Cassava Production Marketing and Utilization in Meghalaya, India

RESULTS OF A VALUE CHAIN ASSESSMENT

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Cassava Production, Marketing and Utilization in Meghalaya, India: Results of a value chain assessment

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Abbreviations

CIP	Centro Internacional de la Papa
CMD	Cassava mosaic disease
DOH	Meghalaya StateDirectorate of Horticulture,
FGD	Focus group discussions
EGH	East Garo Hills
IBDLP	Integrated Basin Development and Livelihoods Programme
ICAR RC-NEH	Indian Council of Agricultural Research - Research Complex for NEH Region
ICAR-CTCRI	Indian Council of Agricultural Research – Central Tuber Crops Research Institute
IFAD	International Fund for Agricultural Development
KII	Key informant interviews
MBDA	Meghalaya Basin Development Authority
MSAMB	Meghalaya State Agricultural Marketing Board
LAMP	Meghalaya Livelihoods and Access to Markets Project
NEH	North Eastern Hill
RTC	Roots and Tuber Crops

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EXECUTIVE SUMMARY

The scoping study of RTCs in Meghalaya led by FoodSTART+ and LAMP in 2016 recommended conducting a cassava value chain study in key cassava producing areas in Meghalaya to strengthen the value chain and increase benefits to farmers. This study was conducted in September-October 2017 with the overall objective of identifying major constraints in cassava production, marketing and use, and opportunities for interventions that could significantly increase returns for farmers and processors; specifically studying all aspects of cassava value chain in Meghalaya. These pieces of information will be used to plan LAMP/MBDA activities in the cassava sub-sector. This study followed a value chain analysis approach and involved a cross-sectional data collection among a range of stakeholders and value chain actors through review of secondary data, key informant interviews, focus group discussions, and surveys. The study was conducted in the main cassava producing districts of East Garo, West Garo, and West Khasi hills as well other important markets dealing with cassava including Shillong.

Cassava plays a significant role in food security and serves as a major ingredient in the animal feed management in Meghalaya. Consumption of cassava as cereal substitute was reported to be high in Meghalaya. Cassava is available for consumption nearly eight months in a year. The crop is grown in 6300 ha of land in Meghalaya, sharing 3.2 % of the total cultivable area of the state. This is the second highest among all the cassava producing states in India. The area and yield trends of cassava showed that there is a noticeable increase annually, a trend more positive than the negative trend observed nationally.

Cassava is cultivated in various types of production systems namely: Jhum (traditional shifting cultivation), individual holdings, and homestead. Jhum had more cassava area followed by individual holdings and homestead. The value chain mapping revealed that farmers, aggregators, wholesalers, retailers, and consumers are the main actors, and they are supported by input suppliers and government organizations. Cassava cultivation is dominated by small farmers. Women farmers are more numerous than men farmers. Meghalaya farmers grow varieties of short and long durations, and major varieties grown are Meghalaya, Smog, Bolong, and Naga. Farmers use their own seed materials, hence they

do not incur any expenditure on seed materials, and do not use any external inputs like fertilizers and pesticides. Cassava is labor intensive and involves 400 to 424 labor days/ha of land preparation to harvest. Farmers sell 40 % of the production and the balance used as food and feed. All parts of the plant are used in different ways for food, feed and fuel. Farmers convert one sixth portion of the tubers allocated for house use to storable forms of flour and dried chips. There are various recipes prepared in the house and the most popular dish is boiled tubers as breakfast dish. Cassava marketing is unorganized in Meghalaya and appears to be closed space-wise, mostly happening within a village or nearby villages and the farthest reaches the district markets. It involves a short chain of actors done mostly by farmers directly and to some extent, aggregators/retailers. Wholesalers role is limited. Marketing role is dominated by females (90%) which includes aggregators and retailers. Tubers are mostly sold in bundles ranging from 1.5 to 2 kg, and not by standard volume and weight.

There are three types of volume of market arrivals: peak seasons are in November, December and January; medium (non-peak) are in October, February, and March; low arrivals are in August, September, and April. Farmers get maximum price during August and September when short duration varieties are harvested. Tubers are sold as fresh raw and cooked tubers. Boiled tubers sales are more prevalent in West Khasi districts and are very popular in Shillong markets. Value chain mapping indicated that there are four channels in West Khasi and five channels in Garo districts. These channels involve flow of raw tubers from farmers directly to consumers; farmers aggregators and consumers; farmers, aggregators, wholesalers, retailers and consumers. The processed forms are mostly sold directly by farmers to consumers. The price of cassava is unstable and has fluctuations. The cost of production of tubers is priced at Rs 6.5/kg, boiled tubers at Rs 21/kg, and fried chips at Rs 24/kg. Market margin of producers is high when sold as fried chips followed by boiled tubers, however, the volume of business is very small. Producers' share of the final price is high when tubers move from farmers to consumers directly. Major challenges facing farmers and other value chain actors are identified in the area of production, value addition, and marketing of cassava. The producers and other chain actors are facing various issues ranging from damages caused by wild boars and rodents, short

shelf life of the fresh tubers, price instability, less market demand, lack of knowledge on value addition and very few value addition attempts, transportation costs, and restricted flow of tubers spatially. The most critical issues are with value addition and marketing.

To overcome the challenges of actors in the cassava value chain, especially the farmers, a series of opportunities for intervention were identified. These include options for strengthening farmers' and other entrepreneurs knowledge on cassava value addition, encouraging primary processing into flour and dried chips; home and community level and storage; creating a brand awareness as a purely organic food and facilitating marketing in metro cities and exports; facilitating start-up production units on cassava value addition at cottage/community level; small and medium levels, and industrial level for different value addition technologies.

1. INTRODUCTION

Cassava *(Manihot esculenta* crantz) also known commonly as tapioca in India, is the most widely cultivated root crop in tropics and is grown across a broad range of agro-climatic conditions. It continues to be a crop of food security for the millions of small and marginal farm households especially in developing countries. It is an important alternative source of energy to meet the demands of an increasing population. This crop has the potential to produce more food per unit area than other crops, capacity to withstand adverse biotic and abiotic stresses and adaptability to the conditions of drought and marginal lands (Edison et al., 2006). Also, it provides rich sources of energy, vitamins, minerals, etc. The use of cassava as a human food and in the form of value added products has increased in the recent years. All these point towards the positive effects of increase in the production of cassava in India. Cassava is rapidly becoming a major industrial crop owing to the application of its flour and starch. There is potentially a vast scope for area expansion in cassava in most of the states including the North Eastern Hill (NEH) states (in view of its adaptability to complex soil and climate factors and availability of land in Jhum and individual farm production situations.) NEH occupies a significant place in India's plan for economic development both in socio-economic as well as geo-political spheres (Haokip, 2010).

However, the relatively low rate of development in the NEH region impacts on the country's over-all developmental process. The region is endowed with lush green vegetation but there are few signs of the green revolution. With diverse agro-climatic conditions, varied soil, and high and distributed rainfall, this region is highly suitable for cultivation of cassava. It provides food and nutritional security to many people and serves as an important feed component of livestock of this region. Since cassava does not require much attention or care and no serious disease or insect damages are observed, they are preferred as risk averse crop in this difficult region.

Meghalaya is one among the eight states which has a major area for horticultural crops including cassava. Many international development agencies are involved in enhancing the livelihood status of North-Eastern states especially the state of Meghalaya owing to its lagging socio-economic and development indicators compared to other states in India. Among the various Roots and Tuber Crops (RTCs) grown in Meghalaya, cassava is ranked highly among the villagers in terms of productivity, market demand, local preference, contribution to food security and nutrition. This is followed by yam, taro, sweet potato and yam bean (Roy et. al., 2014).

The Meghalaya Livelihoods and Access to Markets Project (LAMP) being part of the State Governments flagship Integrated Basin Development and Livelihoods Programme (IBDLP) functions with a goal to improve family incomes and the quality of life in rural Meghalaya. It focuses on natural resource management, enterprise development, and market access (IFAD, 2014). There is a great scope of achieving the goals of LAMP through enhancement of livelihood of RTCs farmers via appropriate interventions including value chain development, as they constitute a significant proportion of the farming community in Meghalaya. A project, "Food Resilience through Root and Tuber Crops in Upland and Coastal Communities of the Asia-Pacific" (known as FoodSTART+) funded by the International Fund for Agricultural Development (IFAD) is implemented in the state of Meghalaya in cooperation with the LAMP of the MBDA. The overall goal of FoodSTART+ is to enhance food resilience among poor households in upland and coastal communities of the Asia-Pacific region. The scoping study of FoodSTART + has

recommended to undertake a cassava value chain study in key producing areas in the state as one of the action points, in collaboration with LAMP.

Several key issues in agricultural development have arisen in recent years, such as the growing predominance of marginal and small farmers in the agricultural population including in the cassava sector; increasing dependence of farmers on income from sale of their crops, improving the linkages between these farmers and different market types, and increasing the efficiency in the food value chain (Reardon, et.al. 2012). However, the detailed characteristics of current value chains and the way they are changing are not well understood, including cassava value chains. Agricultural innovations bringing about large productivity increases and real price decreases in agriculture over time have mostly been studied in relation to agricultural production. Innovations in trading, marketing, and processing could also have significant impacts on agricultural performance and productivity, and thus even on producers and consumers alike, but less research has been undertaken in this area (Minten et. al., 2011). It was observed by CTCRI (2015) in their NEH programme on RTCs that even modest post-harvest value addition interventions such as cassava slicers, chipping machine, graters etc. could bring in desirable changes among farmers in their post-harvest management of RTCs. When coupled with adoption of new RTCs varieties, appropriate value chain interventions can play a great role in livelihood enhancement of farmers.

For the cassava sector, there is a need for a holistic study of value chains and the development of the crop in Meghalaya, in order to develop future value chain interventions that benefit these rural cassava producing households.

1.1. Key issues for cassava development in Meghalaya

Cassava is cultivated in homestead, individual farms and often in traditional shifting (Jhum) farming production systems. However, there is a lack of official information on the area being cultivated under various production systems. Jhum cultivation occurs in many areas in which land quality has been degraded by soil erosion and nutrient loss. The short post-harvest life (2-3 days) and bulkiness are the innate characteristics of cassava that cause problems in its marketing and price. Marketing of cassava in the north eastern states

of India is further constrained by hilly topography, that comprises about 70 per cent of the total land area. This limits market access, which ultimately affects the resource-poor farmers of the region. A scoping study on RTCs in Meghalaya has indicated that low yield, reliance on traditional varieties only, disorganised marketing, very limited value addition and processing, and a lack of motivation for commercial production by the farmers, combined with poor quality planting material and predation by wild animals and rodents all act as major constraints to cassava production (Anantharaman et. al., 2016).

Saikia (2001) highlighted that storage, processing and marketing facilities for perishable commodities (such as cassava) are deficient in the north eastern region of India. Owing to this technological constraint, that is still relevant today, rural marketing in the region is dominated by unorganized private traders.

The most serious constraint to small farm production relates to problems of access to production resources, which includes inputs like water, power, fertilizers, feed, capital, extension services and information. Alongside this, poor access to markets limits demand side incentives for farmers to increase production. Where marketable production surpluses occur, farmers are often confronted with high transactions costs, damage and deterioration for their fresh produce, and poor prices that discourage commercially oriented production. This complex nature of production from limited resources, marketing, and inadequate profits needs to be better understood through problem diagnosis and consequent development of strategies that will create better income flow. Value chain analysis is a useful tool in this context. Organization of agriculture along the value-chain framework has been conceived as one of the strategies to bring more efficiency in the agricultural sector (Jha et. al. 2011). There has not been so far an organized value chain study on cassava in Meghalaya documenting clearly the production, processing, utilization and marketing of the crop which would help to orient value chain interventions in cassava aiming at livelihood enhancement for smallholder producers. With this view, it is proposed to have value chain study on cassava in Meghalaya with the following objectives.

1.2. Overall objective

Identify major constraints in cassava production, marketing and use, and opportunities for interventions that could significantly increase returns for farmers and processors.

1.3. Specific objectives

1. Provide a comprehensive understanding of cassava production, marketing and consumption in the various production systems in Meghalaya and identify the benefits of market participation to food-insecure households (mainly producers);
2. Map the cassava value chains, characterize actors, and describe how the value chain is organized, coordinated, and governed;
3. Determine profit and marketing margins obtained by actors at various nodes of the cassava value chain;
4. Document the popular cassava recipes which could have marketing potentials;
5. Identify problems, bottlenecks, and opportunities in existing (and novel) market chains, especially for development of value chains over time that contribute to enhanced food security, based on the perceptions of different groups of chain actors and stakeholders, including consumers;
6. Identify potential innovations for piloting in RTC value chains relevant to food security and equity, as well as efficiency and competitiveness; and
7. Use data collected to plan LAMP/ MBMA activities in this sub-sector.

1.4 Scope of the study

The study aims to provide a holistic view of cassava in Meghalaya encompassing the cropping systems and production practices,but focusing more in detail on post-production and utilization, including storage and the marketing system. It includes the views of multiple stakeholders which have been given less attention in earlier studies. By understanding the role of various actors, the distribution of benefits and constraints among the actors and across the existing value chain the study seeks to help farmers and other actors to improve the efficiency of the whole chain and increase the economic benefits flowing back to farmers. The study will also provide a basis for formulating policies of the cassava sector in Meghalaya.

1.5 Limitations of the study

The usual limitation of time like in any study in terms of total duration as well as the timing of the study would have had its own effect on this research. In view of the resources constraint, both time and finance, sampling area was restricted to three districts, however sampling was done to represent significantly the cassava area. The investigators would have wished to spend more time in the field, hence enabling them to visit more areas in the field. Also, the timing of the research brought in limitations. The deadline of the report influenced the planning of the mission and unfortunately not all key resources persons were around during the field study. Moreover, the data could not be collected over a period of time and therefore variations and fluctuations came in, for example, demand and prices could not physically be validated. Other challenges were to extract accurate information from the farmers on yield, costs, and profits in view of complex cassava production system like jhum cultivation, mixed cropping system and trading measures mostly by tuber bundles and not by weights and volumes, and also from other actors on costs and profits, and the inadequate and to some extent unreliable agricultural production and marketing data. In spite of these limitations, the investigators were able to collect meaningful information which sufficed for the analysis and the development of recommendations.

2. RESEARCH METHODOLOGY

The scoping study on roots and tubers in Meghalaya under FoodSTART + recommended a research on value chain analysis of cassava within the framework of cassava production, marketing, and other related aspects. The broader objective is to identify major constraints in cassava production, marketing and use, and opportunities for interventions that could significantly increase returns for farmers and processors.

A research design was developed in order to fulfil the objectives set for the study which are given in the introduction. The study followed a value chain analysis approach. As a product moves from the producer to the consumer, several transformations and transactions take place along the chain of interrelated activities and value is added at each stage of the chain, hence the term value chain is used to describe the product's movement and

interaction along this chain. Value chains adapt and respond to other factors, local conditions, policy and institutional environment, market power and consumer preferences. The aim of a value chain analysis, therefore, is to assess these factors influencing the value chain.

2.1. Data collection methods

A cross-sectional research design was used in this study to be able to collect information from various stakeholders including scientists, extension workers, traders, processors, farmers and other persons or groups involved in the cassava value chain in Meghalaya. Data was gathered through literature review, KII, FGD, survey of respondents using questionnaires, stakeholders meeting, market visits, and observation. The specific methods used for each of the various data types and information analyzed in this study are shown in Table 2.1.

2.1.1. Primary data collection

Primary data collection activities, such as the KII, FGD, surveys, market visits and observation, were done between September–October 2017 with the help of appropriate and suitable assistance for translation in local languages and dialects. The KIIs were done through semi-structured interviews with representatives of relevant government agencies such as the previously mentioned MBDA, the Meghalaya State Directorate of Horticulture (DOH), Meghalaya State Agricultural Marketing Board (MSAMB), Marketing committee members of village and primary markets, and the Indian Council of Agricultural Research - Research Complex for NEH Region (ICAR RC-NEH) in Shillong, and the Indian Council of Agricultural Research – Central Tuber Crops Research Institute (ICAR-CTCRI), Trivandrum, Kerala

Table 2.1. Methods and sources of data and information used in the study.

Information collected /generated	Methods of data collection
Status of cassava production for each production system districts	Primary data: FGD, KII, survey with respondents Secondary data: market statistics, publications, and baseline research
Trends in area and production for all major seasonal crops and districts	
Production practices for each cropping season including cultivation methods, varieties, cropping pattern, rotation, fertilizer use, yield, land type, and pest, diseases, and weeds management	
Input use including labor, seed, fertilizers, pesticides, and credit sources	Primary data: FGD, KII, survey with respondents
Marketing and utilization patterns, including actors, channels, markets, storage, losses, quality issues, price fixation, market data, marketing costs, trends, and problems	Primary data: FGD, KII, survey with respondents, market visits
Support for cassava producers from government and research and development institutions	Primary data: FGD, KII, survey with respondents Secondary data: existing publications
Production costs and returns for all cropping seasons, progressive farmers' practices, recommended practices, gender disaggregated labors etc.	Primary data: survey with respondents
Opportunities for improvement in terms of input supply, production practices, marketing, and competition	Primary data: FGD, KII, survey with respondents

Similarly, guided questions were used in conducting the FGDs with male and female cassava producers and traders. A total of six FGDs were done, two for each of the three districts selected. Meanwhile, survey questionnaires were designed for the different value chain actors including farmers, seed producers, aggregators, wholesalers, retailers, and consumers in the three selected districts in Meghalaya: West Khasi, West Garo, and East Garo. These districts were purposively sampled because they have the largest land areas for cassava and farmers in these districts are able to plant in various production systems. The target number of respondents for each group as well as the sampling method used are summarized in Table 2.2.

2.1.2. Secondary data sources

Various statistics on cassava production and marketing in Meghalaya, as well as other information previously indicated in Table 2.1. were obtained from existing publications,

both print and online data sources used in this study include, but are not limited to, the following institutions and research organizations:

• Directorate of Horticulture (DOH)

• ICAR RC-NEH

• ICAR-CTCRI

2.2. Value chain orientation meeting

The concept of value chain analysis on cassava and the likely methodology was discussed with a team of MBDA staff who are involved in Farmers Business Schools under FoodSTART + on September 12, 2017 in Shillong.

2.3. Sampling

The sampling units for this study included women and men farmers, traders/aggregators, retailers and consumers of cassava. The distribution is shown in Table 2.2.

Table 2.2. Sampling of districts, villages and chain actors

Sl. No	Actors/Player	No. of Districts	Villages/district	No. of respondents	Sampling method
1	Farmers	3* 1.East Garo 2.West Garo 3.West Khasi	Total 6 East Garo: 3 West Garo: 2 West Khasi: 1	Total 45 East Garo: 20 farmers West Garo: 15 farmers West Khasi: 10 farmers	Districts purposive sample Village: random sampling Farmers: proportionate simple random
2	Traders/ transporters**	3	2	1/village Total 6	Snow ball sampling
3	Processors***	3	2	1 Total 6 if every village has processors	Snow ball sampling
4	Consumers****	3	2	2/ village Total 12	Simple random

*Districts having more cassava area.

**Depending on availability from the selected village or from other places who are involved with the village.

*** Processors selection is subject to availability in the village or from other villagers who procure the raw materials.

****Restaurants and other purchasers were interviewed including urban consumers in Shillong.

2.4. Data Processing and Analysis

The data/information collected from farmers, traders, wholesalers and consumers were subjected to, (1) simple statistical analysis such as frequencies, means, range, ranking, etc., (2) economics analysis such as gross margin analysis, marketing margin analysis and production cost, and (3) mapping analysis to map cassava value chain linkages between actors, processes, and activities in the value chain**.**

The following tools used by (Emana and Nigussie, 2011) were followed:

Tool 1: Mapping the value chain

Mapping value chain helps to get a better understanding of connections between actors and processes and interdependency between actors and processes in a value chain. A value chain map allows one to depict all activities, actors, and relationships among segments of the chain, and the interactions between producers and intermediaries.

Tool 2: Measuring value chain performance: cost and margins

Measuring costs and margins enables the researcher to determine how pro-poor value chain should be developed.

Tool 3: Governance and services

Governance encompasses the system of coordination, organization and control that preserves and enhances the generation of value along a chain. Governance and service analysis can help identify levers for interventions aimed at increasing the overall efficiency of the value chain.

Tool 4: Linkages

Analysis of linkage helps to identify how value chain actors are linked along the value

chain. Linkages analysis involves not only identifying which organizations and actors are linked with one another, but identifying the reasons for those linkages and whether the linkages are beneficial or not.

In this value chain analysis combinations of these tools were applied where suitable.

The various terms used in the value chain analysis in this study are as follows:

Producer: Meghalaya farmers who cultivate cassava and sell the produce to retailers aggregators and consumers.

Aggregators cum retailers: Value chain actors located in villages who collect and purchase cassava in small quantities from farmers, pool them and sells in retail to consumers and wholesalers.

Retailers: Value chain actors who purchase from farmers, aggregators, and wholesalers and sell directly to consumers.

Wholesalers: Value chain actors who purchase cassava from aggregators and sell to retailers in relatively bigger volumes compared to aggregators and sell to retailers. Their volume is not as like potato, located mostly in Tura.

Consumers: are persons who are final users of tubers, they are farmers themselves. Other consumers are from villages and towns, owners of small shops and tea shops.

3. PREVIOUS VALUE CHAIN STUDIES OF CASSAVA

A review of available literature revealed that despite the importance of cassava in India, research on its value chain are limited. There were three studies in India, two under FoodSTART— one in Kerala, second in Tamil Nadu, and the third a PhD thesis. This section presents these studies in India, as well as similar cassava value chain studies in relevant developing countries including Tanzania, Vietnam, Ghana and Niger.

Author /Country	Value chain identified	Problems	Interventions suggested/ Output

International Potato Center, 2015 a, Kerala, India, under FoodSTART project	Five value channels identified for end products: fresh tuber, parboiled chips, dried chips, fried chips, and frozen cassava. Value chain actors identified were producers, traders, processors**,** exporters, wholesalers, retailers and consumers.	High-valued competing cash crops, high wage rate, shortage of laborers, non-mechanized farming activities, ignorance about new varieties and labor-saving machines, poor resource base of farmers, highly perishable nature and bulkiness of the produce, high transportation cost, absence of market cooperatives or farmers' federation, inadequate use of appropriate technology for value adding, and no price supporting mechanism.	• Awareness and trials of new cassava varieties and value addition products. • CTCRI incubation center on value addition
International Potato Center, 2015 b, Tamil Nadu, India, under FoodSTART project	Four types of value chain channels based on starch, sago, wafers, and animal feed. Value chain actors identified were producers, tuber traders, processors**,** marketing society**,** wholesalers, retailers and consumers. Marketing is done in many states in India	Lack of high yielding varieties, price fluctuation, and perishability of tubers. High transportation cost. Quality of starch and pollution control.	• Awareness and trials of new cassava varieties and value addition • Effluent treatment • Market intelligence • SAGOSERVE • WAFERSERVE • Quality testing
Komaravel, 2013, India	Six types of value chains were identified.	Price fluctuations, high input costs, non-availability of quality planting materials,	• Minimum support price for cassava tubers

	Main products are starch and sago. Value chain actors are farmers, commission agents, processors, sago serve as wholesalers, retailers and consumers.	wastage of tubers, transportation costs, poor storage facilities, power shortage, non-availability of tubers throughout year.	• Market intelligence on demand, supply and future prices • Integrated crop management • Contract farming • Co-operative society • Group marketing • Cassava growers Association • Modernising processing equipment
Ministry of Agriculture, the United Republic of Tanzania, 2007, Tanzania	Value chain products are fresh tubers, chips, and flour. The value chain follows input suppliers, producers, rural vendors, small and large traders, processors, retailers and consumers. Marketing done locally and exported.	Cassava mosaic disease (CMD), the poor infrastructure (i.e. feeder roads), inadequate access to appropriate technologies, labor constraints, insufficient capital to invest, distorted market information, and inadequate organization especially farmers' level.	• Making new disease tolerant planting • Creating demand for cassava chips • Financial support by government, development agencies • Promotion of dried cassava in the Lake Zone and neighboring countries
Tuan and Cuna, 2007, Vietnam	The value chain is characterized by farmers and starch processors small producers, local and long-distance assemblers and traders, household processors, and large-scale starch factories. Products of value chains are fresh tubers, wet	Lack of governance; presence of many layers in transaction, high transportation costs, and a lower profit margin received by cassava farmers; weak market coordination and prevalence of spot	• Product upgrading • Process upgrading • Functional upgrading • Participation in the Global Value Chain, Environmental Protection in Production

	starch, dry starch, maltose, etc.	market transaction; low incentives for upgrading; low value generation since the cassava value chain currently operates on a low-quality market segment, mostly composed by un-modified starch; exposure to environmental risks.	
Partnership Initiatives in the Niger Delta, 2011, Nigeria	Three channels exist for cassava and its by-products reach the end markets: small scale production for traditional food; medium scale production for improved food products and large scale production for industrial products. The cassava value chain comprises input suppliers, farmers cooperatives, processors, traders, collectors, intermediate and final consumers within and outside the region.	Under utilization of cassava roots in the improved food and industrial products, weak extension services, lack of access to credit for operating and expanding enterprises, low efficiency of processing enterprises, and the non-commercial orientation of many farmers and processors in the region, etc.	Industrial usage of cassava for improved products such as starch, glucose etc. Diversified uses of cassava and creation of sales outlets.

The literature referred were used in the development of research methods, FGD guide questions, interview schedule, problems diagnosis and results verifications and strategy development.

4. RESULTS AND DISCUSSION

4.1. Cassava global scenario

Cassava is the third most important source of calories in the tropics, after rice and maize. Important in the economy of small scale farming, cassava is one of the major sources of subsistence and cash income for farmers in climatically disadvantaged regions. It is the basic staple food for millions of people in the tropical and sub-tropical belt. Believed to have its origin in Brazil, following the Spanish and Portuguese conquests, cassava was taken from Brazil to the Atlantic coast of Africa. By the 1800s it was being grown along Africa's east coast and in Southern Asia. Farming of cassava expanded considerably in the 20th century, when it emerged as an important food crop across sub-Saharan Africa and in India, Indonesia and the Philippines. Cassava's importance in agriculture has changed dramatically (Howeler, 2013). Between 1980 and 2011, the global harvested area of cassava expanded by 44 percent, from 13.6 million to 19.6 million hectares, which is the biggest percentage increase among the world's five major food crops. In that same period, world cassava production doubled, from 124 million to 252 million tonnes (Howeler, 2013). The top 10 cassava producing countries are Nigeria, Thailand, Indonesia, Brazil, Ghana, Congo, Vietnam, Cambodia, India and Angola. Apart from crop of food security, cassava is known for its diversified use in industries from starch, flour, chips, glucose, fructose, dextrin, ethanol, and in animal feed industries. World trade in cassava products expanded in the recent years due to cassava's price advantage over maize as a source of starch. While Sub-Saharan Africa and Latin American countries lag behind global trends in the development of the cassava value chain, Asia, especially Thailand leads in global trade with its market share of 77% specifically in the form of starch and animal feed (Howeler et al. 2012; Kim et al. 2015). Once seen as the "food of the poor", cassava has emerged as a multipurpose crop for the 21st century – one that responds to the priorities of developing countries, to trends in the global economy and to the challenges of climate change (Howeler et al. 2012).

4.2. India scenario

The crop has been cultivated in India for more than a century. Cassava was introduced into India by the Portuguese when they landed in the Malabar region, presently part of Kerala state during the 17th century, from Brazil. The popularization of the crop in the state of Kerala was attributed to the famous king of Travancore State, Sri Visakham Thirunal by introducing popular varieties from Malaya and other places. Cassava saved the people of former Travancore province from the clutches of famine during World War II (1939-45) when import of rice from Burma (Myanmar) was stopped and the subsequent times of food scarcity. Cassava, which was mostly cultivated in the peninsular states of Tamil Nadu, Kerala, and Andhra Pradesh, also found a place in NEH. Area production and yield under various states are presented in Table 4.1. It is cultivated in an area of 228 thousand ha with production of 8,190 thousand MT with the highest yield potential in the world (35 t/ha). This is largely due to the high yields in Tamil Nadu where cassava is produced under irrigation for starch industries. Tamil Nadu leads in the area (52 %) and production (61%), followed by Kerala in area (31 %) and production (31 %). The NEH has 6 % of cassava area in India while Meghalaya occupies second place after Nagaland (Table 4.1.).

Table 4.1. Area and production of states in India

States/UTs	Area (000ha)		Production (000mt)		Productivity (mt/ha)	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Andaman and Nicobar Islands	0.2	0.2	4.3	3.3	17.7	13.6
Andhra Pradesh	18.3	17.0	365.2	258.0	20.0	14.1
Assam	3.1	3.3	27.6	30.1	8.8	9.6
Karnataka	1.2	1.0	13.5	13.1	11.6	11.3
Kerala	71.1	87.6	2581.4	1207.2	36.3	17.0
Lakshadweep	0.0	0.0	0.1	0.0	3.5	1.0
Meghalaya	5.3	5.6	32.0	34.4	6.0	6.5
Mizoram	0.1	0.1	1.9	1.9	14.6	14.6
Nagaland	6.2	6.2	92.3	92.3	15.0	15.0

Odisha	0.1	0.1	1.0	1.1	16.8	18.3
Puducherry	0.1	0.4	2.6	31.5	25.7	78.75.2
Punjab	2.1	-	42.2	-	20.6	-
Tamil Nadu	120.6	86.1	4975.6	2699.8	41.3	31.54
India	**228.3**	**207.6**	**8139.4**	**4372.7**	**35.7**	**21.1**

Source: Ministry of Agriculture and Farmers Welfare, Government of India. http://nhb.gov.in/

Cassava area and production trends in India for the past 10 years is shown in the Fig 4.1.

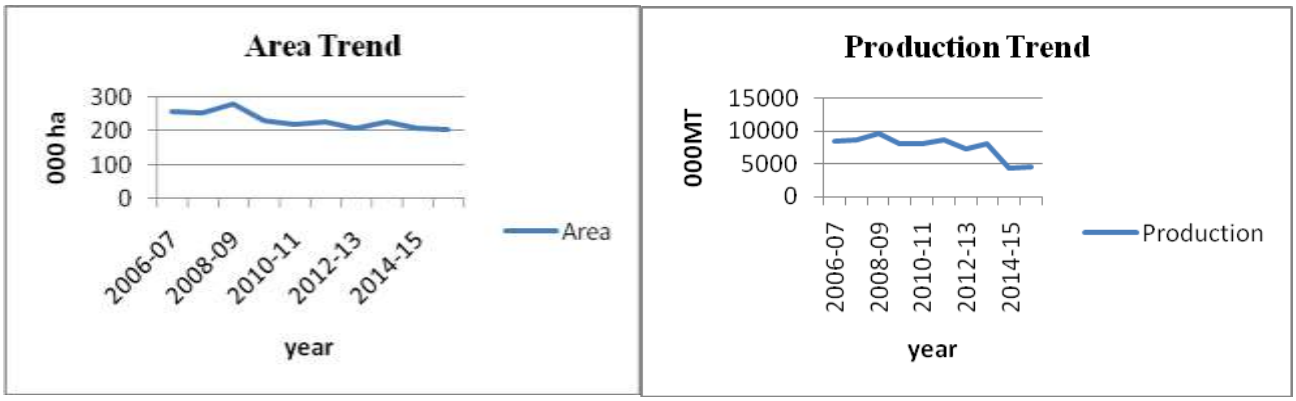

Fig 4.1. Cassava in India Area and Production

The area and production trend indicate a decline over a decade period (2 and 4 % annually). Cassava has a place in the households (40%) as well as in the industries (60%.). In households, it is consumed as cooked/baked tubers in culinary preparations and in making pappads. Nowadays, cassava dishes are seen in big hotels and restaurants in Kerala. Cassava fried chips is another form of utilization observed in Tamil Nadu and Kerala at cottage industries level. Cassava also has wide applications in the industrial level. Many value-added products are prepared from cassava such as starch, sago, flour, chips etc. Cassava starch also has wide industrial applications. It is used in textile industries as sizing agent, in pharmaceutical industries, making adhesives, dextrin manufacturing, paper industry, laundry and in many fast food preparations. A sizeable quantity of cassava produced in Tamil Nadu and Andhra Pradesh is processed in starch and sago factories.

Flour is made from cassava dried chips and this finds applications in gum industry, in making Kumkum (Vermillion) and in making colours applied to faces, during celebrations, festivals etc. Thippi (starch and sago industries fibrous waste) and Peel (waste from chip industries) are used as an ingredient in poultry and cattle feed preparations. Srinivasan and Anantharaman (2005) found that there is a great demand projected for cassava starch in areas of textiles, paper industries, sago, and wafers. India exports raw cassava and products such as raw tubers, flour, meal of sago, starch of manioc, sago, cassava, and its substitutes to countries like United Arab Emirates, Saudi Arabia, Oman, European nations, Kuwait and the United States of America. These products are exported through different ports. The Cochin port handles frozen cassava which is mainly exported to the Gulf nations (Varmudy, 2014).

4.3. Meghalaya

Cassava is one of the most important RTCs grown in the hilly regions of Meghalaya. Cassava has a significant role in food security and as an animal feed. Hence, it significantly contributes to the rural agrarian economy of the state. Although there is no written document on the introduction of cassava in Meghalaya, it is believed from FGDs and KII that cassava would have come to Tura, Meghalaya along with the first Christian missionary from Kerala, Fr. Mathew Elanjipuram in 1956, and thereafter through the development efforts of the Agricultural Department of the state. According Srinivasan and Anantharaman (2005), consumption of cereal substitutes in Meghalaya follows Kerala at 0.96 kg and 0.45 kg per 30 days in rural and urban areas respectively. Cassava crop is grown on over 6,300 ha of land and it shares 3.2% of the total cultivable area of the state, which is second highest among all the cassava producing states in India. The area and production over a decade for cassava in Meghalaya and district-wise area are presented in Table 4.2 and Fig. 4.2.

Table 4.2. Meghalaya: Cassava area production and yield

Year	Area (ha)	Production (mt)	Yield (kg/ha)
2007-08	3980	20840	5227

2008-09	3990	20870	5225
2009-10	4198	21930	5200
2010-11	4187	21770	5060
2011-12	4180	21790	5213
2012-13	4200	22050	5240
2013-14	4980	29750	5970
2014-15	5628	34359	6105
2015-16	5978	37064	6200
2016-17	6353	40151	6320

Source: Department of Economics and Statistics and Directorate of Horticulture, Government of Meghalaya

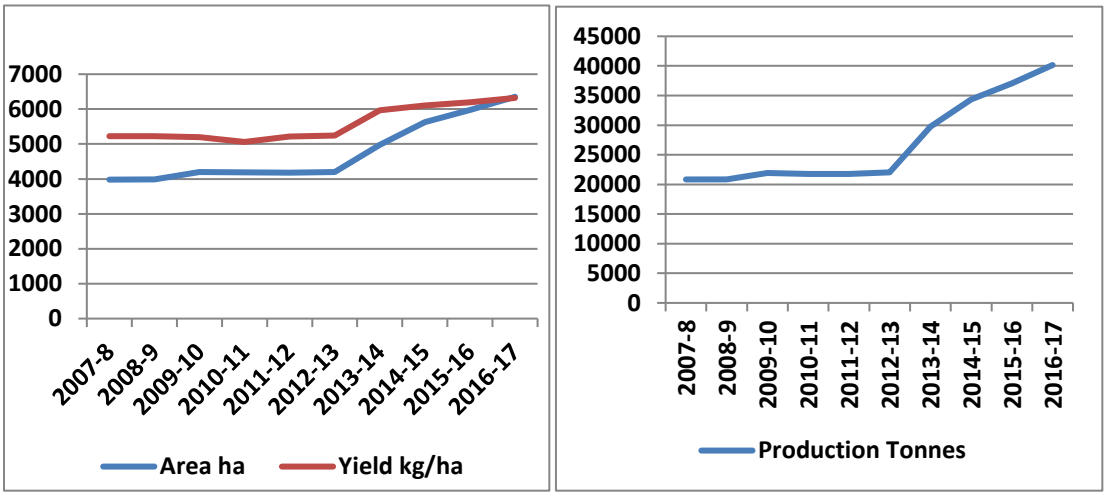

Fig 4.2. Meghalaya year wise area, yield and production

Cassava is cultivated in an area of 6,353 ha with production of 40,151 MT and yield of 6,320 kg /ha. The yield of cassava is much less compared to national average of more than 30t/ha. There is certainly a possibility to increase the yield by at least double with production interventions. Cassava has the second highest area among the RTCs cultivated in Meghalaya after potato having 18,000 ha. The area and yield trends of cassava showed

that there is a noticeable increase annually (6% and 2% respectively), considered as positive trend and very different from the national trend of declining production and area (Figure 4.1.) The district-wise three-year data (2014-17) is given in Table 4.3. Data on area, production and yield were available for all the 11 districts from 2014 onwards only.

Table 4.3. Meghalaya: District wise area production and yield from 2014-5 to 2016-7

Districts	Area (ha)			Production (mt)			Yield (kg/ha)		
	2014-15	2015-16	2016-2017	2014-15	2015-16	2016-2017	2014-15	2015-16	2016-2017
Ri-Bhoi	63	67	71	390	417	448	6190	6224	6310
East Khasi Hills	526	558	592	3491	3762	4071	6637	6742	6877
West Khasi Hills	521	554	584	3689	3994	4283	7082	7209	7334
South West Khasi	291	307	330	1873	2001	2206	6436	6518	6685
East Jaintia Hills	6	5	7	61	62	74	10167	10333	10571
West Jaintia Hills	123	25	26	242	268	287	10522	10720	11038
East Garo Hills	1571	1650	1734	8933	9506	10194	5686	5761	5879
North Garo Hills	718	783	853	4122	4577	5062	5741	5845	5934
West Garo Hills	1144	1212	1282	6529	7049	7638	5707	5816	5958
South West Garo Hills	418	448	483	2619	2829	3073	6266	6315	6362
South Garo Hills	347	368	391	2410	2599	2815	6945	7063	7199

Meghalaya	5628	5978	6353	34359	37064	40151	6105	6200	6320

Source: Department of Economics and Statistics and Directorate of Horticulture, Government of Meghalaya

The district-wise trend in area, production, and yield for three years is shown in Fig 4.3.

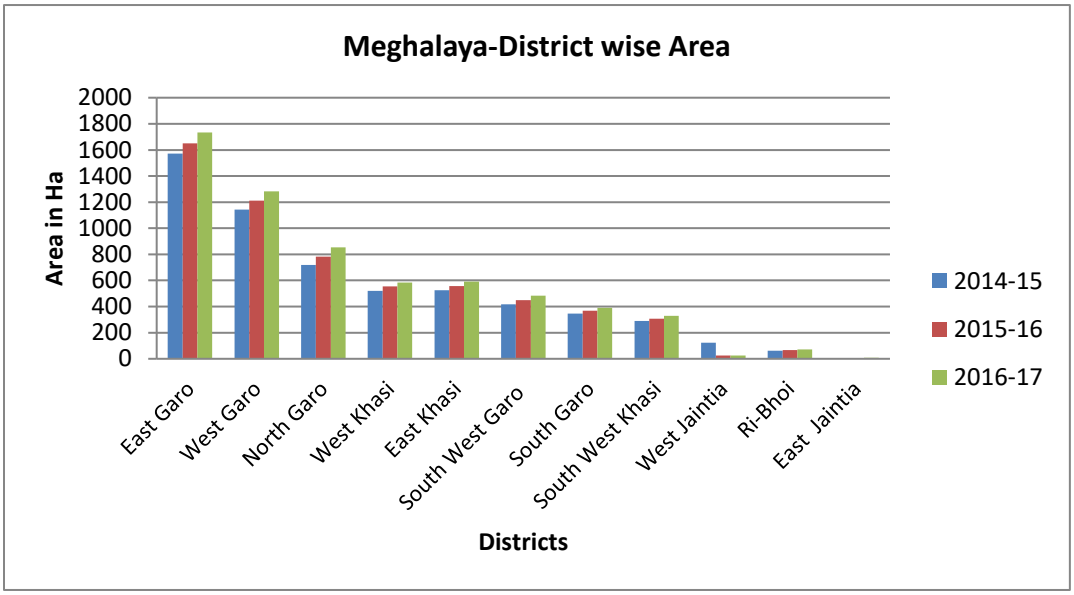

Fig 4.3. Meghalaya district-wise area trends from 2014-5 to 2016-7

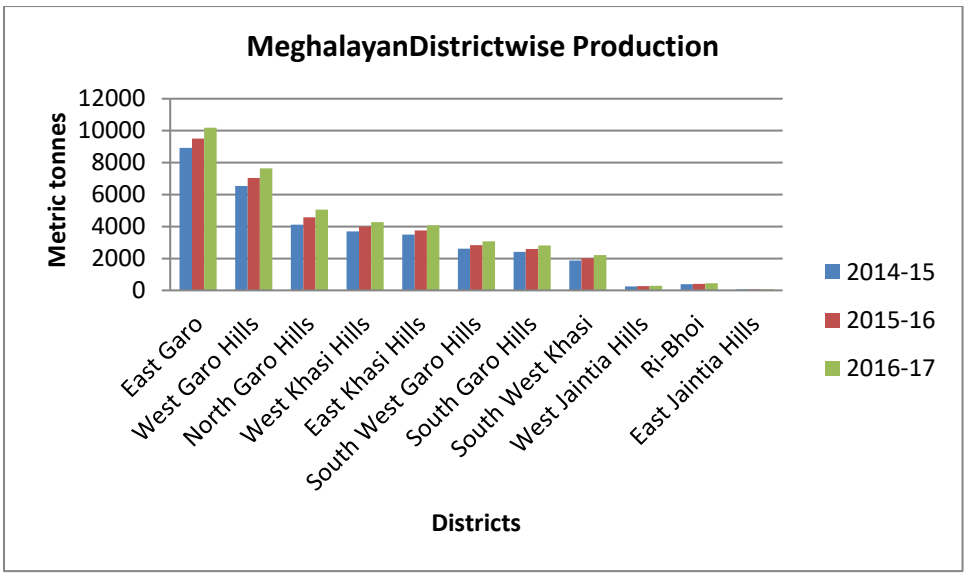

Fig 4.4 Meghalaya district-wise production trends from 2014-5 to 2016-7

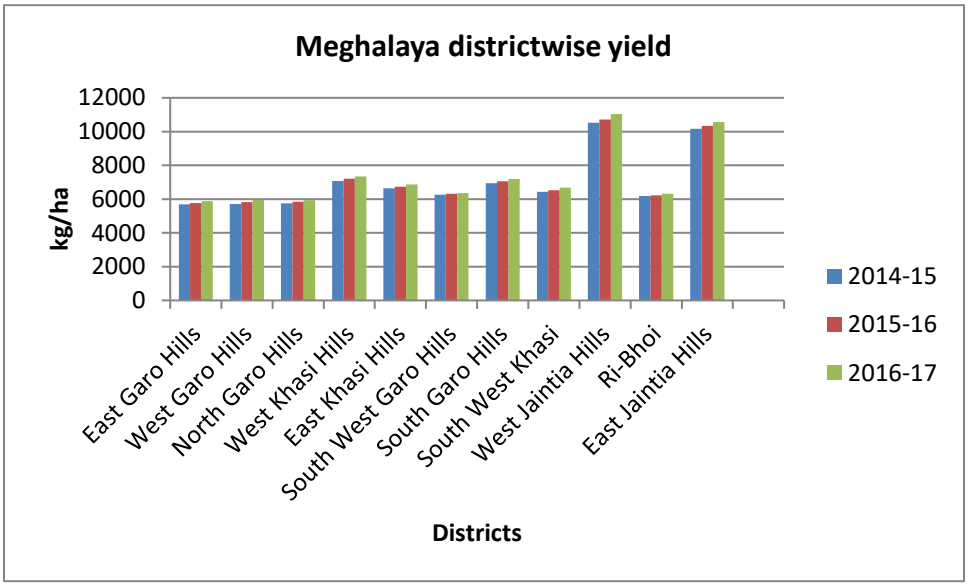

Fig 4.5 Meghalaya district-wise yield trends from 2014-5 to 2016-7

Cassava is cultivated more in East Garo district followed by West Garo, North Garo, West Khasi, and so on; the production of the districts was also in the same order. East and West Jaintia had least area under cassava. However, the productivity of these districts is higher with yields exceeding 10 t/ha. The productivity of districts having more area were observed

to be lower, less than 6t/ha. It is very positive to find that the area, production and yield are increasing in most of the districts over the years. The major portion of cassava goes for consumption in the form of cooked raw tubers.

4.4. The target districts for the value chain study

4.4.1. East Garo Hills is bounded by South Garo Hills on the south, West Garo Hills on the west, West Khasi Hills on the east and North Garo Hills on the north. The total geographical area of the district is 1517. sq.km. The climate of the district is largely controlled by the South-West monsoon and seasonal winds. It comes under North eastern hills warm to hot peri humid agro-ecological sub region with 262 m msl. Temperature ranges from minimum of 5°C to maximum of 36°C with annual rainfall of 2500 mm. The major crops grown in all systems are rice, ginger, maize, cotton, banana, pumpkin, chili, turmeric, cassava, and sweetpotato. Plantation crops such as arecanut, rubber, pepper, tea, coffee and cashew are increasingly visible in the district in the recent years. East Garo tops the area (1734 ha, 27%) and production of cassava (10194 MT 25 %) with yield of 5879 kg/ha.

4.4.2.West Garo Hills is located at the westernmost part of Meghalaya bounded by East Garo Hills district on the east, South Garo Hills district on the south-east, Goalpara district of Assam state on the north and north-west and Bangladesh on the south. It is mostly hilly, with plains fringing the northern, western, and southwestern borders. The district occupies an area of 3,714 km². The climate of the district is largely controlled by South-West monsoon and seasonal winds. The West Garo Hills district being relatively lower in altitude than the rest of Meghalaya, experiences a fairly high temperature for most part of the year. It comes under ecological sub region: North-Eastern Hills, warm to hot peri humid ecosystem. Temperature ranges from minimum of 5°C to maximum of 36°C and annual rainfall of 2700 mm. The major crops grown are rice, maize, cotton, rapeseed, mustard, jute, pineapple, banana, citrus, ginger etc. The potato growing season in West Garo Hills is during winter. Plantation crops such as arecanut, rubber, pepper, tea, coffee, and cashew are increasingly visible in the district in the recent years. West Garo district

occupies second position in cassava area (1,282 ha, 20%) and production of cassava (5,938 MT, 19 %) with yield potential of 5958 kg/ha.

4.4.3. West Khasi Hills presently the largest district of Meghalaya, was carved out of the former Khasi Hills District on 28 October 1976 bounded by East Khasi in the eastern side, Assam and RhiBhoi districts in the north, South West Khasi in the south and East Garo, and South Garo in the east. The district occupies an area of 5247 km^2. It comes under the Agro Ecological Sub Region: Warm per humid Eco Region. It receives an annual rainfall of 3,300 mm. The major crops are rice, potato, millet, maize, pineapple, citrus, banana, potato, ginger, cassava, sweet potato, and arecanut. West Khasi has 584 ha of cassava (9 %) producing 4283 MT, with yield potential of 7,334 kg/ha.

4.5. Cassava production system in Meghalaya

Following are the production systems in which cassava cultivation finds place in Meghalaya

4.5.1. Jhum system

It is a shifting cultivation, an ancient method of agriculture in hilly slopes that is still practiced by tribal communities of Meghalaya. It is a type of land tenure system where the community lands are divided among the farm families by the village councils for their subsistence on a rotational basis. The land size allotment widely varies, normally jhum field size is 1.0 hectare but farm size for a jhum cultivation depends upon the availability of family labor. The average size of operational jhum cultivated area is 0.4 ha. The forest, shrubs, and trees are cut down and burnt after drying under sun. After burning the jungle, the land is prepared for sowing and a mix of crops is sown together. Cutting and burning jungles are done around January to February and planting of crops takes place in March. The crops are harvested and matures over a prolonged period of time, starting from September and extends until December. Cereal crops are the first to be harvested followed by roots and tuber crops. The harvesting of roots and tuber crops starts in September and will continue until December to January. The crops cultivated in shifting cultivation include rice, pulses, beans, maize, chillies, ginger, turmeric, pumpkin, millets, brinjal, bottle gourd, bitter gourd, and a wide range and variety of roots and tuber crops (cassava,

taro, sweet potato and yams). Cassava has invariably a place in Jhum cultivation in the study districts. Cassava is not planted throughout the jhum like rice and taro. It was observed that cassava is planted in three patterns: 1. Along the border of the designated jhum field in two or three rows; 2. Planted around the farm shed; 3. Planted in an allotted area in the Jhum. In between cassava plants, and other crops like rice, taro, brinjal, ginger and beans are planted. Mostly taro is found in between cassava. Normally, 300-600 plants are planted in the jhum.

4.5.2. Individual Owned holdings

Apart from Jhum land holdings, farmers solely own farm holdings located away from their residence. Since the village topography is much undulated, the extent of flat plain land available for cultivation as an individual holding is very small. The major crops grown in individual farms are mainly plantation crops like arecanut, rubber, tea, coffee, cashew nut, and pepper, and crops like rice, broomstick, banana, pineapple, maize, cassava and taro. Cassava in individual holdings is mostly seen nearby river banks. It is grown mostly as an intercrop with maize and taro, but very few farmers do cassava monocropping. Cassava planting is done during March to April and harvested from September to January and February.

4.5.3. Homestead holdings

The homestead land is mainly owned by the households located around the house. It has mostly undulating topography where plantation crops and spices are grown. The main plantation crop grown is arecanut, and pepper plants are trailed on to arecanut plants. Apart from arecanut, some households grow cashew plants and rubber which also gives them good returns. The other tree crops are sal, litchi, jack, squash, mango, rubber, and lemon. The annual crops are: cassava, pineapple, banana, sweet potato, yams, taro, chilli, brinjal, and lady finger. Taro and ginger are found as intercrops with cassava. The planting and harvesting seasons are the same with cassava grown in individual holdings.

4.6. Value chain mapping

Value chain mapping is an analysis which systematically maps the actors participating in the production, distribution, processing, marketing and consumption of a particular product

(or products). (Kaplinsky and Morris 2001) This mapping assesses the characteristics of actors, profit and cost structures, and flows of goods throughout the chain, employment characteristics, and the destination, and volumes of domestic and foreign sales. Value chain actors are classified as those individuals who take ownership of a product, through the exchange of money or equivalent goods or services, during the transaction process of moving the product from conception to the end user. Those individuals or firms providing a service without taking ownership of the product are classified as service providers.

4.6.1. Value chain actors and functions. The value chain actors and their functions in the cassava value chain are shown in Fig 4.6 and Table 4.4.

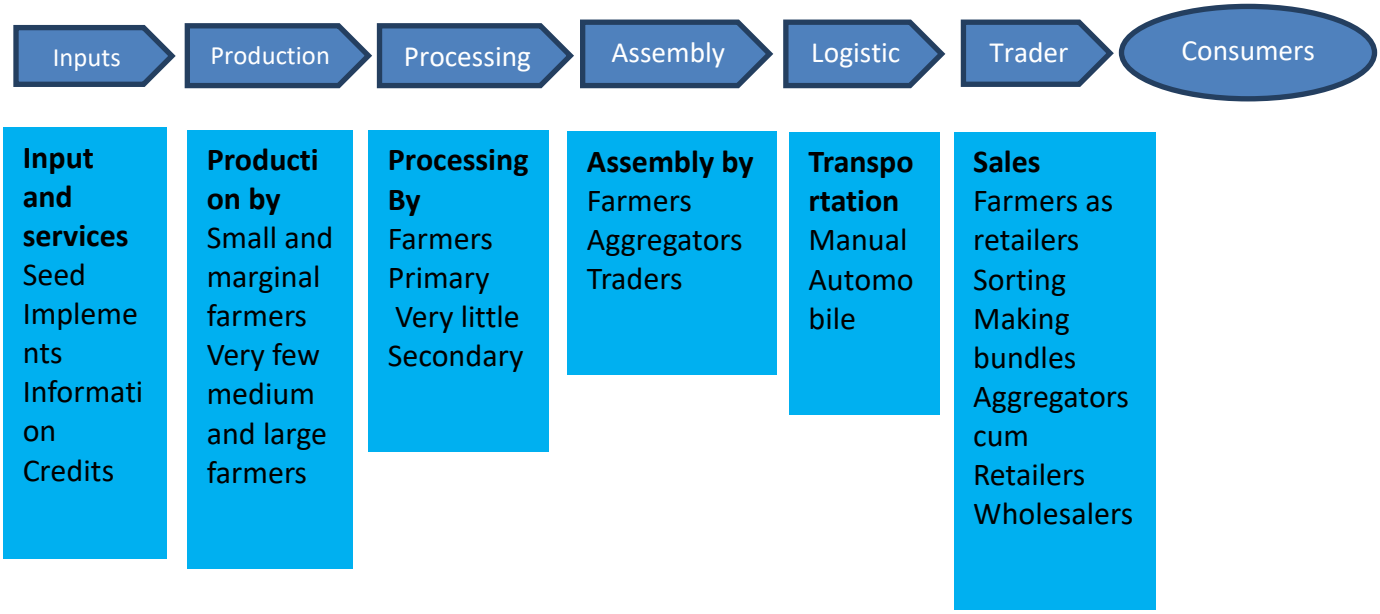

Fig 4.6. Stages of Value Chain and actors

Table 4.4. Functions in the value chain

Functions	Actors involved
Input supply • Seeds • Implements • Labor	Farmers mostly use own seeds, sometimes obtained from fellow farmers. Local blacksmith, craftsmen, own labor and from the local area, bamboo baskets self-made or purchased from local / primary markets. Mostly family members and sometimes hired from the local area.

Credit/ Finance	Own savings mostly or banks in and nearby villages.
Support Services and technical advice	Knowledge sharing among farmers, training from the Horticulture Department, Krishi Vigyan Kendra, ICAR and other extension education agencies.
Production	Small cassava farmers (both male and female),very few large farmers.
Processing	Farmers primary and very rarely secondary.
Assembling and Trading	Farmers (mostly women); aggregators in the local area (men and mostly women); farmers as retailers, other retailers from local wholesalers (men and women); and district markets.
Sorting	Farmers sort into small medium and big for bundling and retailers' re-sorting.
Logistics	Farmers and traders (mini trucks, bus, passenger vehicles, taxi.)
Consumption	Rural and urban household of Meghalaya state.

Input suppliers: Cassava farmers in the study areas depend largely on themselves for their planting materials, and they rarely obtain any from fellow farmers. Planting materials are usually plentiful in the area. Farmers normally do not apply fertilizers for cassava, and applying manure for cassava is practiced by only a very few farmers when it is grown in individual farm holdings. Inputs like traditional spades and sickles are from local blacksmith, while bamboo baskets are purchased from local market, sometimes farmers make their own baskets, and labor is done by family members and rarely hired from the local village.

Credit support: In general, farmers tend to utilize the savings from the profits made in the previous season's cultivation and loans from family members. However, very rarely farmers, also avail loans from traders, which will be paid back after sales of the produce.

Technical advice: The knowledge on cassava cultivation is shared between farmers, they also get very rarely information from DOH and training on cassava along with other vegetable crops from Krishi Vigyan Kendra.

4.6.2. Cassava production

4.6.2.1. Farmers' profile

Carried out mostly by small men and women farmers (75 %), with holdings of less than 2 ha which was inclusive of community allotted jhum land. There were a few larger farmers in the sample involved in cassava agriculture (25%) who own more of individual holdings; these farmers were mainly from West Garo hills. It was found that there were more women farmers than men farmers (71% to 29%) in cassava cultivation (Table 4.5). The average age and experience (in cassava cultivation) of female farmers (38 and 17) was less than male farmers (45 and 22). It can be observed that cassava had been in cultivation in the surveyed areas in the last 50 years. It can also be seen that female farmers (8 years) had more schooling than male farmers (7 years). The average land holding size (which includes land under all the three systems) was 1.87 ha and the farm size owned by farmers in the East (2.07) and West Garo hills (1.89) were larger than West Khasi hills whose farm size was only 1.25 ha. The average area of cassava cultivation by a farm family putting all the systems was only 0.14 ha with more area in West Garo hills (0.16 ha) and less in West Khasi hills (0.08ha) (when cassava was cultivated in mixed cropping, the number of plants and average spacing were considered to come up with the area used for cassava). Cassava was found cultivated more in Jhum system, followed by matching average areas under homestead and individual holdings. Proportion of the farmers' cultivating cassava under various production systems district-wise is presented in Table 4.6. West Garo farmers cultivate cassava more in individual holdings whereas West Khasi and East Garo farmers use Jhum system more for cassava. There was an increasing trend in growing cassava in individual holdings especially in West Garo as there were more available land near the river banks. The average family size is seven (7), much higher than the national average of 5, which implies the need for more food supply. Regarding animal resources, 50% of the farmer respondents maintain cattle, while 80% maintain piggery, and all the farmers have poultry in their homesteads. One third of the farmers in East and West Garo hills were

found to own fish ponds. Eri silkworm rearing is very popular in West Khasi districts and 30% of cassava farmers interviewed were engaged in this enterprise. Reasons for cassava cultivation were for food security, livelihood and animal feed, respectively. While majority of the farmers (89%) responded that cassava area is slowly increasing and a matching proportion of the farmers responded that their yield is increasing. The yield increase in cassava is based on its yearly plantation in fresh areas near river banks, where more organic manure is applied.

Table 4.5. Basic information about cassava farmers and cultivation (n:45)

Particulars	Mean	Std Dev	Max	Min	%
Gender of farmers					
Men	--	--	--	--	29
Women	--	--	--	--	71
Age of farmer (years)					
All	40.17	11.69	78	18`	--
Men	45.14	12.67	78	32	--
Women	37.93	13.65	69	18	--
Experience in cassava cultivation (years)	18.82	13.92	50	2	--
All	22.4	11.38	50	10	--
Men	17.2	11.64	50	2	--
Women					
Schooling (years)					
All	7.27	4.54	13	0	--
Male	6.71	4.58	12	0	--
Female	7.95	3.39	13	0	--
Land holding (ha)					
All	1.84	1.54	5.98	0.13	--
West Khasi hills	1.25	1.43	4.16	0.15	-----

East Garo	2.07	1.63	5.98	0.4	
West Garo hills	1.89	1.57	4.22	0.13	
Cassava cultivation area(ha)					
All	0.13	0.09	0.38	0.024	--
West Khasi hills	0.08	0.08	0.33	0.024	------
East Garo Hills	0.14	0.067	0.29	0.03	
West Garo hills	0.16	0.08	0.26	0.024	
Cassava in different production system (ha)					
Homestead	0.04	0.06	0.33	0	
Individual holdings	0.04	0.05	0.19	0.	
Jhum cultivation	0.06	0.06	0.33	0	
Family size	7.00	1.82	12	3	

Table 4.6. Cassava farmers growing cassava under production systems

Districts	Homestead %	Individual holdings%	Jhum%
EastGaro	55	35	90
West Garo	47	86	47
West Khasi	20	10	80
Over all	44	47	73

4.6.2.2. Cassava varieties

Meghalaya farmers usually grow varieties of short and long durations and other varieties considering various varietal attributes. The cassava varieties cultivated and adoption of these varieties district wise is presented in Table. 4.7. It could be seen that the popular varieties in terms of percentage of farmers adopting the varieties are Meghalaya, Smog, Naga, Dame, and Kanem. It is also observed that there were strong similarities among varieties grown in different districts with different names. Based on the characteristics it

appears that Smog, Smuel, and Bolongmay may be the same variety, in the same way, Meghalaya, Phansaw, Dame, Gipak may be the same. Some varieties are preferred for their exclusiveness, e.g. Meghalaya and Naga are short duration varieties and are harvested from sixth month after planting until the eighth month (September to October); the long duration varieties (Bolong, Smogand Kanem) are harvested during December to February. Nangam variety is preferred for wine preparation and variety Gipok for chips and its leaves for curry preparation. The popular varieties were evaluated based on the preferred traits collected from FGDs and surveys. The results are given in Table 4.8.

Table 4.7. District wise adoption of varieties

Varieties	District wise % of farmers			Overall % of farmers
	East Garo	West Garo	West Khasi	
Meghalaya	90	47	60	69
Smog	90	7	40	47
Smuel	10	0	10	7
Bolong	0	93	10	33
Dame	0	27	10	11
Naga	0	60	0	20
Kanem	20	13	0	13
Kamba gi	0	13	0	4
Pul	0	7	0	2
Phanli	0	0	20	4
Phansaw	0	0	10	2
Phanmir	0	0	20	4
Kadak	0	0	10	4
Katch red	0	0	10	2
October	0	0	10	2
Cake	0	13	0	4
Gipak	0	0	10	2

Table 4.8. Overall assessment of varieties and special characters

Varieties	Assessment of Traits and ranking				Striking visible characteristics
	Yield	Cooking	Market demand	Duration	
Meghalaya	Good	Good	Very Good	Short	Petiole white, Rind red, tuber white
Naga	Good	Good	Good	Short	Petiole white, Rind red, tuber yellow
Smog	Very good	Very good	Very Good	Long	Petiole red, Rind white, tuber white
Bolong	Very good	Very good	Very Good	Long	Petiole red, Rind white, tuber white
Kanem	Very good	Very good	Good	Long	Petiole white, rind red, tuber white

Smog, Bolong and Kanem have very good yield, and very good cooking qualities, while Meghalaya, Smog and Bolong have very good demand in the market. All these varieties are best suited for the climate and are relatively free from pests and diseases.

4.6.2.3. Land preparation Cassava is grown in three systems as mentioned earlier. In all the systems, land preparation starts with clearing the area by cutting the small trees, plants, shrubs etc., left to dry and then burnt in situ during January to February, and done mostly by equal number of male and female. Normally there is no fine tilling of the soil by ploughing or digging the area. However, in very few cases where land is plain by the side of river banks, the land is ploughed. In the homestead area where the crop is to be planted also, the soil is dug to make the soil loose. Farmers do not add any manure or fertilizer in the Jhum system. In the homestead and individual holdings, very few farmers apply organic manure. Cassava crop cultivated in Meghalaya is purely organic.

4.6.2.4. Planting In the cleared land, small portion is dug so as to place cassava setts horizontally and covered with soil. Planting setts are prepared by cutting the stored planting materials (woody stems), leaving the hard portion at bottom, the length of cutting ranges from 20-30 cms. From one stem they could prepare 6-8 setts. Farmers do not take mounds or ridges as done in southern India, instead they dig the soil with spade half foot depth and place two setts mostly horizontally in the pit and close with soil. Setts are planted with

spacing of 90 to 120 cm spacing both ways normally. Farmers take care in selecting healthy materials, which are bigger in size. In the case of intercropping/mixed cropping, cassava is planted with little more spacing in all systems. This operation is mostly done by female farmers.

4.6.2.5. Weeding Across all the systems, farmers do two to three weedings during June, July and August or October, done using small hoes by female farmers.

4.6.2.6. Pest and diseases management Cassava is almost free from pest and diseases except very few incidences of stem borers. However, cassava faces severe damage from rats and wild boars, especially in Jhum fields causing nearly 15-20 % damage.

4.6.2.7. Harvesting Across all the production systems, farmers plant short duration and long duration varieties, the latter one is planted more. Short duration varieties are harvested from September to October and long duration ones are from November to February. Harvesting is done in a staggered pattern, mostly by women, by digging the soil by spade and pulling the roots. Harvesting would have been easier if the setts are planted on mounds or ridges or planted vertically. Normally farmers harvest 6-15 plants a day. In very few cases of individual holdings, a portion of area to be harvested is given to traders directly for harvest, and the price is fixed based on a small sample harvest of a few plants. Farmers go to Jhum fields early in the morning to harvest, as most of them are located far from their houses.

4.6.2.8. Planting materials management Planting materials (woody stems) of cassava, unlike potato, does not pose much hurdle in storage as well as seed materials. Almost all the farmers use their own stored planting materials as seed materials. Very few farmers get the materials from fellow farmers. After the harvest and separating tubers from the stems, existing leaves are removed and top portion is cut and stored near the field, under a tree vertically, or placed horizontally on branches of trees, or in an aerated shed. Some farmers keep the materials horizontally on a small wooden platform in the field and cover with leaves. It can be stored for 3 to 4 months. One farmer reported that the planting materials are stacked horizontally in an open pit of size 1. 5 square meter with 30 cm depth. Farmers reported that nearly 20% of the stored materials get dried up or damaged.

4.6.2.9. Postharvest management and storage After harvesting the plants, the soil on the tubers are removed and washed in streams nearby or in the house. The tubers are sorted according to size and made into bundles, each having all the three sizes of tubers (4-6 tubers in total) and carried in bamboo baskets either to market directly or to the house depending on the locality. Normally fresh tubers are sold on the same day and they convert fresh to boiled tubers in the following day for sale. Whereas, the tubers brought to the house are used on the same day or the following day. Some of tubers brought to the house are converted into chips or flour and stored in plastic containers or gunny bags. It was reported that 10 % of tubers are damaged during harvest and postharvest, but are not wasted as they are used as animal feed. The monthly production activities and marketing are represented in Fig. 4.7.

Cultivation operations (All systems/ districts)	J	F	M	A	M	J	J	A	S	O	N	D
Land preparation	■	■										
Planting			■	■								
Weeding						■	■	■	■			
Harvesting	■	■							■	■	■	■
Marketing	■	■							■	■	■	■

Fig 4.7. Calendar of production activities

4.6.2.10. Labor use in production From the FGDs and the survey, it was observed that there was not much variation between the homestead and individual farms production systems in deploying the labor towards cultivation practices and hence number of labor days were worked out in common for these systems. It was also found that only family labor was used. Determining the number of labor days engaged exclusively for cassava was difficult due to inter or mixed cropping. As a solution, a criteria was followed to estimate the number of labor days: 1. The area of cassava planted was found based on the number of plants and planting space; 2. Land preparation: It was common to all crops that total number of labor engaged in the jhum cultivation collected and labor engaged proportionate to the area under cassava was estimated; 3.Planting: exclusive labor utilized for cassava planting was accounted; 4.Weeding: number of labor engaged in cassava

planted area divided by number of intercrops (usually two intercrops); 5. Harvesting: it was done exclusively for cassava, hence the actual number used was accounted. It may be noted that the labor days are only estimates and indicative.

The number of labor days for jhum and other production systems (homestead and individual farms) gender-wise is presented in Table 4.9. The table reveals that relatively huge labor days of 424 for jhum and 403 for other systems are engaged for cassava cultivation. It may be noted that jhum needed more labor for land preparation and other practices, while the number of labor days used is more or less the same for all systems. This is mainly due to more effort needed on clearing of trees and shrubs in the jhum. It could be seen from the table that female labor dominates the cultivation operations sharing two thirds of labor used. It was found that male laborers are more involved in land preparation (55%) and female laborers dominate in planting, weeding, and harvesting which includes cleaning and making bundles for marketing.

Table 4.9. Labor inputs towards cassava cultivation (person days/ha)

Operations	Jhum Production system			Individual farm and Homestead		
	Male	Female	Total	Male	Female	Total
Land preparation	101(56)	79(44)	180(43)	89(54)	76(46)	165(41)
Planting	17(29)	40(71)	57 (13)	14(25)	41(75)	55(14)
Weeding	24(21)	88(79)	112(26)	22(20)	87(80)	109(27)
Harvesting including postharvest	8(11)	67(89)	75(18)	7(10)	67(90)	74(18)
Total	150(35%)	274(65%)	424	132(32)	271(68)	403

4.6.3. Cassava utilization Unlike Potato in Meghalaya**,** cassava was found to have multiple use from tuber to leaves to stems, catering to the needs of family members, cattle, pigs, fishes and silkworm. On average, a farm family in the surveyed districts produced 2,368 kg of cassava/family with a maximum and a minimum of 7200 and 720 kg

respectively. Of this, 1,413 kg (59.6%) is allocated for home consumption (both food and feed). Nearly 951.42 kg/per family (40.17%) of total production is sold in the market (maximum 4,896 kg and minimum 0 kg). The average quantity of cassava used as food was 1,110 kg /family (maximum 4,320 kg and minimum 151 kg) constituting 78.46% of tubers allocated for home consumption, and the remainder is used as feed for cattle and pig, i.e. 304 kg (maximum 2073 and minimum 0) constituting 21.53%. Nearly 80% of the farmers process fresh tubers into primary processing form, namely dried chips/flour, for storage and later use mostly by the same household (through secondary processing, preparing items like Tabulcho Pita, T. Gindae Joe etc given in Fig 4.8) in varying quantities, and boiled tubers for immediate sale. It was observed that 6 % of farmers were sometimes engaged in making fried chips and selling in small quantities. On average, 173 kg tubers/family is processed in the said forms, i.e. about 16 % of the tubers apportioned for food. Home consumption of tubers starts from September and continues until March. Availability of tubers and consumption are low in September and October, high in November, December, January and February, and medium in March and April. During low consumption period, tubers are consumed 2 days a week, medium 3 to 4 days and high 4 to 6 days a week. Normally, a bundle 1.5 to 2 kg is used in a day. Farmers' family of size more than 10 people use 3 bundles (4 to 6 kg) per day. Cattle and pigs are fed 2-3 days a week, usually with damaged and small tubers.

Cassava leaves are used in various recipes. Farmers use tender leaves harvested during June, July, and August, about 8-10 times in a year. Some farmers (10 %) sell cassava leaves in the market. Cassava leaves are also used as feed for cattle and as a fish feed. Stems are also used as fuel and for preparation of soda. In West Khasi hills where 30 % of farmers practice erisilk worm rearing (larva used as food and cocoons sold for silk) cassava leaves are sometimes used as feed during third week of larval stage. Various forms of tuber utilisation on domestic front are described below.

4.6.4. Food and Feed preparations from Cassava

Cassava plays a major contributor to food security as well as a major component in animal feed. All the parts are used in various forms of food and feed.

Food from tubers

Tabulchu Rita (Garo) and Phandieng Phon (Khasi) (boiled Cassava)

Raw Cassava tubers are cleaned to remove the soil and washed in water. Skin and rind are removed. The tubers are cut into long cylindrical pieces 5 to 8 cm long. Sometimes cylindrical pieces are cut longitudinally into two halves or kept as whole (given that the tubers are small in size) and boiled in water for 20-30 minutes until the flesh becomes soft. This is the most common preparation (almost daily) and is eaten in the morning and evening as a snack, along with salt and green chillies, and sometimes accompanied by black tea. It is also sometimes taken during lunch along with rice. This form of consumption is seen when tubers are widely available, immediately after harvest. During summer, the boiled tubers are consumed within 3 hours of cooking while in winter, they can be stored for one day without spoilage.

TabulchuNakam

Cassava tubers (two tubers) are cut into pieces. All the ingredients namely: turmeric powder (half teaspoon), salt (1teaspoon), chilli (6-7 pcs.), onion (3 pcs.), and dried fish (8 pcs.) are added to the cut pieces in a pan and cooked for 2-3 minutes. Add half liter of water and boil. It is served as breakfast and sometimes as lunch. This is made 10 to 20 times a year

Tabulchu curry

Tubers are cleaned and washed, skin and rind are removed, cut into pieces and prepared with dry fish/ fresh fish/ chicken along with necessary ingredients (salt, chilly, turmeric, masala) and served during lunch.

Tabulchu Fried Chips (Garo) Phandieng Sdieh (Khasi)

Cassava tubers are cleaned to remove the soil washed in water, skin and rind are removed, cut horizontally with a thickness of 2-3 mm as round chips and deep fried in oil for 2-3 minutes. It is stored for one to two weeks. It is also regularly consumed in the evening. These chips are prepared 10 to 20 times in a year in households.

Tabulchu Grand (Par boiled chips)

Cassava tubers are cleaned to remove the soil and washed in water; skin and rind are removed, cut into circular pieces and boiled; dried for two days under sun and stored in bags. Shelf life can last up to 6-8 months, made 10 times in a year. It is usually consumed in the evening as a snack along with tea.

Tabulchu Joa (French Fries)

Cassava tubers are cleaned to remove the soil and washed in water; skin and rind are removed, cut into cylindrical pieces measuring 5-8 cm and split into 8-10 longer pieces, boiled in water for 2-3 minutes, and deep fried in oil. It is usually served as urban /peri urban dish consumed as breakfast and as snacks in the evening; made two to four times a month. It is also prepared in a few restaurants in east Garo district.

Tabulchu Pita (Sweet dices)

Cassava tubers are cleaned to remove the soil, washed in water, skin and rind removed, cut into small pieces and dried for 2-3 days. Dried chips are pounded and sieved to get powder. The powder is mixed with water and kneaded to make a dough, sugar added, formed into small dices, and deep fried in oil for 2 minutes. It is stored and eaten as and when needed. It is made 20-25 times a year and taken along with breakfast.

Tabulchu Spine Pita

Cassava tubers are taken, cleaned to remove the soil, washed in water, skin and rind removed, well boiled, the central fibre removed and kneaded. While kneading, sesame and sugar are added and made into circular shapes using hand and deep fried for two minutes and is usually taken in the evening. It is prepared around thirty times in a year.

Tabulchu Gindae Joa (Powder fry)

Cassava tubers are cleaned to remove the soil and washed in water. The skin and rind are removed, cut into pieces and boiled and sliced with knife, and dried for two days under sun, pounded and sieved (not fine powder), added with water and sugar, and fried in a small amount of oil. Store this in a bowl and consume for one week. This is normally prepared from one bunch of tubers; made 20 times in a year and consumed in the morning.

Tabulchu Gindae (Rawa)

Cassava tubers are cleaned to remove the soil washed in water. Skin and rind are removed, cut into pieces, boiled, sliced with knife and dried for two days under the sun. It is pounded and the sieved powder is stored in small bags or in vessels. The powder is prepared 10 times in a year. It is normally consumed raw in the morning.

Tabulchu Pakora

Cassava tubers are cleaned to remove the soil, washed in water, skin and rind are removed, cut into pieces, boiled and dried for two days under the sun, pounded and sieved. Water and sugar or salt, turmeric and fresh chilly are added to the sieved powder. The dough is cut into small pieces and deep fried for 3 minutes. This pakora is made 20 times a year and eaten as breakfast. A person normally consumes 10 small pieces.

Tabulchu Nemki

Cassava tubers are cleaned to remove the soil and washed in water. Skin and rind are removed, cut into cylindrical pieces and boiled. This is sliced as chips, dried, deep fried and kept for nearly a month. It is prepared 25 times a year and consumed during breakfast.

Tobulcho Gata

Cassava tubers are cleaned and cut into pieces, boiled using an earthen pot with bamboo mat kept over metal vessel sprinkle some salt, steamed for 30 minutes; made 2 times a month

Tabulchu Gopba

Cassava Tubers are cut into pieces and cooked using charcoal for 10 minutes.

Tabulchu Chappati

Tabulcho stored flour is made into dough by adding water. Dough is made into small rounds with rolling pin, deep fried in oil using a pan for 3-4 minutes. It is normally consumed during breakfast.

Tabolchu Borom (CASSAVA LADU)

Tubers skins are peeled and then washed and chopped and boiled for half an hour. Kept aside until cassava becomes cold. Made into dough by mixing cassava, coconut powder,

and sugar powder. Make small balls with the dough. Consumed as evening snack and is rarely prepared.

Tabulchu Sakkinidli

Tabulcho stored flour is made into dough by adding water. The dough is steamed in a vessel or bamboo and consumed as breakfast.

Tabulchu Bitchi (Wine)

Cut cassava tubers into small pieces. Boil and place them in bamboo baskets, sprinkle with yeast, place in earthen pot or plastic container, and close it for two months. One liter is produced from one basket.

From Leaves

Tabulchu Bijak Rita (Cassava boiled leaves)

The cassava tender leaves are chopped and washed. Chili, ginger, onion and salt are added and roasted for 3 minutes, water and fish are added and boiled for 20 minutes. This dish is prepared once a month during the first three months of cassava cultivation which is around April to July.

Tabulchu Bijak chutney

Bijakchutneyis prepared with dry fish, chilli, salt, and cassava tender leaves.

Tabulchu Otepba

Tender cassava leaves are cut into small pieces, 50-60 leaves a time, mixed with 2 pcs. chopped onions, 6 pcs. chilli, 3 pcs. dried fish, half teaspoon salt, and a pinch of soda. Rolled along with all ingredients on a banana leaf, and cooked using charcoal for 20 minutes, prepared three to four times a year.

Tabulcho Pura

Use cassava tender leaves 30-40 numbers, 150 g rice powder, 12 pcs. chili, half spoon soda, 1 ½ spoon salt, 1 kg chicken. Fry the chicken without oil, add cassava leaves and fry for sometime, add soda, chili and salt, add water and make it boil for 5-6 minutes, and lastly add rice powder.

Tobulcho bijakkappa

Cassava tender leaves 50 number, soda, salt, chilli and dried fish added to requirement and put it in a cooking vessel and cooked for 10 minutes. This is prepared once a week.

From Stems

TabulchoKaritchi (Soda)

Harvest the stem during October to November, dry the stem for three months, burn the stems on the ground, collect the ashes, put the ash in funnel made of bamboo and fill with water. After four days collect it as soda in a vessel

Animal feed

Pig: After removing rind and skin, cassava raw tubers are cut into pieces and boiled along with chopped taro leaves and stalks, pumpkin, and rice husk (the composition should be: 30% cassava, 30% taro leaves and stalks, 30% pumpkin and 10% husk). Boil for half an hour, and feed to adult pig 3-5 kg/day, 2-3 times a week. Cassava can also be mixed with horse gram, salt, and water.

Cattle: Raw tubers are cut in to pieces and fed to cattle once or twice in a week. Cassava leaves are chopped, dried, and fed to cattle.

Chicken: Cassava leaves are directly fed to chicken.

Fish: Branches of cassava leaves are fed to fish by putting the leaves in the pond.

Eri silkworm: Leaves are put in trays where eri silk worm is reared during the third week of larva stage. This is practiced by some farmers in West Khasi hills.

This shows that a wide variety of value addition practiced by the farmers and gives ample scope for selective commercialization. In order to know the possibilities of commercialization of cassava value-added products, farmers were asked to initially select the cassava products that possess potential commercial value. A matrix ranking of the farmers' preferences is presented in the Table 4.10.

Table 4.10. Preference of value added products for possible commercialization.

Potential cassava value added products	Matrix ranking					
	Frequently done	Most liked	Easiness	Commercial value	Demand	Over all ranking
Rita	1	6	1	6	4	4
Spin pita	2	1	4	1	2	1
Nemki	3	2	3	3	3	3
Chips	4	3	2	2	1	2
Pakora	5	4	8	4	6	5
Joa	6	7	7	5	5	6
Grand	7	8	5	7	7	7
Ginde	8	5	6	8	8	8

(1 as the highest preference and 8 as lowest)

The preferential ranking of cassava value-added products indicated that spin pita, chips, nemki and rita would hold good for commercialisation,

The utilisation pattern of cassava in Meghalaya is presented in Fig 4.8.

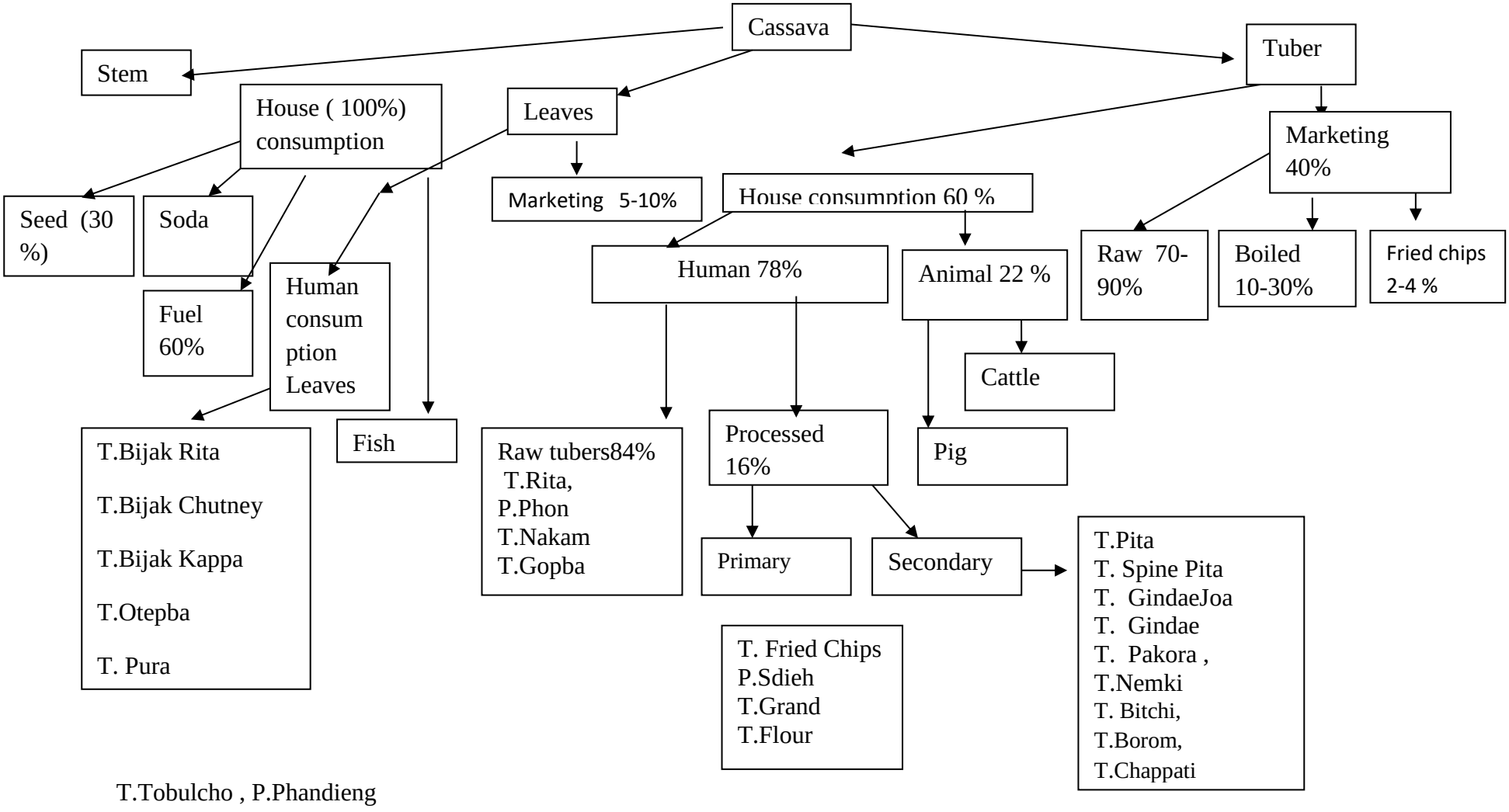

Fig 4.8.Utilization pattern of cassava by farmers

4.6.5. Marketing

4.6.5.1. Market infrastructure

According to the documents, there are about 278 weekly markets selling agricultural commodities in partial wholesale and retail in Meghalaya. With regards to market ownership — some are being owned by kings, clans, autonomous district councils and municipal boards. The market can be administered, i) directly by market owners, ii) through market committee, iii) through bidding (e.g. Songsak Market in EGH). Revenue model is always planned in consensus between market owners and market administration. Taxes are not fixed and often vary from market to market. Management and Maintenance: Waste management and sanitation are done directly by the market owners or market committee through contribution of the market stakeholders. The market of Mawiong is the only whole sale regulated market in Meghalaya in which cassava is not a notified crop. The Commodities that are notified by the government are the ones whose trading is to be regulated. It was observed that cassava is included in the list of crop commodities arrivals only in five markets in West Garo district by the Meghalaya State Agricultural Marketing portal. Farmers mostly do not have to pay tax in the market owned by Kings and clans. The biggest market available in Meghalaya is Iewduh (Bada Bazar) located in Shillong which is not a regulated market. Apart from the 278 weekly markets, there are many road side markets in which cassava is marketed. Cassava arrivals are reported for only few markets located in West Garo districts which are presented in Table 4.11and Fig 4.9.

Table 4.11. Cassava arrivals month wise for reported markets 2017 (Quintals, (Q))

Markets	September	October	November	December
Dalu (West Garo)	3	2.5	4	-
Purakhasia (West Garo)	3	-	-	3

Tura (West Garo)	35	76	99	22
Rongram (West Garo)	5	1	2	3
Raksamgiri (West Garo)	2	-	-	-
Total	48	79.5	105	28
Grand total	260.5			

Source: Meghalaya State Agricultural Portal

http://www.megamb.gov.in/Public/MktProfile.aspx

Cassava arrivals reported for 2018 January are (Dalu 2 Q, Rongram 3 Q) and February (Rongram 2 Q). Tura is the major market for cassava. It may be noted that cassava is grown and marketed in other districts which do not have a place in the government portal. For example, a good amount of tubers are arriving in Williams Nagar (EG) and Iewduh in Shillong. The quantity of arrivals reported in the markets shown in Table 4.11 is only 26 MT, which is only a fragment considering the total quantity produced in West Garo district (7638 MT), which means tubers are marketed more in other villages and road side markets.

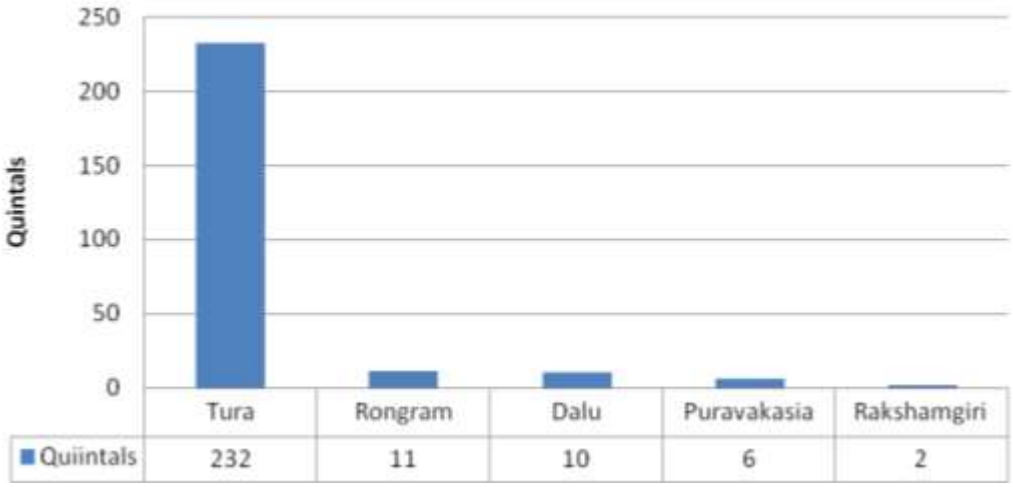

Fig 4.9. Cassava arrivals for reported markets 2017

4.6.5.2. Marketing by farmers

Cassava marketing is unorganized in Meghalaya and appears to be a closed one space-wise, where marketing mostly happens within a village or nearby villages, and at the most it reaches the district markets. According to survey results, cassava rarely cross to the state capital of Shillong or to the neighboring states unlike potato, which means demand is restricted. It involves a short chain of actors done mostly by farmers directly, and to some extent, by aggregators/retailers. On the other hand, wholesalers' role is limited. Marketing role is dominated by females (90%), in direct sales, as well as aggregator and retailer roles. According to farmers and traders, market demand for cassava is not increasing significantly, however production at farm level is increasing for house use.

This is because the cassava market is dependent on local sales within the district and sail beyond distances seldom happens. Marketing of tubers is not assured. Sometimes farmers return with unsold tubers which they can use in the house as food or feed. Once the tubers are harvested, soil is removed and washed with water. The tubers are sorted into big, medium and small and made into bundles having 4-6 tubers having all the three types of tubers. They are tied with strings of bamboo or ropes. The tubers are marketed in terms of bundles and not by weight or specific volume-based measures. The volume and weights vary from locality to locality and month to month. It was found from weight taken from ten locations (road side markets, Williams Nagar and Tura markets) that the weight of bundles vary from 1.5 kg to 2 kg. There are three types of market arrivals: peak season is in November, December and January; non-peak season in October, February and March, and low arrivals in August, September, and April. While there are no supply of cassava in May, June and July. Price varies in these three periods, the price is high during less arrivals and vice versa. Normal prices observed in terms of weight are Rs 10-15/kg during peak season, Rs 15-20/kg during non-peak season, and Rs 25-

30/kg during low season. The volume of arrivals during peak period is above 70%. Farmers get maximum price during August and September when short duration varieties are harvested. It is interesting to note that farmers in the surveyed areas vary the size of the bundles, that is, they make the bundle size smaller during low periods and bigger during peak, keeping the price constant instead of varying the prices according to seasons. Another interesting observation is nearly 50% of the tubers are sold by cutting its two ends. The reason stated is to show the freshness of tubers. Contrary to their practice, this method increases the chances of tuber damage and decreases shelf-life. There is no distress sale by farmers since unsold tubers could be used by the farmers in the house as food or feed; farmers tend to reduce price up to 50% at the end of the day and when the money is required very much. Seventy to ninety percent of tubers are sold as fresh raw tubers. Farmers also sell cooked tubers wrapped in leaves around 150-200g. Nearly 10% of total volume of sales is found in the form of cooked tubers from sample farmers. This is more prevalent among Khasi farmers in West Khasi districts where more than 50% of cassava produce is marketed as boiled tubers as stated by the farmers. However, from the surveyed respondents in villages in West Khasi district, which is dominated by Garo tribes, it was found that 28% of marketed tubers were in the form of boiled tubers. Cooked tubers are more popular in East Khasi district, including Shillong. Sales from the cooked tubers appear remunerative (more details provided in profit analysis). In the surveyed districts, it was noticed that a very small proportion (2-4 %) of marketed volume, is converted into fresh fried chips and sold in shops, festivals and carnivals which also gives a good margin on value addition. Farmers also sell cassava leaves usually in village and district markets at Rs 10/bundle (approximately 200 leaves) during June to November, with farmers selling 2-3 bundles at a time. Farmers and aggregators cum retailers normally sell the tubers in road side and village markets. A farmer/aggregator takes a basket to road side markets; 2-3 baskets when they sell in village markets, and a retailer

deals 3 baskets or more in district markets. A very insignificant (very small portion) volume of cassava tubers go from the surveyed districts (Garo) to Bada Bazar and Polo markets in Shillong, however Shillong markets receive relatively larger volumes of cassava tubers from neighbouring district Rhiboi for sales. Marketing is described in detail in the Value Chain section while the seasonality of cassava tuber price is shown in Fig. 4.10.

Price types	J	F	M	A	M	J	J	A	S	O	N	D
Low												
Medium												
High												

Fig 4.10. Seasonality of Price levels of cassava tubers in Meghalaya

4.6.5. Consumption pattern

Cassava forms an important part of daily food — at breakfast and as snacks in the evening. Cassava utilization by the cassava cultivators has been detailed in earlier section. The preferred and widely eaten form of cassava in villages and urban areas is boiled tubers. People in rural areas purchase and use the cassava more frequently than in semi or urban areas. It was found that during the peak season, families in rural/ semi urban areas, e.g. Tura and Williams Nagar, eat cassava 2-3 days in a week totalling to 3-4 kg in volume, and during non-peak season it is consumed once a week. Whereas in urban areas, families consume cassava less than 1-2 times in a month only during peak season. Consumers also prepare fried cassava chips twice a month and consume them as snacks in the evening. Cassava French fries (Tabulcho Jio) are very popular in Garo hills. Even though cassava is not popular in restaurants, a few tea shops in West Garo district, especially in Tura, have boiled cassava tubers in their menu during peak seasons. In rural areas, cassava leaves are purchased as an ingredient in curry making. It was observed in Shillong town that boiled

tubers in small quantities are brought to the offices along with other snacks by small vendors to be taken along with tea.

4.6.6. Commercialized value addition

Although there is an array of cassava value-added products, their use is restricted within farmers' households for want of suitable promotional activities. However, it is noted that cassava fried chips and boiled tubers have a commercial front to some extent. While fried chips are found in the market/shops in Garo hills, boiled tubers are prevalent in markets of West Khasi and East Khasi districts including Shillong. It was understood that 2 and 4% of farmers in Khasi and Garo districts respectively make fried chips (not on regular basis) for sales during carnivals and festival times, and nearly 80% of farmers in Khasi district are engaged in marketing boiled tubers. Households engaged in fried chips production for sales, normally produce about 300 packets of 50-100g during peak season. It was observed that few shops in Tura are marketing fried chips, each one marketing nearly 150 packets a week.

The operation flow for fried chips are as follows:

1. Cleaning and washing of tubers
2. Removing shin and rind
3. Slicing using knife
4. Mixing with salt and spices
5. Deep fry in the oil
6. Cooling and packing in to 50 or 100g in plastic packets.

Around 3-4 packets of 100grams can be made from one kilogram of tubers. These are marketed by farmers through house sales or petty shops. For boiled tubers sold commercially, 5-10 kg tubers are first cleaned, skin and rind removed, boiled in a vessel until well-cooked, kept in baskets, and made into small packets wrapped with leaves. From one kilogram they can make 5-6

packets. During peak season 20-30 sellers can be found in Shillong market selling boiled tubers. From the KII and FGDs it was understood that ICAR RC NEH has set up village-level cassava-based incubation centers (following the model established by CTCRI in Riha village in Manipur), in four locations in Meghalaya, specifically in Bajengdopa (North Garo hills), Dengasi and Dalu (West Garo), and Ganolaphalin East Garo districts operated by self-help groups in which cassava flour-based extruded products like cassava crisps and chips are produced and marketed with in the village and during festivals and carnivals time. Among these, Dalu unit is operating well. Involvement and management play a major role in the success of the unit. It was understood that lack of group cohesion and leaderships are the main reasons for unsuccessful functioning of the units. It was noticed during the survey that 5-6 traders in Anugreg, a bordering village to Assam state, are involved in selling fried cassava. The traders purchase the extruded product, brand name Pino (Rs 850 for 5 kg) which has potato and cassava flour as main ingredients and is ready to fry and eat. The product is produced by Noble agro-products in Gujarat state. They could make 100 packets of 100g each and sell at Rs 25/packet, thus making a good margin. All these show that there is a great scope of value chain development in Meghalaya.

4.6.7. Value chain marketing channels

Normally, any agricultural crop passes through different channels over great distances before it reaches the consumer. Based on FGDs, KIIs and surveys it was observed that cassava is more straightforward.

Even though actors and type of channels are the same for various districts surveyed, it was observed that there was a subtle difference in the volume of sales of boiled tubers between Garo and Khasi hills and an element of wholesalers in Garo hills. Hence, value chain and market channels are depicted separately for West Khasi and Garo hills (Fig 4.11 and 4.12).

4.6.7.1. Value chain and marketing channels in West Khasi hills

There are four channels through which the cassava is marketed in West Khasi Hills (Figure 4.11.) Cassava is marketed in three forms: raw tubers, boiled tubers, and fried chips.

Channel 1: Most farmers, 90% of which are composed by women, act as retailers and sell 40% of their cassava as raw tubers directly to consumers in road side and village markets. Farmers sell in road side markets three to five days in a week, each farmer sells one to two baskets weighing 25-30kg. Farmers collect tubers from the field early in the morning and after making around 10-15 bundles (weighing 25 to 30 kg) enough to be carried in a bamboo basket. These are brought to the road side markets between 10 to 12 o'clock. Transportation is manual as farmers have to carry the baskets to the road side markets most of the time. Some farmers make use of trucks/automobiles when they sell the tubers in village markets. Sales are not consistent -- on some days the tubers sell fast, some days not so and they wait until evening to complete the sales. On average they can sell 80% of tubers during peak and medium seasons. Transaction is by cash. When farmers go to markets, they sell cassava tubers and other available produce at that time.

Channel 2: In this channel, farmers sell their cassava to aggregators, most of them belong to the same village and majority are female (> 90%). The aggregators get the commission of one free bundle by purchasing five bundles of tubers. Furthermore, the aggregator has to give the prevailing price of cassava. Through this channel around 40% of tubers are sold to markets, and 60% to village markets. Transportation is usually manual and sometimes by trucks.

Channel 3: In this channel farmers boil tubers and wrap with leaves. Around 28% of the volume are sold as boiled tubers. All these are directly sold by farmers on road sides, villages, and district markets.

Channel 4: A very small proportion of tubers (2%) are converted into fresh fried chips by the farmers and directly sold to the villagers and small shops.

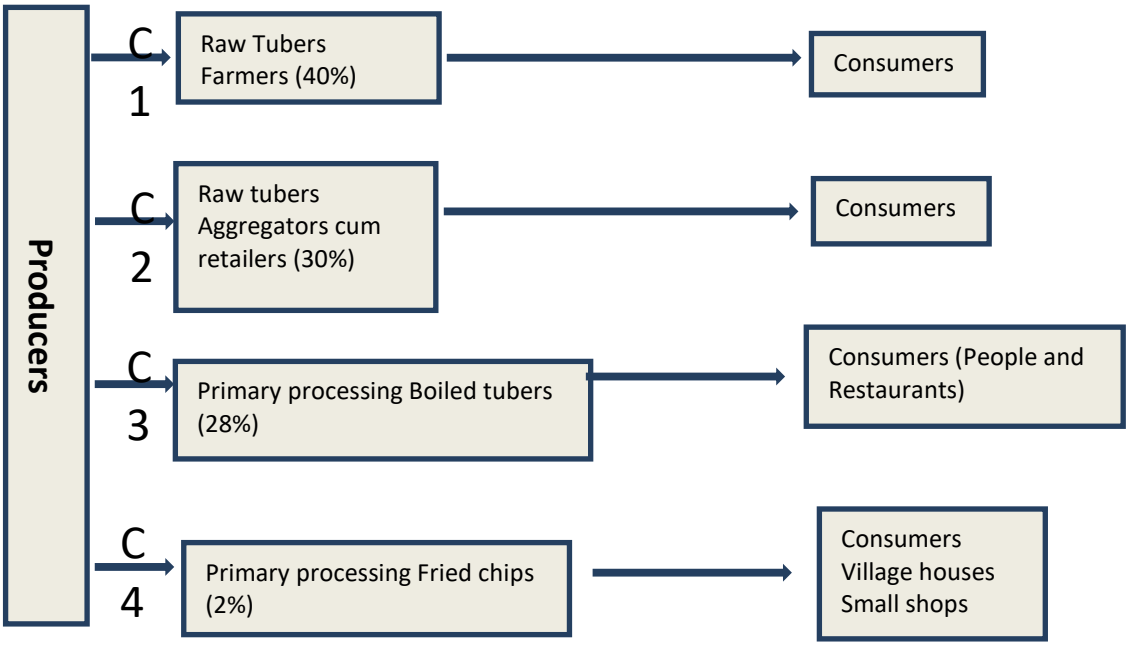

Fig 4.11 Value chain map of cassava in West Khasi district

There are five channels through which the cassava is marketed in Garo Hills (Figure 4.12). Cassava is marketed in three forms: raw tubers, boiled tubers, and fried chips.

Channel 1: Similar to West Khasi district, most farmers act as retailers and sell 40% of their cassava as raw tubers directly to consumers. They sell most of the volumes in road side and village markets. Farmers sell in road sides three to five days in a week using a bamboo basket weighing 25-30 kg. Whereas in village markets farmers sell around two baskets once in a week. Mode of transportation is by manual or by trucks.

Channel 2: In this channel farmers sell their cassava to aggregators, most of them belong to the same village and majority are female (> 90%). The aggregators get the commission of one free bundle by purchasing five bundles of tubers. and the aggregator has to give the prevailing price of cassava. The aggregators get the tubers mostly by bundles. Through this channel around 40 % of tubers are sold in markets. Sixty percent (60%) of tubers are sold in village markets. Transportation is by truck.

Channel 3: In this channel tubers (10%) move from farmers to aggregators, wholesalers, retailers and consumers. There are not as many wholesalers for cassava tubers compared to potato. They are mostly located in Tura in peak periods and the volume sold is not much and tubers are rarely stored overnight.

Channel 4: In this channel farmers boil tubers and wrap them with leaves. Volume is less when compared to West Khasi. Around 6% of the volume of tubers are sold as boiled tubers. All these are directly sold by the farmers in road side, village, district markets during festivals and carnivals, and also to tea shops.

Channel 5: A very small proportion of tubers (4%) are converted into fried chips by the farmers and sold to villagers or to small shops. They are sold directly by the farmers.

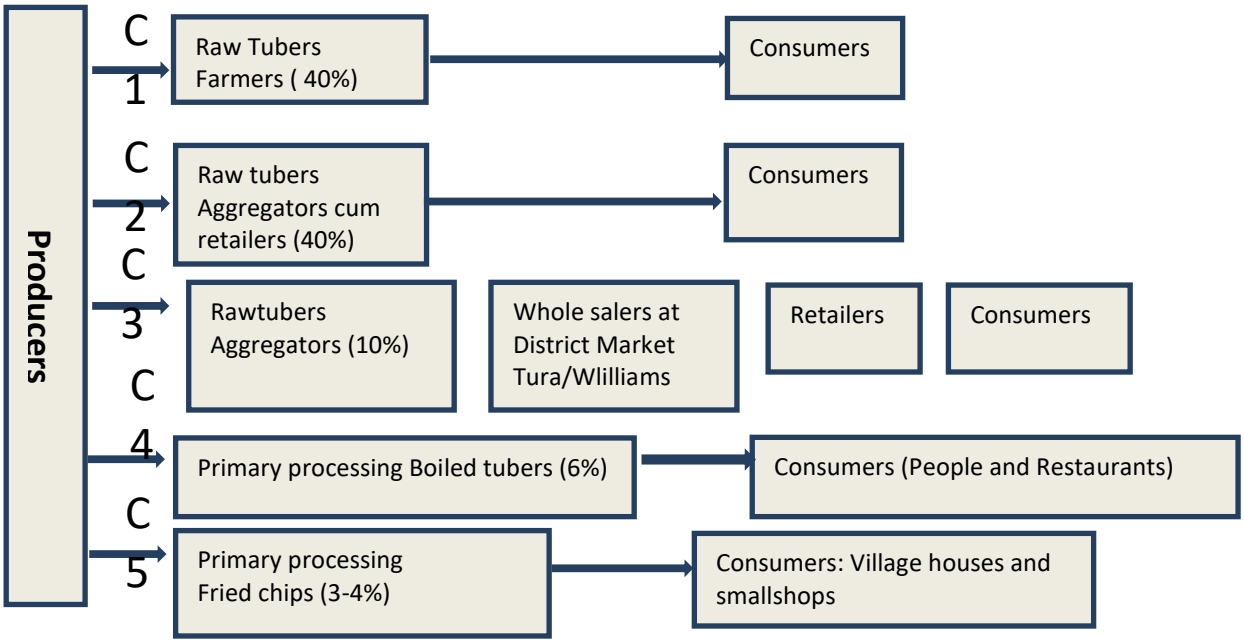

Fig 4.12. Value chain map of cassava in East and West Garo districts

4.6.8. Economic analysis of potato value chain

4.6.8.1. Cassava price analysis

Cassava is neither imported from other states or exported to other states, hence the price cannot be directly affected by external price of cassava. Marketing is done entirely within Meghalaya. From the price figures available for cassava low arrivals (September) and peak period (December) presented in Figures 4.13. and 4.14. It could be seen that there is a fluctuation in price in September, from a maximum of Rs 34/kg high during initial weeks and tapering down to a minimum of Rs 18/kg towards the end, of the month. There appears to be an error in the dataset where the modal price in the latter part of September is higher than the maximum price. In December, peak price was at Rs 22/kg and minimum at Rs 10/kg. It was noted that there was fluctuation in this month. For most of the period, the price ranges between Rs 10 to 18/kg. The price fluctuation shown in this data illustrate the main constraint reported by farmers and traders. Factors affecting the price is basically due to the

volume of arrivals of cassava and the availability of tubers like potato, sweet potato, yams, and taro and other vegetables.

Source: Meghalaya State Agricultural Portal

http://www.megamb.gov.in/Public/MktProfile.aspx

Fig 4.13. Price trend of cassava during September in Rs /Quintal (2017)

Source: Meghalaya State Agricultural Portal

http://www.megamb.gov.in/Public/MktProfile.aspx

Fig 4.14. Price trend of cassava during December Rs/Quintal (2017)

4.6.8.2. Cost of production

4.6.8.2.1. Raw Tubers

The cost of cultivation was worked out based on the operational cost for jhum and other systems. As there were not much external inputs used for seed materials and manure and fertilizers, only labor costs were considered for cost of production. Only family labor was used invariably in all the cultivation operations (Table 4.14.). However, the imputed cost on the family laborers were taken into account in the cost of cultivation. These were presented production system-wise. The total cost of cultivation was Rs106000/ha and Rs100750/ha for jhum and other production systems, no significant difference. Land preparation costs account for 41-42 % followed by weeding 26-27%, harvesting 18%, and planting 14%. There is a scope for reducing cultivation costs with harvesting tools interventions. The cost of production of

tubers was Rs 6.42 and Rs 6.54/ kg for jhum and other systems respectively. The net income derived was Rs 92000 and Rs 8635/ha. It appears that cassava is a remunerative crop provided that farmers can sell the marketable surplus.

Table 4.12. Cost of production of cassava tubers in Jhum and other systems (Rs/ha)

Cost items (Labor costs)	Jhum	Other systems
1.Land preparation	45000(43)	41250(41)
2.Planting	14250(13)	13750(14)
3.Weeding	28000(26)	27250(27)
4.Harvesting	18750(18)	18500(18)
Total labor costs	106000	100750
Yield (Kg/ha)	16500	15400
Gross income	198000	184800
Net income	92000	84050
Cost of production (Rs/kg)	6.42	6.54

Note: Figures in parenthesis indicates percentage

4.6.8.2.2. Boiled tubers

Based on the discussion with sellers of boiled tubers in Khasi hills and Shillong market, from one kg of raw tubers they can produce 5-6 packets of boiled tubers weighing 150-200g. Total cost incurred when one kg of raw tubers converted to boiled tubers is Rs 21 (raw materials cost Rs15/kg, labor costs Rs 3/kg, transportation costs Rs 2/kg, and packing leaf costs Rs1leaf/packet). Boiled tubers are sold at t Rs 60/Kg to Rs 80/kg.

4.6.8.2.3. Fried chips

According to fried chip producers, to convert one kg of tuber to fried chips of four packets weighing 100g, each kg incurs a cost of Rs24.10 (raw material

costs Rs 15/kg, ingredients cost Rs 5/4 packets, labor costs Rs 4, and packaging Rs 0.10.) They could sell the chips at Rs 20/ packet i.e. Rs 80/kg of tuber, they get a profit of Rs 60/kg when they convert raw tubers to chips.

4.6.8.3. Market margins in different marketing channels

This analysis sought to understand how much value is added by the different value chain actors in the West Khasi and Garo hills. The value addition is the difference between the costs invested and the selling price at each stage of the value chain. Producers' share and price spread were also worked out to assess the percentage of total value added enjoyed by the farmers (see detailed results for the two districts in annexes I and II). As indicated in an earlier section, there are four channels in the value chain mapping for Khasi Hills, which includes two on raw tubers and one on boiled tubers and another on fried chips. In the first channel, which accounts for 40% of total volume traded are done only by the producers. The producers' margin is Rs 5.50/kg in this channel. In the second channel, where 40% of tubers are traded and aggregators cum retailers are involved, producers' market margin is Rs 5/kg and aggregators' market margin is Rs 1.5/kg. In the third channel, raw tubers are converted into boiled tubers and marketed by farmers, producers' market margin is Rs 37/ kg of tubers. Finally, in the case of fourth channel where tubers are converted into fried chips, producers margin is Rs 52/kg. Among all the channels, producers get maximum value addition in making fried chips followed by producing and selling boiled tubers.

Table 4.13. Producers' share and price spread of value added in different cassava marketing channels, West Khasi district.

	Channel 1	Channel 2	Channel 3	Channel 4
Producers' share %	96.15	79.31	96.67	97.5

Price spread Rs/kg	1.00	3.00	2.00	2.00

Producers' percentage share and price spread of total value added were calculated for all the channels (Table 4.13). Through channels 1, 2 and 3 where products are directly sold to consumers, farmers obtain a maximum percentage share of 96, 96, and 97, respectively. The price spread (Rs 3) was more in the channel where aggregators cum retailers were involved. Similarly, producers' share and price spread for Garo hills analyzed and presented in Table 4.14.

Table 4.14 Producers' share and price spread of value added in different cassava marketing channels in Garo districts.

	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5
Producers' share %	96.15	79.31	63.88	96.67	97.5
Price spread Rs/kg	1.00	3.00	6.5	2.00	2.00

As earlier discussed, Garo had an additional channel where wholesalers were involved (channel 3), producers' share was as low as 63.88 and price spread was the highest at 6.5, remaining channels were similar to Khasi hills (Table 4.14). In general, it could be stated that farmers enjoyed more value addition by producing and selling boiled tubers and fried chips, although done on a small scale.

4.6.8. Value chain linkages

Value chain linkages refer to the relationships existing between actors. Farmers maintain good relations among themselves, maintaining regular contact and showing a very good level of trust. The relationship and mutual

trust among farmers is evident in seed exchanges, sharing of information on cultivation practices and market prices, and even exchange labor in the process of marketing. This can be the basis for looking at options for collective marketing which will be discussed in later sections. Farmers' linkage with the Agriculture Department and Extension Agency is not evident except for participating in general agricultural training programs not specific to cassava and is formalised through verbal agreement. The relationship between farmers and aggregators is very good since most of them are from the same village. their interactions are regular and they help each other by extending credit in the form of cash and in kind with no written agreement. Nearly 40 % of the cassava traded in Meghalaya is through aggregators/retailers available within the village. The price is decided mutually by the farmers and aggregators, depending on the prevailing situation. Farmers maintain a moderate linkage with banks for obtaining loans for other crops except cassava as this crop is more labor-driven than input-driven like potato.

4.6.9. Value chain Governance

The underlying fact that drives the cassava enterprise in Meghalaya is its role in supplementing the people's food and feed requirements. The value chain actors such as the farmers, traders, and consumers play a decisive role with the passive support from government institutions more by the available marketing structures like village and district markets where cassava is traded by value chain actors. As far as production is concerned, there cannot be dearth of land for cassava production as it is cultivated in various production systems especially jhum, but farmers restrict the area to be cultivated depending on availability of family labor. They cultivate more jhum area if they have more family members. Farmers also feel if they produce more they may face difficulties in selling the tubers.

The major players in the value chain are the farmers as they play a significant role in producing and marketing the crop. Nonetheless, the role of aggregators

cum retailers cannot be completely ignored as they mostly determine the flow of commodities. While the prices are mainly governed by the arrivals and availability of other tubers and vegetables. Apart from contributing to food security, cassava has an important role in the market economy. Traditionally, cassava is used to exchange with other commodities, this practice has reduced considerably as nearly 40% of cassava produced is marketed. Farmers themselves regularly engage in marketing. Furthermore, cassava is increasingly sold to aggregators, wholesalers, and retailers. Most tubers are sold on temporary informal arrangements even though it is quite common to sell it to the same buyer (aggregators). However, institutionalized marketing arrangements where farmers are contracted and assisted by buyers seem not to exist. Cassava's role in supplementing animal feed is very significant, although not commercialized, the roots that are no longer marketable due to deterioration. Conversion of value-added products and commercialization are limited to producers. All these aspects point to the fact that cassava, as an enterprise, depends more on the farmers, which is a good sign to initiate actions on cassava value chain development through farmer groups and organizations.

4.6.9. Challenges and opportunities in the cassava value chain

The key challenges expressed by the value chain actors are summarized in Figure 4.13. The problems related to inputs are limited as cassava is not an input-driven crop in Meghalaya. However, the problem encountered by farmers is the lack of new improved varieties to replace the long-used traditional varieties. There is also shortage of labor in Meghalaya which restricts the increase of area used for cassava cultivation was a shortage of labor input from the house so as to increase the area of cassava cultivation. There was practically no schemes or program for cassava from the state. The scheme run by the state concentrates only on potato seed production. Hence, cassava is not prioritized in extension programs and which also results to the lack of information dissemination on production technology. Cassava is a

robust crop, hence it did not face much production constraints except for attack of wild boars and rodents on tubers which causes damages considerably during harvest stage, and especially in jhum systems. Rotting due to rodentattack is another challenge. There is absolutely lack of mechanized cultivation or use of labor-saving implements. The nature of terrain Jhum/ individual farms lands are mostly in hilly areas and accessibility for tractors and other big machineries is not feasible, however in some operations like weeding and harvesting, appropriate tools would save lot of labors. Constant use of same varieties over a long period make the varieties lose their vigor, resulting to yield thresholds. Logistics of tubers from fields to homes and marketing places poses problems due to the bulkiness of tubers, lack of motor-friendly roads from fields to markets is addressed by manual transportation, however this incurs more cost on transportation.

Both farmers and traders expressed concerns about price instability and even price crashes that have occurred in the past, leaving farmers to make distress sales. Farmers felt strongly that market demand for cassava is not growing in view of restricted market happening within the district, not even moving to neighboring districts and movement of tubers to State capital Shillong is very low compared to other surveyed areas. There are no standard measures by volume or weight of cassava tubers when it is traded. It is surprising to note that tubers are marketed even in village and district markets in bundles and sizes that are not standardized and highly varying. The unfavorable way of displaying the tuber by cutting the ends also add to postharvest deterioration. Transportation to marketing yards is a problem which adds to market costs. Farmers are not aware of market prices in big markets like Shillong. More so, cassava is not a notified crop in the markets except few markets in West Garo district. There are no organizations formally taking care of cassava marketing or cassava collection centers, completely left to farmers.

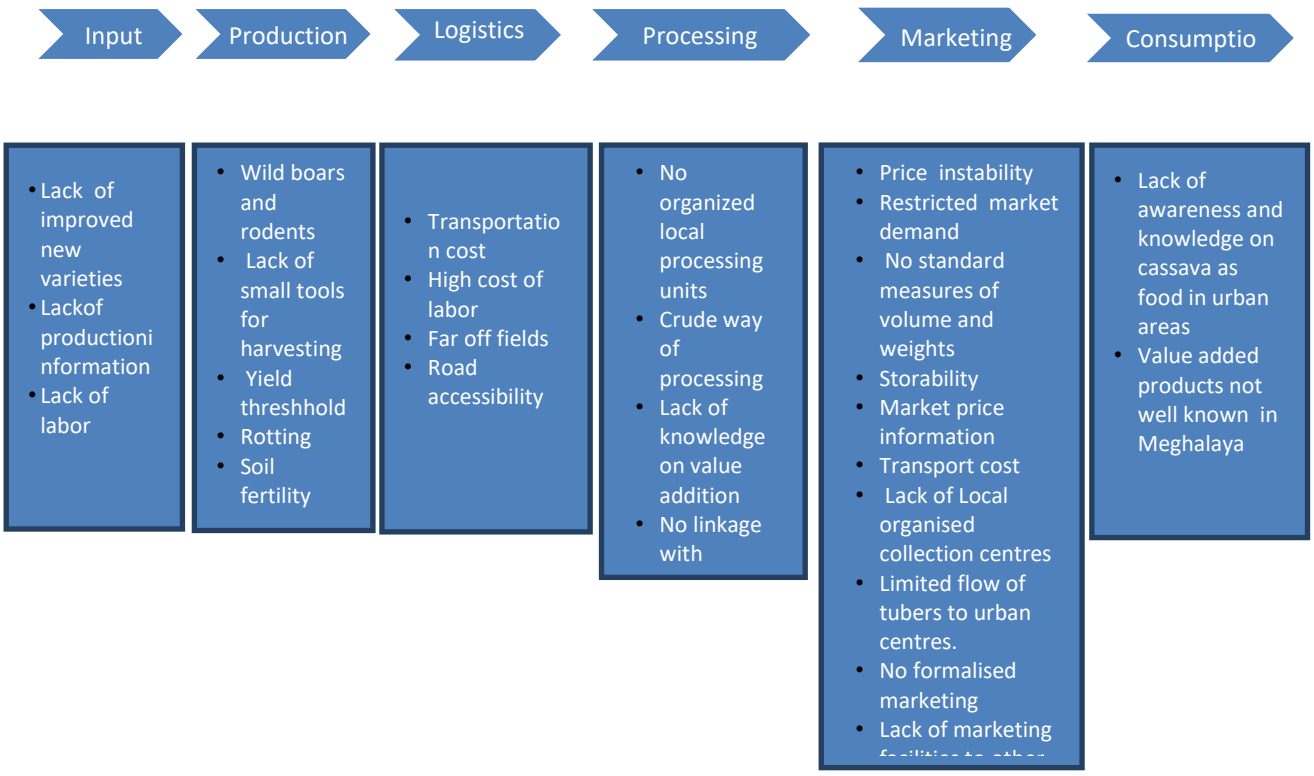

Fig 4.15. Major constraints in the cassava value chain, as identified by respondents

Another challenge identified is that farmers are not organized and the government has no support to form farmers organizations for cassava value addition and marketing. From the survey it was noticed that almost all the women farmers are members of Self Help Groups (SHGs), but none of the SHGs focuses on Cassava. Cassava consumption largely takes place in rural areas and there is a lack of awareness on cassava as food security crop in urban areas and its wide selection of value added products. It is worth mentioning that leaves also are very good source of nutrients. As well as identifying these challenges, the study also documented various opportunities to overcome them and strengthen the cassava value chain (Table 4.15). The focus of these opportunities is on the value-added products and marketing. There is an array of cassava value-added technologies which can be manufactured at different level of production units (see annex III). Broad based interventions that

address the constraints and unlock its potential are often a pre-requisite for value chain development. Such interventions need to go hand in hand with specific value chain development strategies to make a lasting impact. Opportunities for overcoming some of the production constraints are also mentioned in the table. It is recognized that not all opportunities can be acted upon immediately.

SUMMARY AND CONCLUSIONS

The study aimed to analyze cassava value chains in order to identify major constraints in cassava production, marketing, use, and opportunities for interventions that could significantly increase returns for farmers and processors, and specifically study all aspects of cassava value chain in Meghalaya. The study mapped and surveyed cassava value chains; examined how the value chain was organized, coordinated and governed across the key actors along the value chain; the production system and the practices followed, determined profit, and marketing margins obtained by actors at various modes of cassava value chains; identified challenges faced by actors and strategies to overcome the problems. Cassava is an integral part in the livelihood of Meghalaya farmers in terms of food security support, as animal feed, and as source of income. There is slow and steady increasing trend in area and production of cassava. Cassava is grown in jhum, individual farms and homestead production systems, out of which jhum systems leads in the production. Female farmers dominate the cassava enterprise, both in production and in marketing. An array of varieties, suited for long and short duration, are cultivated by the farmers. Leading varieties are Meghalaya, Bolong, and Naga. Minimum tillage is given to soils while preparing land and setts are planted horizontally in small pits. Cassava cultivation engages more than 400 labor days and land preparation and weeding have major share of two thirds of total labor. Cassava was found to have multipart and multidimensional utilization using all plant parts and as food and feed to cattle,

pig, chicken, fish and eri silkworm. Nearly 60 % of tubers are utilized in the house (78 % food and 22% feed) and 40% are marketed. Home consumption of tubers start from September and goes up to March. Availability of tubers and consumption are low in September and October, high in November, December, January and February, and medium in March and April. Multi-various food preparations are made from cassava, where 16% of raw tubers are converted into flour and chips. The preferential ranking of cassava value-added products indicated that Spin pita, chips, nemki and rita in that order have good potential for commercialization. The cassava market is unorganized in Meghalaya and appears a closed one space-wise, mostly happening within a village or nearby villages and at maximum it goes up to district markets. The tubers are marketed in terms of bundles and not by weight or specific volume-based measures. Two types of processed food are sold, a major type is boiled tubers and insignificant proportion of fried chips. ICAR RC NEH has set up village-level cassava-based incubation centers (following the model established by CTCRI in Riha village in Manipur), in four locations in Meghalaya.

There are four channels through which the cassava is marketed in West Khasi Hills and five channels in Garo districts. Nearly 40% of tubers are marketed directly by farmers. Cassava is marketed in three forms raw tubers, boiled tubers and fried chips. There is high fluctuation of price over the months. Cost of production of cassava tubers was found to be 6.5 Rs/kg, and farmers can earn a net profit of Rs 88,000/ha. Farmers earn a net profit of Rs 5.5 /kg when sold as raw tubers and Rs.61 and 65/kg when sold as boiled tubers and fried chips. Producer's share is around 96% when tubers are sold directly. In general, cassava as an enterprise runs fairly profitable with the current production level.

The findings show that there are several challenges and constraints that exist in the cassava value chain. Among other things include lack of information on

improved methods of production, transportation cost, price fluctuation, lack of market information, poor support services, lack of value addition, and poor marketing infrastructures.

RECOMMENDATIONS

Based on the findings of the study the following recommendations are suggested for the development of sustainable cassava value chains:

1. Improving Production: Farmers are growing traditional varieties for long period and it is time to replace old varieties with new high yielding, climate resilient with good culinary characters and suitable for frying by conducting trials and popularizing the best ones. Farmers do not follow proper land preparation like ridges or mounds which will enhance yield and make harvest easier. Necessary agronomic interventions may be tested and popularized, including tools that will reduce the high labor demand for land preparation.

2.Value addition enhancement: there is lack of knowledge and processing units in Meghalaya. Hence, there is a need to strengthen farmers' and entrepreneurs' knowledge on cassava value addition through capacity building. Farmers business schools and exposing farmers and private entrepreneurs to cassava processing opportunities would help in production and marketing of value added products. Facilitating adoption of CTRCI technology**:** fried cassava chips with good texture or from other sources (e.g. private entrepreneurs who have been successful in the business) would help start cassava processing units.

3. Short shelf life and deterioration of tubers: Conduct capacity building on primary processing into flour and dried chips in the field, home and community level, and storage and popularizing animal feed preparation by silage of tubers and leaves.

4. Enhancing market demand: Create brand awareness for Meghalaya cassava

as purely organic and facilitate marketing in metro cities like Kolkatta may help broaden the demand. Popularize cassava value-added products in urban cities, which was successful in Kerala. Facilitate linkage of farmers with bakeries or enterprises making flour with units producing gums, adhesives and confectionary.

5. Government policy and interventions: Government is one of the institutions which is pertinent to create a conducive environment for the development of sustainable cassava value chains. Thus, the government policies and interventions affect cassava value chains development potential as well as chain sustainability. Therefore, in order to have sustainable cassava value chains, the study recommends that the government should: i. Strengthen transportation infrastructure for transporting the produce to the consuming markets in the cities and across states; ii. Facilitate the dissemination of market information through all possible mass media for the benefit of the farming community; iii. Facilitating start-up production units on cassava value addition at cottage/community level; small and medium levels and industrial level for different value addition technologies.

Table 4.15. Opportunities to overcome the challenges and strategies for cassava value chain.

Challenge	**Opportunity**	**Possible Stakeholder involvement**	**Strategies/actions**
Lack of knowledge on value addition	1.Strengthening farmers' and other entrepreneurs knowledge on cassava value addition 2.Exposing farmers and private entrepreneurs to cassava processing opportunities	MBDA/LAMP/CTCRI /Sago Serve Salem/DOH/CIP	1.Value chain capacity building for facilitators of Farmers business school 2.Value chain capacity building for farmers/FBS group 3. Value chain capacity building for private entrepreneurs 4. Establishment of village cassava processing incubation centers: model followed by ICAR-CTCRI and ICAR RC NEH 5. Exposure visits for farmers, FBS facilitators and LAMP staff to ICAR-CTCRI for cassava value addition and visit to cassava-based processing units in Kerala and Tamil Nadu and to Sago Serve and Wafer Serve, Tamil Nadu.
Crude way of processing by the producers (fried chips and flour)	Facilitating for adoption of CTRCI technology**:** Fried cassava chips with good texture or from other sources	MBDA/LAMP/CTCRI /DOH/CIP	1.Capacity building of producers / FBS group through demonstration of CTCRI technology 2.Testing and introducing required CTCRI chippers/ other company slicers
No standard volumes and weights	Sensitization on use of standard measurements of volume and weights	MBDA/LAMP//DOH/CIP/ Marketing board	Organizing sensitization meetings on the use of standard weights for farmers and traders
Short shelf life and deterioration of tubers	1. Encouraging Primary processing into flour and dried chips at field, home and community level and storage 2. Facilitating the linkage with bakeries/ flour-based	MBDA/LAMP/CTCRI /DOH/CIP / Marketing Board/ Animal husbandry department	1.Capacity building of farmers/FBS on flour / dried chip making and storage by using CTCRI technologies/ using Cassava chippers (see Annexure) 2. Establishing community/FBS/group level units for dried chips and flour making and small drying yards and storage.

	units/adhesives units/animal feed who are in need of chips/flour 3.Using cassava tubers and leaves based silage -- Vietnam model.		3. Finding out the demand for flour and chips in Shillong, Guwahati and Kolkatta 4. Capacity building of Farmers on silage production 5. Sensitization of farmers and traders on the importance of limiting damage to maximise shelf-life of fresh roots, change in practices needed to eliminate deliberate root damage at markets.
Less market demand	1. Creating a brand awareness of Meghalaya cassava as purely organic and facilitating marketing in metro cities like Kolkatta 2. Popularizing cassava through urban school gardens and cassava recipes and dishes in urban areas 3. Popularizing cassava value 4. added products in Urban cities 5. Exploring branded raw tubers export to Gulf countries / chips to China /Europe (only exploring possibilities harping on organic) 6. Facilitating Linkage with processing units using flours for product making and adhesives	MBDA/LAMP/CPRS/DOH/CIP and Marketing board/	1. Publicity through mass media and department portals on branding. 2.Establishing RTCs school gardens 3.Action research through FBS marketing value added products in cities. 4.Demand assessment of branded tubers for export (Tubers -- frozen and fresh -- are exported from Kerala) and establishing linkage 5.Demand assessment of flours and chips in flour based product and animal feed units and establishing linkage
Price instability	Price stabilization through better access to price	MBDA/LAMP/Marketing board	1. Facilitating cassava storage in community drying yards by MBDA/DOH.

	information to guide harvesting decisions and converting to chips/flour for storage decisions.		2. Price information-based market intelligence to farmers by Marketing boards and DOH. 3. Development and use price forecasting models for cassava by CTCRI /Marketing boards
No organized local processing units	Action programs Facilitating start up production units on cassava value addition at Cottage/community level ; small and medium levels and industrial level for different value addition technologies (See Annex III)	MBDA/LAMP/CTCRI DOH/CIP/Marketing board/Small Farmers Agri business consortium (SFAC)/Industrial Department	1. Capacity building of farmers /FBS/entrepreneurs on value addition and entrepreneurship 2. Start-up value addition units between State Government, private sector and local communities to develop technical capacity and entrepreneurship skills in product development and market positioning. 3. Develop linkage and collaboration for training with existing cassava processing businesses by LAMP / SFAC and Marketing boards.
Lack of means for direct marketing of cassava to other districts and states from major producing districts	1. Facilitation flow of tubers to other districts market including Shillong from major producing centers. 2. Establishment of cross-state federations of regulated markets to enable direct marketing to regulated markets of other states	MBDA/LAMP, DOH and Marketing board	1. Development of farmers' collective marketing capacity to market directly to neighboring districts markets and wholesalers of neighboring states, by Marketing board. 2. Policy development to market cassava directly from marketing federation of Megalaya to federations of neighboring states.
Lack of Transportation facilities and cost	1. Facilitating Infrastructural improvements, particularly the feeder roads with the markets. 2. Introducing small garden trolleys for carrying tubers	MBDA/LAMP, DOH and Marketing board	1. Develoment of feeder roads to near by markets 2. Testing various models of garden trolleys
Yield thresh hold	1. Identifying suitable short duration and long duration cassava varieties with high yielding, good culinary quality, dry matter, fried chips	MBDA/LAMP/ICAR-RC NEH/CTCRI /DOH/CIP	1. Testing varieties with the traits mentioned for its suitability in Meghalaya 2. Popularizing the selected varieties 3. Capacity building in production technologies

	suitability for Meghalaya 2. Introducing Production technology through agronomic interventions in land preparation and planting		
Soil fertility decline due to continuous cultivation and nutrition depletion	Farmers exploit the cassava fields by continuously cultivating cassava . Suitable Crop Rotation involving pulses would enrich the soils . Periodical Fallowing also helps in maintaining soil fertility	DOH/MBDA/LAMP/ Farmers	Awareness creation on soil fertility management and need for following by DOH
Wild boars attack	Facilitating fencing around the Jhum fields	DOH/MBDA/LAMP/	Putting low cost fence around the Jhum fields
Labor employed is huge and lack of family laborers	1.Facilitating the farmers in use of cassava harvesting tools	MBDA/LAMP, DOH	Testing and introducing CTCRI harvesting tools and training of the farmers (See Annex III)
	2.Introducing appropriate tools for weeding	MBDA/LAMP, DOH/CPRI	1. Identifying appropriate weeding tools 2. Training the farmers on the handling of tools

LITERATURE CITED

Anantharaman, M., Vijay, M., Evangel, S., Sohliya, B.K., Rathore, N.S., Augustus, S., Prain, G., & Bertuso, A. 2017. Roots and tubers for Livelihood enhancement in Meghalaya, India Results of Scoping Study. FoodSTART +, International Potato Center, Manila.

Central Tuber Crops Research Institute (CTCRI). 2015. Annual Report, Central Tuber Crops Research Institute, Trivandrum, Kerala, India.

Edison, S.M., Anantharaman & T. Srinivas. 2006. Status of cassava in India: An overall view, Technical bulletin Series 46, Central tuber Crops Research Institute, Trivandrum, India.

Emana, B. & Nigussie, M. 2011. Potato Value Chain Analysis and Development in Ethiopia Case of Tigray and SNNP Regions. International Potato Center, Ethiopia.

Haokip, T. 2010. India's Northeast Policy: Continuity and Change, *Man and Society: A Journal of North East Studies*, Volume VII, 2010. http://kukiforum.com/2010/10/indias-northeast-policy-continuity-and-change-2/.

Howeler, R.H. 2012. Recent trends in production and utilization of cassava in Asia. *In* R.H. Howeler, ed. *The cassava handbook – A reference manual based on the Asian regional cassava training course, held in Thailand*. Cali, Colombia, CIAT. pp. 1-22.

Howeler, R., Lutaladio, N., & Thomas, G., 2013. Save and Grow Cassava: A guide to Sustainable Production Intensification. Food and Agriculture Organization of the United Nations, Rome, Italy.

International Fund for Agricultural Development (IFAD). 2014. Final Design Report. Livelihoods and Access to Markets Project Document Date 11 Jan 2014. Programme Management Department, Asia Pacific Department. https://www.ifad.org/documents/10180/5c925f8c-1d08-4455-944f-719eae6fd98bJ

International Potato Center (CIP). 2015a. Value chain analysis of cassava in Kerala, India, FoodSTART, International Potato Center.

International Potato Center (CIP). 2015b. Value chain analysis of cassava in Tamil Nadu, India, FoodSTART, International Potato Center, Manila.

Jha, A. K., Harbir, S., Sant, K. & Surabhi, M. 2011. Value Chains of Agricultural Commodities and their Role in Food Security and Poverty Alleviation – A Synthesis, Agricultural Economics Research Review Vol. 24 January-June 2011 pp 169-181.

Kaplinsky, R. & Morris, M. 2001 A Handbook for Value Chain Research; International Development Research Centre (IDRC): Brighton, UK.

Kim, H., Nguyen, T.T.M., Nguyen, B. M., & R. H. 2015. Cassava conservation and sustainable development in Vietnam. In R.H. Howeler, ed. Sustainable Cassava production in Asia for multiple uses and multiple markets, Proceedings of Ninth Regional Cassava workshop, Nanning, Guangxi, China P.R. 27 November -3 December, 2011 Centro Internacional de Agricultura Tropical (CIAT). Cali, Colombia.

Komaravel, S. 2013. Value chain analysis of tapioca in Western parts of Tamil Nadu, Tamil Nadu Agricultural University. Coimbatore, Tamil Nadu, India.

Ministry of Agriculture, the United Republic of Tanzania. 2007. Cassava Sub Sector/Value Chain Analyses (draft 1, July 2007). Study commissioned by KILIMO trust and conducted by Match Maker (MMA) associates, Tanzania.

Minten, B., Thomas, R., Singh, K.M. & Sutradhar, R. 2011. The potato value chain in Bihar: An assessment and policy implications. International Food Policy Research Institute, Michigan State University, Indian Council of Agricultural Research-Research Complex for Eastern Region, Jawaharlal Nehru University. New Delhi, India. http://mpra.ub.uni-muenchen.de/54350/MPRA Paper No. 54350.

Partnership Initiatives in the Niger Delta. 2011. A Report on Cassava Value Chain Analysis in the Niger Delta. Foundation for Partnership Initiatives in the Niger Delta, Abuja, Nigeria.

Reardon, T. et.al. 2012. The quiet revolution in staple food value chains: Enter the dragon, the elephant and the tiger. Asian Development Bank. Mandaluyong, Philippines.

Roy, A., et. al. 2014. Marketing of root and tuber crops (RTCs) in Meghalaya: A case study of West Garo hills district. Indian Council of Agricultural Research. Meghalaya, India.

Saikia, A. 2001. Performance of Agricultural Economy of the North Eastern India: Constraints and Priorities. Presented at the workshop, "Prioritization of strategies for Agricultural Development in Northeastern India" organized by National Centre for Agricultural Economics and Policy Research/ New Delhi, India.

Srinivasan, T. & Anantharaman, M. 2005. Cassava Marketing System in India. Technical Bulletin Series: 43. Centrla Tuber Crops research institute. Trivandrum, India.

Tuan, N.D.A. and Cuna, L. 2007. The Participation of the poor in Agricultural Value Chain: A case study of cassava. Discussion Paper, National Institute of Science and Technology Policy and Strategy. Ha Noi, Vietnam.

Varmudy, V. 2014. Cassava cultivation and Export: Vast scope in India I. Market Survey. http://lfymag.com/admin/issuepdf/22-25_Cassava_FFYJan-14.pdf

ANNEXES

Annex I. Market margin, Producers share and price spread across different channels West Khasi

Particulars	Channel 1 (40%)		Channel 2 (30%)		Channel 3 (28%)		Channel 4 (2%)	
	Rs/kg	%	Rs/kg	%	Rs/kg	%	Rs/kg	%
Farmers Cost of production	6.5	---	6.5	--	6.5	--	6.5	--
Cost of production value added	--	--	--	--	21	35.00	24	30.00
Gross price	13.00	100	11.50	79.13	60.00	100	80.00	100
Market cost	1.00 (1.00)	7.6	--	--	2.00 (2.00)	3.33	2.00 (2.00)	2.5
Market margin	5.50	42.43	5.00	34.48	37.00	61.67	52	65.00
Net selling price	12.00	92.30	11.50	79.31	58.00	96.66	78.00	97.5
Aggregators cum retailers Purchase price	---	--	11.50	79.31	--	--	--	--
Market cost	----	--	1.50 (1.00)	10.34	--	--	--	--
Market margin	---	---	1.50	10.34	--	--	--	--
Selling price	---	---	14.50	100	--	--	--	--
Consumers Meghalaya Purchase price	13.00	100	14.50	100	60.00	100	80.00	100
Price spread	1.00	--	3.00	--	2.00	--	2.00	--
Producers share	96.15	--	79.31	--	96.67	--	97.5	--

Annex II. Market margin, producers share, and price spread across different channels in Garo districts.

Particulars	Channel 1 (40%)		Channel 2 (40%)		Channel 3 (10%)		Channel 3 (28%)		Channel 4 (2%)	
	Rs/kg	%	Rs/kg	%			Rs/kg	%	Rs/kg	%
Farmers Cost of production	6.5	---	6.5	--	6.5		6.5	--	6.5	--
Cost of production value added	-	--	--	--	---	----	21	35.00	24	30.00
Gross price	13.00	100	11.50	79.13	11.50	79.13	60.00	100	80.00	100
Market cost	1.00 (1.00)	7.6	--	--	--	--	2.00 (2.00)	3.33	2.00 (2.00)	2.5
Market margin	5.50	42.43	5.00	34.48	5.00	34.48	37.00	61.67	52	65.00
Net selling price	12.00	92.30	11.50	79.31	11.50	79.31	58.00	96.66	78.00	97.5
Aggregators cum retailers Purchase price	---	--	11.50	79.31	11.50	79.31	--	--	--	--
Market cost	----	--	1.50 (1.00)	10.34	2.00 (1.50)	11.11	--	--	--	--
Market margin	---	---	1.50	10.34	1.50	8.33	--	--	--	--
Selling price	---	---	14.50	100	15.00	83.33	--	--	--	--
Whole sellers Purchase price	--	--	--	---	15.00	83.33	-	-	-	-
Market cost	--	--	--	--	0.50	2.77	-	-	-	-
Market margin	--	--	--	--	1.00	5.55	-	-	-	-
Selling price	--	--	--	-	16.50	91.67	-	-	-	
Retailers Purchase price	---	--	--	--	16.50	91.67	-	-	-	-
Market cost	--	--	--	--	0.50	2.77	-	-	-	-

Market margin	--	--	--	--	1.00	5.55	-	-	-	-
Selling price	--	--	--	--	18.00	100	-	-	-	-
Consumers Meghalaya Purchase price	13.00	100-	14.50	100	18.00	100	60.00	100	80.00	100
Price spread	1.00	--	3.00	--	6.5	--	2.00	--	2.00	--
Producers share	96.15	--	79.31	--	63.88	--	96.67	--	97.5	--

Annex III. Cassava Value addition Technologies from ICAR-CTCRI and other sources

Name of value addition	**Type of value addition**	**Stakeholders/Level of value addition production**	**Remarks**
High protein mini-papads	Secondary processing	Small scale unit	Flour based functional food, can be managed by small group of ladies.
Dietary fibre enriched mini papads	Secondary processing	Small scale unit	Flour based functional foods, can be managed by small group of ladies.
Cassava pop ups	Secondary processing	Small scale unit	Flour based functional foods, can be managed by small group of ladies.
Fried cassava chips with good texture	Secondary processing	Small scale unit	Tubers based, can be managed by small group of ladies.
Cassava Sooji (Semolina, Rava) and Kesari	Primary processing	Household unit/ restaurants	Snack foods, can be managed in a house.
Cassava Samosas and Bondas	Primary processing	House hold unit/ restaurants	Snack foods, can be managed in a house.
Cassava Cutlets	Primary processing	House hold unit/ restaurants	Snack foods, can be managed in a house.
Cassava crisps	Secondary processing	Small scale unit	Flour based fried chips, can be managed by small group of ladies.

Cassava pukkavada	Secondary processing	Small scale unit	Flour based fried chips, can be managed by small group of ladies.
Cassava sweeties	Secondary processing	Small scale unit	Flour based fried chips, can be managed by small group of ladies.
Cassava nutrichips	Secondary processing	Small scale unit	Flour based fried chips, can be managed by small group of ladies.
Cassava starch wafers	Secondary	Small and cottage level	Starch based fried food, can be managed by small group of ladies.
Cassava starch	Secondary	Small to big industry level	Multiple uses from food to textiles uses.
Cassava sago	Secondary/Tertiary	Small to big industry level	Popular food in North India.
Pre-gelatinized Starch	Secondary/Tertiary	Medium to big industry	Modified starch for textile industries.
Starch Esters	Secondary/Tertiary	Medium to big industry	They are also used in canned foods and frozen desserts.
Cross-linked Starch	Secondary/Tertiary	Medium to big industry	Surgical dusting powers, carriers, absorbents and ion-exchange resins. Used in textile sizing and in bakery products.
Oxidized Starch	Secondary/Tertiary	Medium to big industry	Used in food and textile industries.

Harvest and Postharvest tools for cassava developed at CTCRI

Name of the tool	**Stake holder/level of use**	**Uses**
Cassava harvesting tool	Farmers	Easy and faster in harvesting tubers
Cassava chippers	Farmers and small units	Easy and faster in making slices and chips for drying and flour making
Mobile starch extraction plant	Farmers and small units	Handy mobile field level use
Cassava raspers	Small starch units	For rasping tubers for starch production
Feed granulators	Farmers and small units	Preparation of animal feed in granulated forms
Liquid adhesive plant	Farmers and small units	Preparation of adhesives and gums