be noted that Mizoram is one of the most urbanized states of India where around 50% of the total population reside in urban areas. Given the trend of urbanization, the existing areas of shifting cultivation is still substantial enough to make conclusion that it is still the mainstay of the rural population of the State. So, shifting cultivation has been the main livelihood provider of the rural population in the state of Mizoram.

To examine the significance of the shifting cultivation in the rural livelihood in Mizoram, the classification of workers in the last three Population Censuses is presented in Table 3.3.

Table 3.3: Classification of Workers in Mizoram in Different Censuses

Sl. No	Classification	1991	2001	2011
Major Classification of Workers				
1	Total workers (% to Total Population)	48.9	52.57	44.36
2	Marginal workers (% to total population)	6.8	11.78	6.53
3	Main workers (% to total population)	42.1	40.79	37.83
Activity wise Classification of Workers				
1	Cultivators	61	62.14	55.32
2	Agricultural labourers	3.28	3.32	10.07
3	Household industry workers	1.02	1.33	1.89
4	Other workers	34.35	44.22	49.99

Source: Directorate of Census Operations, Mizoram

Table 3.3 shows that around 44% of the total the population in Mizoram are workers, while main workers constitute around 37.83% of the total population in 2011.

The percentage of main workers decrease from 42.1% in 1991 to 40.79% in 2001 and 37.83% in 2011. Activity wise classification of workers have shown the dominance of cultivators in the total workers as it constitute more than half of the total workers in the last three censuses. According to census definition, a person is classified as a cultivator if they are engaged in the cultivation of land. Given this definition, it is thus clear that agriculture occupies a dominant place in the economy of the study areas and in Mizoram as a whole. Thus, shifting cultivation has been the main sources of livelihood in rural areas of Mizoram.

3.4. Socio-Economic Profiles

In our attempt to study the post harvest loss and management activities of the produces under shifting cultivation, a survey of 75 households were conducted in 4 villages. The sample were selected randomly to represent the conditions of the families under shifting cultivation. It may be worthwhile to examine the socio-economic status of these families so as to examine their day to day cultivation and production of crops.

Table 3.4 presents the demographic profiles of these households. It is observed from this table that the average family size of farmers was estimated at 6.07 persons with a standard deviation of 2.34. According to the Population Census 2011, the average family size of Mizoram, both rural and urban, was around 5 persons per households. Thus, our result show that the farmers engaged in shifting cultivation has higher family size than the overall state average in Mizoram.

Table 3.4: Demographic Profiles of the Cultivators

Sl. No	Demographic Indicators	Average Number	Std. Deviation
1	Family Size	6.07	2.34
4	Working family members	3.33	1.38
8	Members working in Shifting Cultivation (Number)	2.72	1.20
9	Members working in Shifting Cultivation (Percent)	81.60	

Source: Field Survey, October 2017

Out of the 6.07 average number of persons per family, around half of them (3.33) are the working family members. The average number of family members who primarily engaged in the activities of shifting cultivation turned out to be 2.72 persons which is more than 80 percent of the total workers. Thus, one may conclude that more than two-third of the work force are engaged in the activities of shifting cultivation in rural areas of Mizoram.

Figure 3.3 presents the poverty status of the shifting cultivators in the study areas. It may be noted that measurement of the household poverty level is very difficult task due to the multidimensionality of the poverty situations among the people. Accordingly, this study simply adopted poverty level determined by the State Government for the implementation of National Food Security Act 2013. According to the criteria given by the NFS Act 2013, the poorest of the poor are categorized as Antyodaya Anna Yojana (AAY), and those who do not have food security and need assistance from the government are categorized as Priority Household (PHH). The PHH are those who are in the second layer of the poverty ranking, while above poverty line

(APL) are non-poor and not covered by the NFSA. Given this definitions, it can be seen that 5.3% of the shifting cultivators are at the bottom of poverty ranking, and so they may be called very poor. Around 76% are in the middle income groups, but could not be considered as non-poor. At the same time, 18.7% are APL. So, it may be concluded that more than three-fourth of the cultivators are poverty ridden and do not have food security on their own.

Figure 3.2: Poverty Status of the Cultivator Households
Source: Field Survey, October 2017

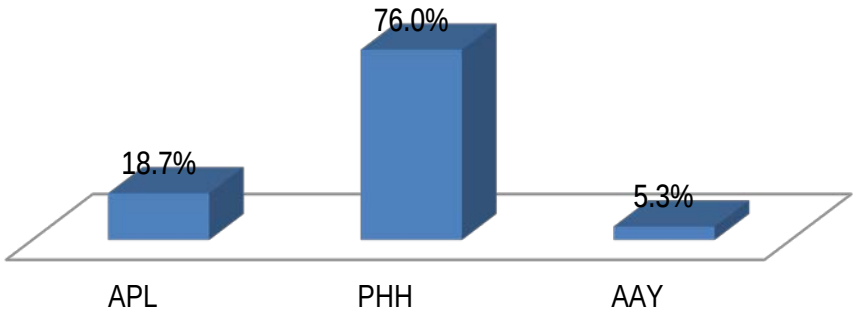


Figure 3.3: Housing Conditions of the Cultivators
Source: Field Survey, October 2017

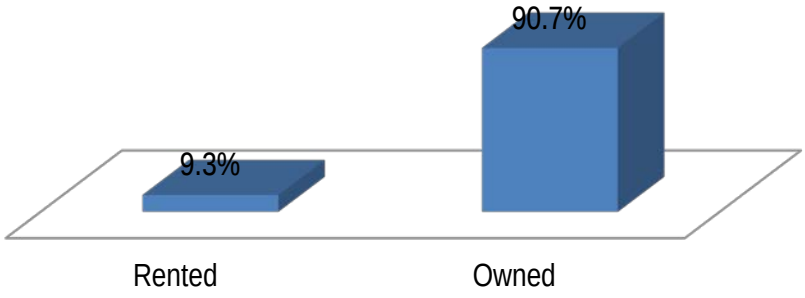
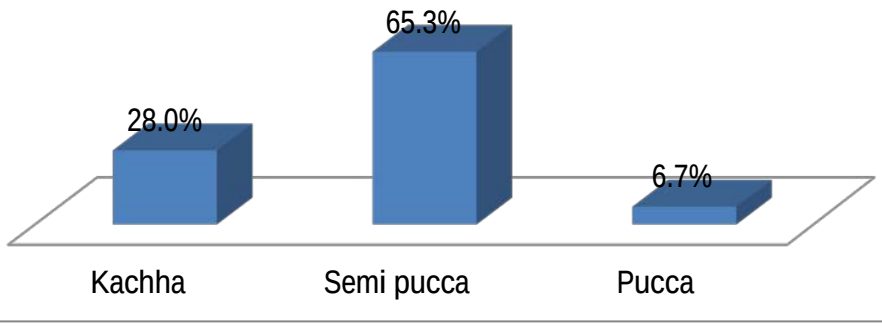


Figure 3.4: Housing Status of the Cultivators
Source: Field Survey, October 2017



It is observed from Figure 3.4 that more than 90% of the households live in owned house while 9.3% are in rented house. Unlike in urban areas where land for housing is scarce and beyond the reach of the poor, there is no problem of land for housing as the village normally has large area as community land. So, house ownership may not be a yardstick for measuring poverty level of the households.

Figure 3.4 presents the housing status of the shifting cultivators in the study areas. It is observed from this table that almost one third (28%) of the households live in kutcha house, while 65.3% are in semi-pucca house and 6.7% in pucca house. Kutcha house is the house made with material like thatch, bamboo, and woods. At the same time, if the majority of the materials are timber with galvanized roof, we simply called semi pucca. Thus, most of the families engaged in shifting cultivators stay in the house made of timber, wood and galvanized roofing sheet in the roof.

The most crucial indicators of household economic status should be the income, especially per capita income. Table 3.5 presents the income distribution of the shifting cultivator households in the four selected villages of the study. It difficult to assess the

income of those families who do earned income in sporadic occasions rather than regular stream. The respondents were asked to recall their income during last 365 days from the date of interview, and the results so obtained were divided by 12 to estimate the monthly income.

Table 3.5: Distribution of Monthly Income of the Cultivator Families

Sl. No	Monthly Income (Rs)	No. of Families	Percent
1	below 5000	11	14.67
2	5000-10000	36	48.00
3	10000-15000	11	14.67
4	15000-20000	7	9.33
5	20000 & above	10	13.33
	Total	75	100

Average monthly income = Rs.11768.89 & Std. Deviation = Rs.11425
Source: Field Survey, October 2017

Table 3.5 shows that more than 62% of the families are having income less than Rs.10000 per month. Taking into consideration, the average family size of around 6.03, the per capita monthly income for the family would be well below Rs.2000. Thus, it is safe to conclude that more than half of the families engaged in shifting cultivation has very low income, and the case of 14.67% of the families are more disturbing. In spite of the fact that the monthly income of more than 60% of the families is less than Rs.10000, the average monthly income among the families when taken together turn out to be quite high at Rs.11768 with a standard deviation of Rs.11425. Thus, the average income

is likely to be due to the affect of those having comparatively very high income in the distribution.

3.5. Cultivated Areas under Shifting Cultivation

Table 3.6 and Figure 3.5 present the details of areas per family for shifting cultivation during the last one year from the date of survey. Despite the substantial number of family workforce being engaged in shifting cultivation, the areas put under cultivation is surprisingly low. The average cultivated area per family is estimated to be 1.75 acre only with a standard deviation of 0.9 acre. Almost half (49.33%) of the family have cultivated area up to 1 acre only, while those having below 2 acre constitute more than 80% of the farmers. At the same time, only 4% of these families have greater than 3 acres.

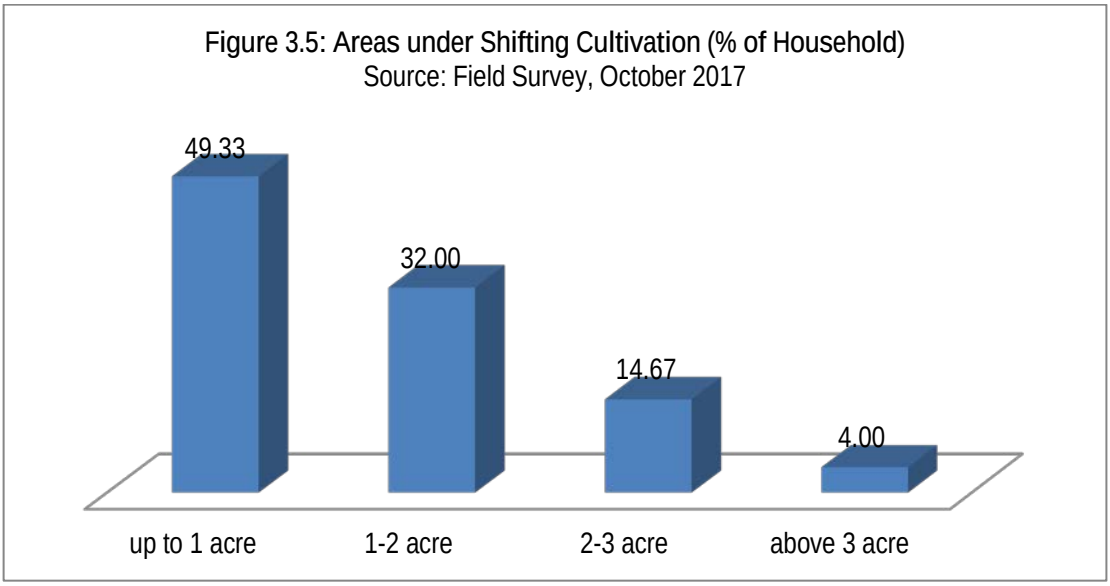
It is thus clear that though the system still persists in rural areas with substantial labour force engaged in it, the shifting cultivation has been undertaken in a lesser scale, likely to be at subsistence level only. The main reason behind this small cultivated among the majority of the farmers is that many farmers have adopted settled cultivation like plantation of orange, fruits, etc. These are initiated through different government sponsored schemes like NLUP, IWDP, etc. In the same way, there are families who are growing crops under shifting cultivation for domestic consumption only, especially to meet the family demand for vegetables.

Table 3.6: Areas cover under Shifting Cultivation (Acre)

Sl. No	Area (Acre)	No. of Households	Percent
1	up to 1	37	49.33
2	1-2	24	32.00
3	2-3	11	14.67
4	above 3	3	4.00
	Total	75	100

Average area of shifting cultivation = 1.75 Acre & Std. Deviation = 0.9 Acre

Source: Field Survey, October 2017



To substantiate the observations given above, the study also found that around 20% of the households covered have better income sources other than shifting cultivation but still practice the system to get the family consumption needs only. In addition, all of them said they had adopted mixed cropping in their jhum field. So,

cultivation of cash crops at commercial scale is hardly found, and majority of them are cultivated for the purpose of family own consumption.

Chapter 4

POST-HARVEST ACTIVTIES AND LOSSES OF AGRICULTURE PRODUCES: AN ANALYSIS

4.1. Introduction

Generally agricultural crops cultivated under shifting cultivation in Mizoram are perishable and need to be disposed of quickly after harvest. In the absence of adequate storage facilities and marketing channels for these produces, the farmers has to sell them in the nearby market destination and to the commission agent quickly after harvest. Excepting few crops like ginger, the major portions of the agricultural produces in Mizoram are consumed by the farmers themselves. So, it is difficult to make conclusive study on the marketing channels and post-harvest activities undertaken by the farmers.

This chapter attempts to study the general practices of marketing, post-harvest activities and post-harvest loss of agriculture produces under shifting cultivation in Mizoram using 10 major crops as case. The whole analysis is based on the data of sample survey conducted in 4 selected villages. The survey covered 75 households who were directly or indirectly involved in shifting cultivation during the reference period, i.e. one year from the date of interview. One difficulty faced while studying the nature of post-harvest management activities and estimation of losses is lack of proper record among the respondents. The study has to rely on the recollection of the respondent. As the major parts of the produce are used for home consumption and only small portion are marketed, people don’t care about the importance of post-harvest management

activities. In addition, as only limited quantities are marketed, post-harvest loss are quite minimal in some cases.

4.2. Area and Production of Crops

Table 4.1 presents the estimates of average cultivated areas of jhum crops (in acre) per household and production of the each crops (in kg). One clear observation of this study is that all the respondents said they practised mixed cropping, i.e. growing of two or more crops in the same jhum land. Thus, it is safe to assume that all the items presented in Table 4.1 are mixed crops and the areas are likely to be overlapping. Thus, one cannot take the cultivated areas of individual crops separately as they are normally grown in the same land simultaneously.

Table 4.1: Area and Production of Jhum Crops in the Study Areas (2016-17)

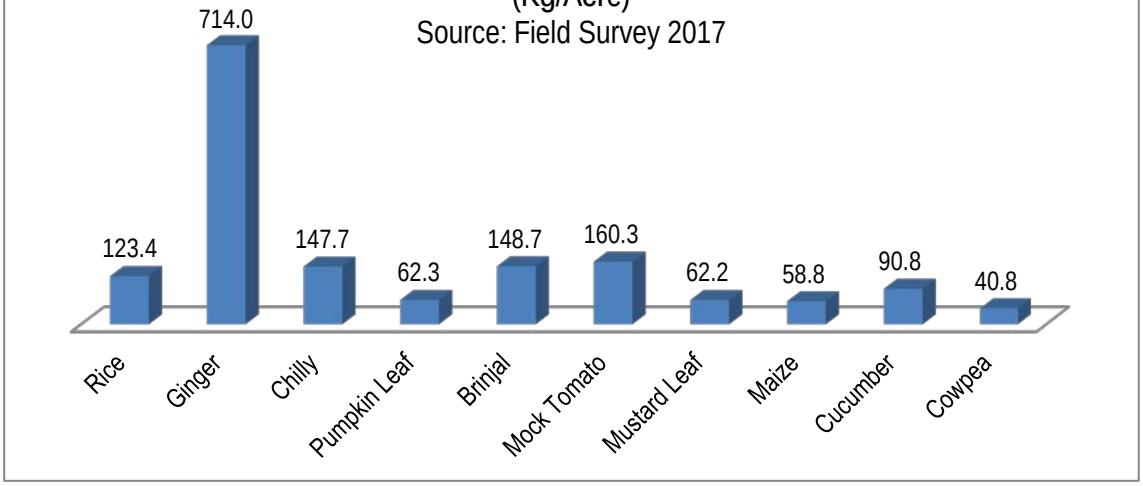
per household

Sl. No	Crops	Cultivated Area (Acre)		Production (Kg)	
		Mean	Std. Dev.	Mean	Std. Dev.
1	Rice	2.10	0.97	258.83	277.07
2	Ginger	1.86	0.96	1330.00	1840.58
3	Chilli (dry)	1.81	0.93	267.65	396.84
4	Pumpkin Leaf	1.76	0.88	109.93	99.20
5	Brinjal	1.81	0.94	269.52	732.25
6	Mock Tomato	1.78	0.93	285.58	821.00
7	Mustard Leaf	1.83	0.94	113.92	185.71
8	Maize	1.87	0.96	110.18	105.02
9	Cucumber	1.80	0.95	163.52	278.08
10	Cowpea	1.95	1.03	79.66	91.89

Source: Field Survey, October 2017

It is observed from Table 4.1 the average cultivated area for rice is largest among the 10 selected crops. It may be noted that rice or paddy is the staple food items of the people and has been the main crops since time immemorial. At the same time, the average areas per household for other crops range from 1.76 acre for pumpkin leaf and 1.95 acre for cowpea. The average production per household is highest for ginger (1330 kgs) and is lowest for cowpea (79.66 kgs).

Figure 4.1: Productivity of Different Crops under Shifting Cultivation (Kg/Acre)
Source: Field Survey 2017



Having presented the average production and area per household for different crops, examination of the productivity of these crops is of pertinent importance. This is presented in Figure 3.1. It may be observed from this figure that the production per acre is highest in case of ginger (714 kg) while it is lowest for cowpea (40.8 kg per acre). As noted earlier, ginger has become the main cash crops cultivated in jhum land in an extensive manner in most of the villages. There was no enough demand for ginger produces in these villages and there were only limited market avenues at low price during the reference period. Thus, several households prefer not to harvest the ginger

they cultivated. Taking into consideration this scenario, the productivity could be much higher had all the farmers harvested their ginger.

4.3. Home Consumption and Marketable Surplus

Table 4.2 present the distribution of production between home consumption and sold in the market. It is observed from this table that cultivation of rice is meant for only own consumption by the farmers as there was no record of sale among the respondents. Among the 10 selected crops, four crops namely ginger, chilli, brinjal and mock tomato are comparatively market oriented crops as more than half of the produces of these crops are said to be sold by the respondents.

Table 4.2: Quantity of Produces of Jhum Crops used for Home Consumption and Market

Sl. No	Crop Name	Production (Kg)	Own Consumption (%)	Quantity Sold (%)	Rate (Rs/Kg)
1	Rice	258.83	100.00	0.00	0
2	Ginger	1330.00	3.02	96.98	5.92
3	Chilli (dry)	267.65	20.52	79.48	104.64
4	Pumpkin Leaf	109.93	62.94	37.06	14.72
5	Brinjal	269.52	48.17	51.83	8.23
6	Mock Tomato	285.58	45.66	54.34	8.63
7	Mustard Leaf	113.92	60.42	39.58	15.62
8	Maize	110.18	74.22	25.78	11.91
9	Cucumber	163.52	63.28	36.72	14.23
10	Cowpea Leaf	79.66	68.30	31.70	11.59
	Total	2988.79	54.65	45.35	

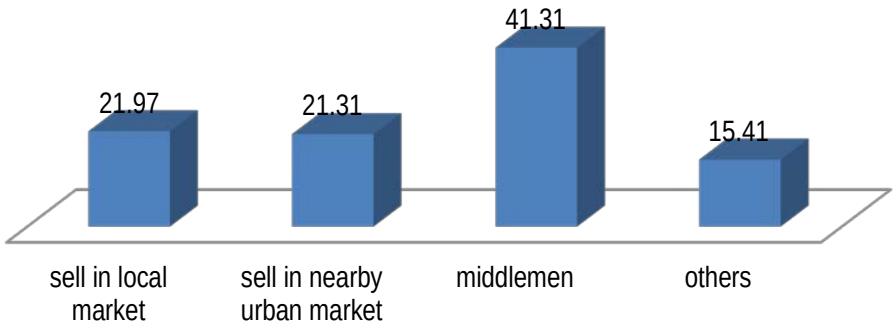
Source: Field Survey, October 2017

The prices range from Rs.5.20 per kg in case of ginger to a high of Rs.104.64 per kg for chilli. It may be noted that the respondents of the survey did not sell the rice they produce. So, the price of rice is recorded at zero.

4.4. Marketing Channels

There is no organised marketing channel accessible for the farmers for their produces. The existing channels through the farmers disposed their produces are group into four categories as sell in local market (sale in the village), sell in nearby urban market, sale through middlemen, and other. Figure 4.2 presents the percentage share of these channels for the marketing of the 10 selected shifting cultivation crops in the study areas. It should be noted that this figure considered only the marketable surplus, i.e. quantities of produces that is available for marketing.

Figure 4.2: Marketing Channels of Crops cultivated in Shifting Cultivation in Mizoram (%)
Source: Field Survey, 2017



It is observed from Figure 4.2 that the middlemen are the main marketing actor for agricultural commodities. This is in line with the observations of other studies

(Thanga, 2016). The middlemen control more than 41% of the total market volume of the agricultural commodities, and this followed by sale in the local market and in nearby urban market. Item wise marketing channels are presented in Table 4.3.

Table 4.3: Marketing Channels of Jhum Crops Sold by the Farmers

Percent

Sl. No	Crop Name	sell in local market	sell in nearby urban market	middlemen	others	Total
1	Rice	NA	NA	NA	NA	NA
2	Ginger	3.45	3.45	82.76	10.34	100
3	Chilli (dry)	15.00	15.00	30.00	40.00	100
4	Pumpkin Leaf	25.71	22.86	40.00	11.43	100
5	Brinjal	22.22	22.22	44.44	11.11	100
6	Mock Tomato	21.05	23.68	44.74	10.53	100
7	Mustard Leaf	27.27	27.27	30.30	15.15	100
8	Maize	43.48	21.74	26.09	8.70	100
9	Cucumber	35.48	29.03	32.26	3.23	100
10	cowpea Leaf	11.11	38.89	50.00	0.00	100
	Total	21.97	21.31	41.31	15.41	100

Source: Field Survey, October 2017

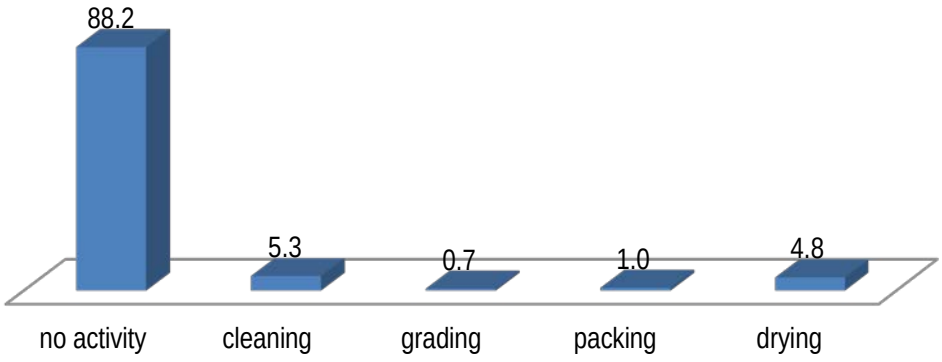
It is notable from Table 4.3 that around 83% of the ginger are sold by the farmers through the unorganised network of middlemen, who hailed from the neighbouring states of Assam. This is because ginger is the export oriented commodities and local consumption constitute only a negligible quantities. Large portion of around 40-50% of the produces for pumpkin leaf, brinjal, mock tomato and cowpea leaf are also disposed through middlemen. Unlike ginger, the main destinations of these crops are the towns and city to which the middlemen transported. The middlemen (or commission agent) come to the village to collect the produce and

brought it to the market destination (Aizawl city and other towns) and sold it to the retailer. Surprisingly, major portion of maize and cucumber produces are sold in the local market or within the village.

4.5. Post-Harvest Activities

Even though the one of the main objectives of this study is to examine the practice of post-harvest management practices of agricultural crops under shifting cultivation, it is unfortunate to see the limited practice of even simple activities by the farmers in the study areas. Figure 4.3 presents the major post-harvest management practices by the farmers for the 10 selected items in the study areas during last one year.

Figure 4.3: Activities Undertaken by the Farmers Immediately after Harvest
Source: Field Survey, 2017



It is observed from Figure 4.3 that more than 88% of these crops did not go through even simple post-harvest management activities in the study areas. This excludes any activity which could be part of harvesting activities while considering the

post-harvest activities. Table 4.4 presents the practice of post-harvest activities for different items of agricultural produces in the study areas.

Table 4.4: Post Harvest Activities Undertaken Immediately After Harvest

SN		no activity	cleaning	grading	packing	drying	Total
No of Cases Reported							
1	Rice	41	0	0	0	0	41
2	Ginger	44	7	0	0	0	51
3	Chilli (dry)	47	1	0	0	21	69
4	Pumpkin Leaf	68	2	0	2	0	72
5	Brinjal	62	2	0	0	0	64
6	Mock Tomato	62	2	0	0	0	64
7	Mustard Leaf	60	2	1	2	0	65
8	Maize	52	3	0	0	0	55
9	Cucumber	48	9	3	0	0	60
10	cowpea Leaf	33	2	0	2	7	44
	Total	516	31	4	6	28	585
Percentage of Cases Reported							
1	Rice	100	0	0	0	0	100
2	Ginger	86.27	13.73	0.00	0.00	0.00	100
3	Chilli (dry)	68.12	1.45	0.00	0.00	30.43	100
4	Pumpkin Leaf	94.44	2.78	0.00	2.78	0.00	100
5	Brinjal	96.88	3.13	0.00	0.00	0.00	100
6	Mock Tomato	96.88	3.13	0.00	0.00	0.00	100
7	Mustard Leaf	92.31	3.08	1.54	3.08	0.00	100
8	Maize	94.55	5.45	0.00	0.00	0.00	100
9	Cucumber	80.00	15.00	5.00	0.00	0.00	100
10	cowpea Leaf	75.00	4.55	0.00	4.55	15.91	100
	Total	88.21	5.30	0.68	1.03	4.79	100

Source: Field Survey, October 2017

Table 4.4 showed that the highest practice of post-harvest activities is found in case of chilli (68.12%) and cowpea leaf (75%). At the same time, there is no post-

harvest activities found in rice, while only negligible activities are undertaken for pumpkin leaf, brinjal, mock tomato, mustard leaf, maize, and ginger where more than 90% of these crops are sold without any activities. The main activity undertaken are cleaning, drying and packing.

4.6. Post-Harvest Materials

Table 4.5 presents the packing materials of the crops which went through post-harvest activities. It is clearly seen in this table that packing the commodities in gunny bags has been the common practices as more than 80% of them are using it on an average.

Table 4.5: Material Used for Packing of Jhum Crops before Sale

Sl. No	Crops	Material (No. of Cases)			Material (Percentage of Cases)		
		gunny bags	tree leaf	Total	gunny bags	tree leaf	Total
1	Rice	41	0	41	100	0	100
2	Ginger	51	0	51	100	0	100
3	Chilli (dry)	67	2	69	97.1	2.9	100
4	Pumpkin Leaf	26	46	72	36.1	63.9	100
5	Brinjal	63	1	64	98.4	1.6	100
6	Mock Tomato	64	0	64	100.0	0.0	100
7	Mustard Leaf	27	38	65	41.5	58.5	100
8	Maize	55	0	55	100.0	0.0	100
9	Cucumber	59	1	60	98.3	1.7	100
10	cowpea Leaf	16	28	44	36.4	63.6	100
	Total	469	116	585	80.2	19.8	100

Source: Field Survey, October 2017

At the same time, there is also a traditional practice of wrapping the vegetables using tree leaf (cane, wild banana leaf, etc) before consumption to protect from rotting. This is also still found in the packing material observed for vegetables in Table 4.5. More than 63% of pumpkin leaf, 58.5% of mustard leaf and 63.6% of cowpea leaf are packed by tree leafs. There is no adoption of modern packing materials for agricultural produces in the study areas.

Table 4.6 presents the storage arrangement adopted by the farmers to store their produces before marketing.

Table 4.6: Storage Arrangement before Sale of Agricultural Commodities

Sl. No	Crops	No. of Cases Reported				Percentage of Cases Reported			
		outside the house	refrigerator or cooler	no separate arrangement	total	outside the house	refrigerator or cooler	no separate arrangement	total
1	Rice	NA	NA	NA	NA	NA	NA	NA	NA
2	Ginger	2	0	49	51	3.9	0.0	96.1	100
3	Chilli (dry)	1	0	68	69	1.4	0.0	98.6	100
4	Pumpkin Leaf	0	4	68	72	0.0	5.6	94.4	100
5	Brinjal	9	4	51	64	14.1	6.3	79.7	100
6	Mock Tomato	10	5	49	64	15.6	7.8	76.6	100
7	Mustard Leaf	3	4	58	65	4.6	6.2	89.2	100
8	Maize	2	4	49	55	3.6	7.3	89.1	100
9	Cucumber	2	4	54	60	3.3	6.7	90.0	100
10	cowpea Leaf	1	2	41	44	2.3	4.5	93.2	100
	Total	30	27	528	585	5.1	4.6	90.3	100

Source: Field Survey, October 2017

It is surprising to see from Table 4.6 that more than 90% of the cases do not have separate storage arrangement for the produces before marketing. The possible reason for this is the practice of selling the commodities immediately after harvest to avoid losses due to the absence of proper cold storage. People in the study area normally defer harvest to wait for marketing opportunities. Meanwhile, storing the commodities in cold storage or refrigerator constitute only 4.6% of the cases while separate arrangement was made for 5.1% of the cases. This has clearly reflected the negligible uses of modern cold storage for agriculture produces in Mizoram resulting in the weak retention capacity of the produces by the farmers. This has caused rush sale at very unremunerative prices by the farmers several time.

4.7. Means of Transportation

Figure 4.4 and Figure 4.5 present the means of transportation of the produces from jhum to village and village to market destination respectively.

Figure 4.4: Transportation of Agriculture Produce from Field to Village (%)
Source: Field Survey 2017

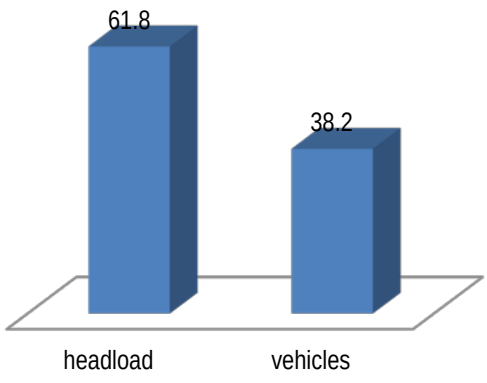
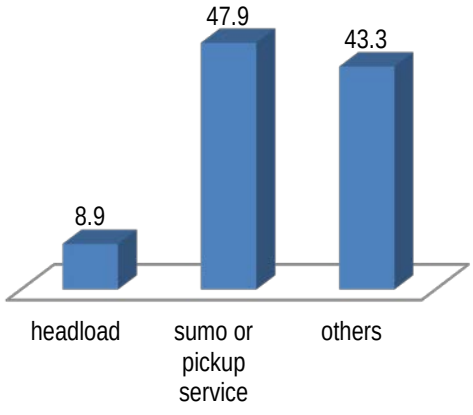


Figure 4.5: Means of Transportation from Village to Market (%)
Source: Field Survey 2017



Changing of the jhum land every year has made construction of link roads in all the areas used for shifting cultivation in the village. This has been reflected in the means for transportation of the produces from field to village as presented in Figure 4.4. It is observed that more than 61% of the produces are transported from jhum to the village or motor by head load, while transportation by vehicle constitutes 38.2% of the cases. AS it is observed from Figure 4.5, maxicab or pick up service (light motor vehicle) service are the major means of transportation of the commodities from the village to the market (towns and city).

4.8. Estimates of Post-Harvest Loss

In the absence of proper record among farmers about their expenditure and losses of the commodities after harvest till it is sold to the final consumers, it is very difficult to have comprehensive information about the post-harvest losses of the produces. In spite of this problem, attempt was made to ascertain at least rough estimate about the extent of post-harvest losses of the produces before it reach the final consumption stage. However, the study does not cover loss incurred in the harvesting activities. So, it covered only the losses incurred after the completion of all harvesting activities.

Table 4.7 and Table 4.8 present the extent of losses in different post-harvest activities of agriculture produces. On an average, 55.38% of the respondents said they loss less than 5% of their produces, while 37.09% said they had no loss as their produces were consumed immediately after harvest. It may be noted that ginger remains

the main cash crop cultivated extensively in different parts of the state. It is worth seeing that around 20% (19.61%) of the respondents said they had loss around 5-10% of their produces, while it is less than 5% for majority of the respondents (64.71%).

Table 4.7: Post Harvest Loss of Agriculture Produces – Immediate Handling

Percentage of Households

Sl. No	Crops	no loss	< 5%	5-10%	10-20%	20-30%	Total
1	Rice	29.27	68.29	0.00	0.00	2.44	100
2	Ginger	11.76	64.71	19.61	1.96	1.96	100
3	Chilli	26.09	68.12	4.35	1.45	0.00	100
4	Pumpkin Leaf	56.94	41.67	1.39	0.00	0.00	100
5	Brinjal	26.56	64.06	7.81	1.56	0.00	100
6	Mock Tomato	21.88	67.19	9.38	1.56	0.00	100
7	Mustard Leaf	63.08	33.85	1.54	1.54	0.00	100
8	Maize	34.55	52.73	12.73	0.00	0.00	100
9	Cucumber	33.33	60.00	6.67	0.00	0.00	100
10	cowpea Leaf	65.91	34.09	0.00	0.00	0.00	100
	Total	37.09	55.38	6.32	0.85	0.34	100

Source: Field Survey, October 2017

Table 4.8 present the losses in the process of transportation, storage and marketing of the commodities. It is surprising to see that the magnitude of loss is quite low in transportation and storage. All respondents said their loss was less than 5%, if they incurred. However, only 0.7% of them said they had incurred loss transportation, 0.9% in storage, and 4.3% in marketing. At the same time, there is substantial loss in marketing. Inadequate marketing facilities and storage for longer retention period, the producer has to incur loss while attempting to dispose their produce in whatever available markets.

Table 4.8: Post Harvest Loss in Transportation, Storage and Marketing

Percentage of Households

Sl. No	Name of Crops	Transportation		Storage		Marketing	
		no loss	< 5%	no loss	< 5%	no loss	< 5%
1	Rice	100.0	0.0	100.0	0.0	97.6	2.4
2	Ginger	98.0	2.0	90.2	9.8	98.0	2.0
3	Chilli	98.6	1.4	100.0	0.0	89.9	10.1
4	Pumpkin Leaf	100.0	0.0	100.0	0.0	95.8	4.2
5	Brinjal	98.4	1.6	100.0	0.0	95.3	4.7
6	Mock Tomato	98.4	1.6	100.0	0.0	96.9	3.1
7	Mustard Leaf	100.0	0.0	100.0	0.0	96.9	3.1
8	Maize	100.0	0.0	100.0	0.0	96.4	3.6
9	Cucumber	100.0	0.0	100.0	0.0	96.7	3.3
10	cowpea Leaf	100.0	0.0	100.0	0.0	95.5	4.5
	Total	99.3	0.7	99.1	0.9	95.7	4.3

Source: Field Survey, October 2017

From the distribution of loss presented in Table 4.7 and Table 4.8, attempt is made to work out the exact percentage of post-harvest loss in different stages. This is presented in Table 4.9.

Table 4.9 shows that on an average, around 2.09% of the produces are lost immediately after harvest in the process of handling, grading, etc. While the estimated average loss on different stages are 0.02% in transportation, 0.02% in storage, and 0.10% in marketing. And the total average loss for all items is estimated to be 2.23% of the produces.

Table 4.9: Average Loss of Jhum Crops in Different Post Harvest Stages

Percent

Name of Crops	Immediately	Transportation	Storage	Marketing	Total Loss
Rice	2.32	0.00	0.00	0.00	2.32
Ginger	3.87	0.05	0.25	0.05	4.22
Chilli	2.25	0.04	0.00	0.25	2.54
Pumpkin Leaf	1.15	0.00	0.00	0.10	1.25
Brinjal	2.42	0.04	0.00	0.12	2.58
Mock Tomato	2.62	0.04	0.00	0.08	2.73
Mustard Leaf	1.19	0.00	0.00	0.08	1.27
Maize	2.27	0.00	0.00	0.09	2.36
Cucumber	2.00	0.00	0.00	0.08	2.08
cowpea Leaf	0.85	0.00	0.00	0.11	0.97
Total Average	2.09	0.02	0.02	0.10	2.23

Source: Calculated from Field Data, 2017

4.9. Impact of Post-Harvest Management on Loss

In spite of the limited information and limited number of observations and quantities pertaining to the post-harvest activities undertaken by the farmers under shifting cultivation, attempt is made here to test the impact of post-harvest activities on the level of losses using simple hypothesis testing technique. The post-harvest loss percentage are broadly divided between those items where no activity was undertaken and those where at least one activity was undertaken are compared using t-statistic. Thus, the main factor adopted for post-harvest loss has become post-harvest activities. Further, the difference is tested between these two categories for each stage where losses occurred.

The t-statistic for difference of means adopted here is given by the following expression:

$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{S^2(\frac{1}{n_1}+\frac{1}{n_2})}}$ which follows students t-distribution with $(n_1 + n_2 - 2)$ degrees of freedom. Where $S^2 = \frac{\sum(X_1-\bar{X}_1)^2+\sum(X_2-\bar{X}_2)^2}{(n_1+n_2-2)}$, and $\bar{X}_1$ and $\bar{X}_2$ are the means in case of no activity and some activities respectively.

The result of the test is presented in Table 4.10. It is clearly observed that the crops where no post-harvest management activity was undertaken have shown higher losses than for the crops on which management activities were undertaken in all major post-harvest stages. Thus, one can conclude that with the increasing post-harvest management activities, the post-harvest loss for agricultural crops tended to decline.

Table 4.10: Estimated Post Harvest Losses for No Post Harvest Activities and Some Activities undertaken

	No Activity undertaken		Some Activties undertaken		
Post-Harvest Stages	Ave. Loss (%)	Std. Dev.	Ave. Loss (%)	Std. Dev.	t-value
Immediately After Harvest	2.06	2.52	2.14	3.19	-0.19
Transportation	0.02	0.22	0.00	0.00	2.00**
Storage	0.02	0.25	0.00	0.00	2.24**
Marketing	0.12	0.53	0.04	0.30	1.86*

Source: Calculated from Field Data, 2017

*significant at 10% level, ** significant at 5% level

The calculated t-statistics are all significant at 10% level (5% in transportation and storage). However, there is no difference for loss in the stage immediately after the harvest as the calculated t-statistic is insignificant. The result of the test presented in

Table 4.10 confirms that there is significant differences in the level of loss between the items on which post-harvest management activities was undertaken and no post-harvest activities undertaken. This result is in support of our study hypothesis that *post-harvest management practices has reduced post-harvest loss for agriculture produces under shifting cultivation.*

Chapter 5

MAJOR FINDINGS & CONCLUSIONS

5.1. Summary of Findings

1. Families engaged in shifting cultivation are having low socio-economic status in the study areas. It is observed that the monthly income of more than 62% of the these farmers is less than Rs.10000. The average family size is estimated at 6 of which half of them are regularly working in the cultivation. As per the criteria of National Food Security Act 2013, more than 80% of the families are not having food security, while 28% are living in kutcha house.
2. In spite of its significance in the livelihood system of the people in rural areas of Mizoram, the jhum size is quite low. The average jhum size per family is estimated at 1.75 acre with a standard deviation of 0.9 acre and almost half (49.33%) of the farmers have cultivated areas less than 1 acre. It is also worth noting that all these households are found to have adopted mixed cropping by cultivating different types of crops in the same jhumland.
3. It was observed that more than half (54.65%) of the produce from shifting cultivation are used for home consumption, and around 45% only are sold in the market to earn income. The major crops which are cultivated for commercial purposes as indicated by the percentage of quantities sold are ginger (96.98%), dried chilli (79.48%), mock tomato (54.34%) and brinjal (51.83%). At the same time 100% of the paddy produced are home consumed.

4. In the absence of organised marketing channels for agriculture produce under shifting cultivation, the main marketing stakeholder is middlemen through which more than 41% of the marketable surplus are sold by the farmers, while 21.31% are sold in the nearby urban market by the farmers themselves and sell in the village constitute 21.97%.
5. The total average loss is observed higher for all the items which do not go through any post-harvest management activities while compared with those which went through some post-harvest management activities. The calculated t-statistic to compare the difference between the two are found to be significant for different post-harvest stages. Thus, it is safe to conclude that post-harvest management activities significantly reduce post-harvest loss of agriculture produces. This justifies our study hypothesis.

5.2. Conclusions

This study observed that subsistence nature of farming under shifting cultivation Mizoram, where major portion of the produces are meant for domestic consumption. At the same time, the farmers have started selling of their surplus produces in the market, and started to select cash crops in their jhumland. People in the study areas have earned substantial amount of income by selling their produces. They do not have the proper skill, knowledge and materials to adopt modern post-harvest technology. Moreover, due to the absence of adequate storage facilities quantities they produce have to be disposed quickly after harvest to avoid loss. In spite of the quick selling of these produces, they are still found to have loss substantial quantities of their crops before selling it. Thus, it

is necessary to introduce the practice of post-harvest management among the farmers to avoid loss and enhance their income from agriculture.

5.3. Suggestions

Given the existing scenario of post-harvest management practices and loss of agriculture produces under shifting cultivation, and to increase the farmers' income, this study has made the following suggestions.

6. It is necessary to make awareness among the farmers about the necessity and importance of post-harvest management practices to ensure higher farm income and hence agriculture development. In addition, skill development initiative may be made on the post-harvest management of agriculture commodities. This will have dual effect of generating employment and increasing farm income.
7. It is necessary to make the tools and equipment for proper post-harvest management available and accessible to the farmer producers. This will greatly increase the practice and significantly reduce the loss by the farmer. The facilities may be made through either subsidy or other public intervention scheme.
8. Inadequate storage facility is the main hurdle for the emergence of organised marketing channels for agriculture crops in Mizoram. So, it is suggested that the government may create environment for the coming of investment in the areas through the legislative and infrastructural provisions.

BIBLIOGRAPHY

Ahsan,Dr.Hafiza(2006), 'India(1)', in *Post Harvest Management of Fruit and Vegetables in the Asia-Pacific Region*, Asian Productivity Organization(Tokyo, Japan)and Food And Agriculture Organization of the United Nations(Rome, Italy).

Alexandratos, N and Bruinsma, J (2012), 'World agriculture towards 2030/2050: the 2012 revision,' ESA Working paper No. 12-03. Rome, FAO

Basavaraja, H; Mahajanashetti,S.B., & Udagatti,Naveen, G. (2007), 'Economic Analysis of Post Harvest Losses in Foodgrains in India: A case study of Karnataka,' *Agricultural Economics Research Review*,Vol.20 January-June 2007 pp 117-126.

Changule;RB, Shelke;RD and Mane, BB(2011),'Economic evaluation of post harvest losses in tomato in Latur district of Maharashtra State',*International Research Journal of Agricultural Economics and Statistics*,Vol.2(1),March 2011,page 38-41

Chikkasubbanna,Dr.Venkatarayappa(2006), 'India(2)', in *Post Harvest Management of Fruit and Vegetables in the Asia-Pacific Region*, Asian Productivity Organization(Tokyo, Japan)and Food And Agriculture Organization of the United Nations(Rome, Italy).

Choudhury, M.L (2006), 'Recent Developments in Reducing Post Harvest Losses in the Asia-Pacific Region', *Post Harvest Management of Fruit and Vegetables in the Asia-Pacific Region*, Asian Productivity Organization(Tokyo, Japan)and Food And Agriculture Organization of the United Nations (Rome, Italy).

Devi,S.Roma & Singh,L Kanta(2015),'Scope for Post Harvest Management in North East India through Zero Energy Cool Chamber',*Indian Journal Of Hill Farming*,Vol.28,December,2015 page 137-143

Directorate of Economics and Statistics,*Statistical Abstract of Mizoram:2015*,Government of Mizoram

Gangwar; Raveesh, Kumar; Tyagi, Swati, Kumar; Singh, Vikas; Kamini, and Singh, Garima (2014), 'Food Production and Post harvest Losses of foodgrains in India,' *Food Science and Quality Management*,Vol.31, 2014.

Garg,M.K(2007),'Postharvest Managment',In Ashwani K.Goel,Rajinder Kumar and Satwinder S.Mann(Eds.),*Postharvest Management and Value Addition*,(60-73),Delhi:Daya Publishing House,2007.

Guleria,S.P.S(2007) ,'Enhancing Food and Nutritional Security through Postharvest Management and Value addition in the Present Era of Globalization',In Ashwani

K.Goel,Rajinder Kumar and Satwinder S.Mann(Eds.),*Postharvest Management and Value Addition*,(60-73),Delhi: Daya Publishing House,2007.

Hegazy,Rashad(2013),'Post-harvest Situation and Losses in India'. 10.6084/m9.figshare.3206851.v1.

Iilyas,S.M and Goyal,R.K.(2007),'Postharvest Management and Value Addition:Prospects and Opportunities',In Ashwani K.Goel,Rajinder Kumar and Satwinder S.Mann(Eds.),*Postharvest Management and Value Addition*,(60-73),Delhi:Daya Publishing House,2007.

Japan International Cooperation Agency (JICA, 2014), *The Study on Development and Management of Land and Water Resources for Sustainable Agriculture in Mizoram, India – Agriculture Production and Market Survey,* A Report submitted by James L.T. Thanga, Department of Economics, MZU.

Jha;SN, Vishwakarma;RK, Ahmad T; Rai A and Dixit,AK (2015),*Report on assessment of quantative harvest and post-harvest losses of major crops and commodities in India,* ICAR-All India Coordinated Research Project on Post-Harvest Technology, ICAR-CIPHET, P.O.-PAU, Ludhiana-141004.

Kitinoja, Lisa & Kader, Adel. (2015). Measuring postharvest losses in fruits and vegetables in developing countries. 10.13140/RG.2.1.3921.6402.

Lakra;Valeria,Singh;Mk,Sinha;Rekha &Kudada,N(2010),'Indigenous technology of tribal farmers in Jharkhand',*Indian Journal of Traditional Knowledge*,Vol.9(2),April 2010,pp 261-263.

M,Rais and A,Sheoran(2015),'Scope of Supply Chain Management in Fruits and Vegetables in India',Journal of Food Proccessing & Technology,Vol(6)3:427

Mitrannavar, D.H.and Yeledalli, R.A. (2014), 'Estimation of Post Harvest Losses of Major Vegetables in Karnataka- A Management Appraisal'. *International Journal of Commerce and Business Management,* Vol. 7(2), pp.349-353.

Patil;Mallikarjun,Bheemappa;A,angadi;J.G and Arvindkumar,B.N(2010),'Production and post harvest management practices followed in organic vegetable cultivation',*Karnataka Journal of Agricultural Sciences*,Vol.23(2):pp 269-273.

Rahemi, Majid (2006), 'Post Harvest Management of fruits and vegetables for better food quality and safety', in *Post Harvest Management of Fruit and Vegetables in the Asia-Pacific Region*, Asian Productivity Organization(Tokyo, Japan)and Food And Agriculture Organization of the United nations(Rome, Italy).

Ramchandra;Dr,Paliwal;Bodh Harsh,James;Dr Abhisek,Kumar;Hemant,Daniel;Sameer and Umrao,Rajiv(2015),'Economic Analysis of Post-Harvest Losses in Marketing of Major Vegetables in Allahabad District of Uttar Pradesh',*Journal of International Academic Research for Multidisciplinary*,Vol.3(2),pp203-211,March 2015.

Rao, Kavita., Naresh, Gautam.& Choudhury, Roy, Indrani (2012), *Mizoram State Development Report 2012*, Indian Institute of Public Finance and Policy.A

Rolle, Rosa S.(2006), 'Improving Post Harvest Management and Marketing in the Asia-Pacific Region', *Post Harvest Management of Fruit and Vegetables in the Asia-Pacific Region*, in Asian Productivity Organization (Tokyo, Japan)and Food And Agriculture Organization of the United Nations(Rome, Italy)

Satapathy,K.K(2007),'Priorities for Postharvest Management of Agriculture and Allied Sectors in North-eastern Region',In Ashwani K.Goel,Rajinder Kumar and Satwinder S.Mann(Eds.),*Postharvest Management and Value Addition*,(60-73),Delhi:Daya Publishing House,2007.

Sharma, Gaurav & Singh, S.P (2011), 'Economics Analysis of Post harvest Losses in Marketing of Vegetables in Uttarakhand', *Agricultural Economics Research Review*,Vol.24 July-December, 2011 page 309-315.

Singh;Vishal,Hedayetullah;Md,Zaman;Parveen and Meher,Jagamohan(2014) ,'Postharvest Technology of Fruits and Vegetables:An Overview',*Journal of Postharvest Technology*,Vol.02(02):124-135,April'2014.

Singh,;Avanish Kumar, Singh;Neeraj and Singh, B.B(2013).,'Marketing and post harvest loss assessment of vegetables in Varanasi district (U.P.), *International Research Journal of Agricultural Economics and Statistics*,Vol.4 (1) : March,2013 pp 47-50.

Sudheer, K.P & Indira,V.(2007), *Post Harvest technology of Horticultural Crops*, New India Publishing Agency, New Delhi.

Verma, Ajay and Singh, K.P. (2004) ,'An Economic Analysis of Post Harvest Losses In Fresh Vegetables', *Indian Journal Of Agricultural Marketing*, Vol. 17 (2): pp 79-91.

Yadav,D.S and Yadav,R.K(2007),'Postharvest Handling and Management of Horticultural Crops in North-eastern region',In Ashwani K.Goel,Rajinder Kumar and Satwinder S.Mann(Eds.),*Postharvest Management and Value Addition*,(292-305),Delhi:Daya Publishing House,2007.

Kitinoja, Lisa & Kader, Adel(2015),Measuring postharvest losses in fruits and vegetables in developing countries. 10.13140/RG.2.1.3921.6402.

Gajbhiye,D.T.;Kukade,N.N;Bagde,N.T;Burade,A.L.(2008),'An economic analysis of post-harvest losses of selected vegetables in Nagpur district',*Journal of Soils and Crops*,Vol.8(02) pp 469-472.

Basappa;G,Deshmanya;J.B and Patil,B.L,'Post-Harvest Losses of Maize Crop in Karnataka-An Economic Analysis',*Karnataka Journal of Agricultural Sciences*,Vol.20(1):pp 69-71.

Kalidas, K and Akila, K.(2014),'Micro level investigation of marketing and post harvest losses of tomato in Coimbatore district of Tamilnadu',*Journal of Stored Products and Postharvest Research*, Vol.5(1):pp 1-7.

Hazarika, C. (2008),'Extent of Post-Harvest Losses of Ginger in Assam – A Micro Level Analysis', *Indian Journal Of Agricultural Economics*, Vol. 63 (3): pp 370-371

ANNEXURE

Format of Interview Schedule for Field Data Collection

Post-harvest Loss and Management Practices of Agriculture Produce under Shifting Cultivation in Mizoram

Sir/Madam,

This is a questionnaire for a study on Post-Harvest Loss and management Practices of Shifting Cultivation in Mizoram.I,kindly request you to spare me your time and efforts for answering my questionnaire.

I promise that information supplied will be kept confidential and will be use for research purpose only.

Thanking You

Yours Sincerely

H.Lalhmangaihchhungi

1.Name of the Village :

2.Number of Household :

3.Total member of Family :

Male	Female	Total

4.Family under :

Workforce	Student	Children	Others

5.Number of family member engaged in shifting cultivation :

6.Main Sources of Income :

7.Income from all sources :

8.Family Status: APL( ) BPL ( ) AAY ( )

9.Family's Food Security Status(Ration Card colour) :

White( ) ,Green( ), Yellow( )

10.Housing Condition : Rented( ) Owned( )

11.Housing status: a).Kachha( ) b).Semi kachha( ) c).Pucca( )

12.Area under cultivation(last year) :

13.Types of cultivation : Mixed( ) Single( )

14.Main Crops cultivated :

15. PRODUCTION

Crops	Area	Types(Mixed or Single)	Production	Home Consumption(in %)
Rice				
Ginger				
Dry Chilly				
Pumpkin leaf				
Brinjal				
Samtawk				
Mustard leaf				
Maize				
Cucumber				
Cowpea leaf				

16. MARKETING

Crops	Market Status	Market Chanel	Amount Sold(in Kg)	Rate
Rice				
Ginger				
Dry chilly				
Pumpkin leaf				
Brinjal				
Samtawk				
Mustard leaf				
Maize				
Cucumber				
Cowpea leaf				

Market Status
1=For home consumption only
2=Both home and sell
3=Market only/sell only

Market Chanel
1=Not oplicable
2=sell in local market
3=Sell in nearby urban market
4=middlemen
5=Others

17. POST-HARVEST PRACTICES

Crops	Activities immediately after harvest	Percentage cover	Material used
Rice			
Ginger			
Dry Chilly			
Pumpkin leaf			
Brinjal			
Samtawk			
Mustard leaf			
Maize			
Cucumber			
Cowpea leaf			

Activities immediately after Harvest
1=No activity
2=Cleaning
3=Grading
4=Packing
5=Drying
6=Others

Material Used
1=Gunny bags
2=Plastic material
3=Wooden/Cane box
4=Leaf
5=No Proccessing
6=Others

18. STORAGE

Crops	Before market/consumption	Rodent/insect attack
Rice		
Ginger		
Dry Chilly		
Pumpkin leaf		
Brinjal		
Samtawk		
Mustard leaf		
Maize		
Cucumber		
Cowpea leaf		

Before market/consumption

1=Separate rooms

2=bamboo and wooden in the house

3=Outside the house

4=refrigerator or cooler

5=No arrangement

6=others

Rodent or insect attack

1=Not safe

2=safe to some extent

3=very safe

19. **LOSS**

Crops	Immediately after harvest	Transportation	Storage	Market
Rice				
Ginger				
Dry Chilly				
Pumpkin leaf				
Brinjal				
Samtawk				
Mustard leaf				
Maize				
Cucumber				
Cowpea leaf				

20.TRANSPORTATION

Crops	Transportation from field to village	To market
Rice		
Ginger		
Dry Chilly		
Pumpkin leaf		
Brinjal		
Samtawk		
Mustard Leaf		
Maize		
Cucumber		
Cowpea leaf		

To village from Field
1=Headload
2=Vehicles
3=Cart
4=animal
5=others

To Market
1=Headload
2=Sumo or Pick up service
3=own vehicle
4=Others

POSTHARVEST ACTIVITY

21.Do you find your post harvest management practices are sufficient enough to ensure good income?

22. Do you think that loss of income is due to poor and lack of post harvest management practices?

23'According to you what is the main problem for inhibiting the emergence of sustainable post harvest management practices?