SUB SECTOR STUDY OF ORANGE IN MEGHALAYA

PREPARED BY: INSTITUTE OF LIVELIHOOD RESEARCH AND TRAINING (ILRT), 2014

SUBMITTED TO: MEGHALAYA BASIN DEVELOPMENT AUTHORITY (MBDA)

Institute of Livelihood Research and Training

IBDLP MEGHALAYA

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Table of Contents

Executive Summary

Orange is a major horticulture crop in Meghalaya with an estimated area of 8600 hectares under this crop reported in 2012-2013. The production is 40,600 MT giving an average of 4.7 MT/Ha – almost half of the national average. The estimation of area under cultivation, yield, value addition and market trends are hard to come by in Meghalaya, making it a further challenge to distil the problem areas and find solutions. The variety grown in the state, Khasi Mandarin (*Citrus Reticulata)*, is considered unique for its high sugar content and therefore well suited for further value addition including concentrates and packed ready-to-drink juice. Sadly, like most other agriculture crops, orange too is cultivated with sub-optimal package of practices resulting in productivity gaps and unrealized potential in livelihoods.

Availability of reliable budded saplings is the main reason for low adoption of good planting material. In some villages of Garo Hills, farmers did the budding themselves. While they were very adept at the budding skills, the rootstocks were often obtained from nurseries grown from randomly collected seeds and raised without much care. The nurseries are prone to pathogens such as Phytophthora.Considering the nutrients and soil chemistry of the land, a density of only 120 to 150 trees per hectare is prescribed for flat lands. Corrected for the landscape of Meghalaya, the tree count per hectare should be only 75 to 100.Many parts of orange growing Meghalaya witnesses high acidic nature of soil with pH ranging from 4.6 to 5.5. Most of the farmers we met and interacted with did very little in terms of countering the high acidity.

The estimates of wastage or spoilage (as the difference between total production on the tree and the quantity of production for which market price was realized) ranges from 5% to 15% based on the location and the month of the year due to harvesting practices, storage practices, and transportation modes.Being a seasonally harvested crop, orange cultivators are grappling with rather widely fluctuating market prices. The vulnerability to price volatility has certainly impacted the attitude of farmers towards orange as a reliable source of livelihood. That is the central cause for the widespread adoption of low-input-low-return-low risk model by farmers.

The current value chain situation is quite elementary and poorly evolved. As is the case with most such poorly evolved value chain, the returns and control of the value addition and returns rests with players other than the farmers. The traders, the public extension agencies, input suppliers and processors are able to secure their stakes and investments much better than what a farmer can do. Other players are able to hedge their risks through diversifying either their channels or commodities itself.

The study points out the lack of an integrated approach to input supply. There is need to closely integrate extension and advisories services of the department with the suppliers of planting and plant protection material. The second deals with the absence of persistent and consistent hand holding support to the farmers when a new package of practices are introduced. It is well known that the relationship between extension

messages and adaptation is intrinsically linked to the spatial and temporal consistency in the extension messages.

A systematic study, including quantitative and qualitative aspects of orange sub-sector, will generate information that can then be fed into an institution design process and shape the broad parameters of an organization that will promote the interests of orange growers.

The involvement of organized private sector is almost miniscule in the orange in Meghalaya both in volume and product range. Undertaking these processing activities is best done by competent private sector players who not only have the wherewithal to estimate supply and demand conditions but also be more efficient in setting up units that will optimise the supply and demand opportunities. Branding and marketing efforts through the Meghalaya Trade Promotion Organization (MTPO) targeted at institutional buyers will also ensure sustainable production and cash flow estimation for orange grower associations in the state.

Objectives and Methodology

Institute for Livelihood Research and Training (ILRT) is partnering with the Meghalaya Basin Development Authority (MBDA) in providing capacity building support to the project staff in 8 identified blocks out of 39 blocks of the state in enterprise promotion. As part of the project, ILRT undertook livelihood mapping in the seven blocks and identified potential sub-sectors. A further in depth study of these subsectors will be undertaken to understand the livelihood gaps, identify potential for opportunities to improve the sub-sectors and provide recommendation to the state Govt. The core idea of undertaking these sub-sector studies is to assess the opportunities to bring local communities in to the fold of sub-sector, so that the sub-sector gets strengthened at one hand and the livelihood choices are enhanced.

The specific objectives of the study are to:

- understand existing players and their practices/ contribution for improvement of the sub-sector activities
- assess the gaps which are preventing to perform effectively with specific reference to the primary producer
- recommend implementable solutions to enhance the stake of primary producers in the sub-sector

Scope of the Study

To study Bay leaf sub-sector in the state of Meghalaya covering the following parameters:

- Document existing practices of the sub-sector covering the pre-production, production and post-production stages
- Assess the current status of the sector which will include the number of people engaged in the activity, estimated annual income from the activity, contribution of the activity to the overall income portfolio of the household, current market structure and key players
- Understand the existing market situation and nature of relationship between different market players in the study area (relationships, attitudes and behaviors).

Understand the capacity of producers and their organizations (POs) to access services, credit, information and resources.

Methodology

The following methodology was employed (but not limited to) during the assessment.

Literature Review

Review the existing markets in the state and market regulatory and price control policies and/or laws and mechanisms, any documents on market trends in the target area and any other relevant literature where possible.

- Developing the sub-sector map and map different players in each stage beginning from input supplier to consumer.

- Analysis of subsector dynamics

The analysis focuses on eliciting the information (i) existing practices by different players at each level, (ii) Gaps (iii) opportunities for interventions. Map potential local and regional markets in terms of type, size and volume of market, goods sold and bought, supply chain, type of producers, suppliers and vendors, women led businesses/trades, distance of the market from the target project villages, mode of transportation, market associations/trade organizations, security arrangement/situation especially for women and competitiveness (number of producers/suppliers /vendors versus items in demand).

Study Tools

- Producer interview/ interaction in the primary orange growing belt of the Khasi and Garo hills region.
- Focus Group Discussions (FGDs) with producer groups/ producers
- Semi-structured interviews with Key informants and stakeholders

1. Overview of the subsector

Among the citrus fruits grown in India, Mandarin takes the single largest share at 42% with a total production across the country of 56 lakh tons. Orange is also the third largest fruit sub-sector economy after mango and banana. Over 563,000 hectares of land is put to orange cultivation. The national productivity average at 9.3 MT/ha. Globally, despite having the second largest area under orange, India is a minor player with only 7.6% of the global production coming from the country. The main reason is the low productivity. Against a global average productivity of 16.3 tons/hectare, India performs very poorly at 9.3 MT/Ha. However, an encouraging trend was witnessed in the last decade when the area and production doubled from 249000 hectares to 560,000 hectares and 25.7 lakh tons to 56.1 lakh tons respectively. While production increased, the productivity registered negligible change.

What hold true for orange cultivation in India vis-à-vis the global trend, is true for Meghalaya vis-à-vis India. Orange is a major horticulture crop in Meghalaya with an estimated area of 8600 hectares under this crop reported in 2012-2013. The production is 40,600 MT giving an average of 4.7 MT/Ha – almost half of the national average. The estimation of area under cultivation, yield, value addition and market trends are hard to come by in Meghalaya, making it a further challenge to distil the problem areas and find solutions. The variety grown in the state, Khasi Mandarin (*Citrus Reticulata)*, is considered unique for its high sugar content and therefore well suited for further value addition including concentrates and packed ready-to-drink juice. Sadly, like most other agriculture crops, orange too is cultivated with sub-optimal package of practices. The result is a huge gap in productivity and a livelihood that has tremendous unrealized potential to be a mainstay for many households. As the following sections will detail, the problem ranges from availability of good planting material to under-developed post-harvest value chain development. The combined effect of all these problems is the grossly under-realization of economic value of this produce and a glaring loss of opportunity to improve the livelihoods of many tens of thousands of households in all three regions of Meghalaya. Though the variety comes under the broad Citrus Reticulata species, the local adaptation of it is considered distinctly different from other known varieties in the region and country and therefore a candidate to be listed as a Geographically Indicated species[1] (on the GI list) which gives the producers even better opportunity to develop the subsector into a niche production and economic development activity.

[1] Geographically indicated (GI) species enjoy some monopolistic protection. The produce and its value added products enjoy unique branding. No other similar product can use the brand name or species name in their production and marketing process.

Market

Market information for orange in Meghalaya has not been collated for many years. Data gathered from sample villages and growers indicate that the market for oranges in Meghalaya is rather dispersed between local small town market places and bigger town exchanges where traders do some bulk buying. However, the practice of pre-harvest sale is quite common in the state. Data pertaining to this practices is also hard to come by. The three major channels of market for oranges are:

Producer to local retail market

Small land holders of less than 300 trees prefer to sell their harvest themselves in the local market in smaller quantities spread evenly across the fruiting season. The price is quite steady for most of the season with some occasional spikes due to momentary disruptions in the production in the region. This can happen due to inclement weather induced damages or large scale pest attacks. In 2013, the prices obtained in the local retail market (at Rongram) by the farmers in Garo Hills ranged from Rs 2.00 to Rs 3.00 per fruit. At the same time farmers in Khasi Hills obtained a price ranging from Rs 3.00 to Rs 5.00 per fruit in their local markets like Pynursla. During the early and late harvest period, the farmers carry the produce to the market at their own cost and effort. Gunny bags weighing approximately 50 to 60 kgs are loaded on to jeeps/pick-up trucks that double up passenger vehicles and cargo transport. Depending on the distance to the nearest market, the farmers pay up to Rs 0.20 per fruit on transportation. However, during the peak season, when volumes are larger, traders from the these markets as well as from outside the state come into the villages and buy larger lot. They use pickup trucks to take it to either the nearest local market or, as is perhaps more frequent, to bigger markets outside the state such as Goalpara, Guwahati to the north and Silchar and Agartala to the south. The price offered by these traders range from Rs. 1.80 to Rs 2.50 per fruit at the farm-gate.

Pre-harvest contract between producer and traders/contractors

This is a practice witnessed more frequently in villages from Khasi Hills and Jaintia Hills than Garo Hills. The contractors are predominantly from outside the district and even state, though the last few years have seen the emergence of local entrepreneurial individuals who do that. The contract is drawn up sometime between February and May. Once the contract is firmed up, money changes hands and the responsibility of upkeep, plant care and protection also transfers from the grower to the contractor. The contractor may or may not place a supervisor to oversee the growth and later the harvest and transport to the market. This practice gains popularity whenever they farmers have faced distress the previous year due to large scale crop failure and loss. The terms of contract is heavily stacked in the traders favour. For example, A farmer in Sasat Sakhaladuma Village near Rongram contracted out his entire plantation of approximately 900 trees for Rs 40,000 to a contractor from Guwahati. He admits that

the contractor made a windfall profit from this deal because he counted 4 truck-loads of oranges being shipped out from his plantation during the harvest. At 15000 oranges to a truck, the total estimate of production from his 900 trees was 60,000 oranges. At a rate of RS 3.00 per orange that was the market price that year, the contractor is likely to have earned a gross sale price of Rs. 180,000 and a net of about Rs 125,000 after accounting for the payment to the farmer and other upkeep and transportation costs.

Procurement by agents for processing and value addition

The quantity of orange that finds its way to various value added products is estimated to be a minor proportion of the total production. There are two state owned orange concentrate and ready-to-drink juice extraction plants in the state that procures oranges from farmers in East Khasi Hills and Garo Hills. The plants are located in Shillong and Tura. Both are more or less of the same installed capacity and can process less than 50 MT of various horticulture products, of which one is orange. There are four to five smaller units in the private sector that does similar value added products. Therefore, out of the total production in the state, the share of oranges that goes into this value added products (Concentrate, ready-to-drink juice and jam/marmalade) is likely to be miniscule. The state plants invite tender bids from private traders who offer to do the procurement from the farmers and supply to the units through annually awarded contracts. The contractors do some sorting and grading prior to supplying to the plants.

As a share of the total production, very negligible quantity of orange is sold by the grower directly to consumer as fresh fruit. Yet, it is not uncommon to find many of them, particularly women, set up stalls on the road side and market places to sell directly to consumers. The price paid for this is closer to Rs 5.00 per fruit. This might appear to be significantly higher than other bulk selling channels. However, the direct and indirect costs are quite high in terms of transportation to the market place, cost of space, time spend at the stall etc. There are no known collective effort by growers to pool their produce and set up more organized stalls to cater to this segment of the market. The markets available for such direct sale to end consumers in given in Annexure 2.

Poor sorting and grading is a serious constraint that prevents the producers from getting a fair price. There is an Act, though very archaic, that can govern and have the potential to compel both producers and the traders to fair pricing of the produce based on grading (Agricultural Produce (Grading and Marking) Act, 1937 (Act No. 1 of 1937) as amended up to 1986).

Employment

Even though the horticulture industry has proven to be lucrative for producers as well as other value addition players, it was surprising to observe that very few farmers considered orange cultivation to be their mainstay pre-occupation. As a matter of fact, the labor inputs for tending to the trees and dealing with pre-production, production and post-harvest stages were disproportionately low when compared to the current income they receive from orange sales. One would expect a more planned and substantive labor inputs to increase production and in the process the income. There were a number of farmers who are keen to contract out their plantation to value chain players from outside the block, district or even state on a lump-sum basis. Therefore it is hard to estimate the employment generated by orange sub-sector. As described in the sections on various production stages, the peak labor requirements happen during soil works and during harvesting. There are no statistics available on the paid labor deployed for these activities. However, the information gathered from orange growers from the three region indicate that an estimated 10 person-days of paid labor is required per hectare of orange crop per year. That translates into about 80,000 person days of paid wage earning opportunities generated by orange sub-sector. This obviously is a small percentage of total employment because the bulk of the plantation management responsibilities are shouldered by family members of the farmer. It is hazardous to estimate the quantum of this labout inputs.

Employment generation figures from other stages of the orange value chain is also hard to come by and estimate in the absence of verified information about the extent of value addition that happens in the state and outside the state. However, the fact that local markets do carry Khasi mandarins along with imported oranges (mostly from Maharashtra) this commodity do contribute to employment generation through supply chain players. Since a significant portion of state production finds its way to Bangladesh and other neighboring states for retail sales and processors of orange concentrate, there are jobs dependent on orange cultivation.

2. Preproduction stage

2.1. Planting material and propagation

While both seed and vegetative means of propagation are seen in the state, for reasons of economics, the vegetative method is preferred. The predictability of true-to-type plants, uniform quality, regular and early bearing characteristics are some of the advantages of vegetative propagation. Most popular method of vegetative propagation is budding. The desired variety and quality of orange is chosen (referred to as scion variety) to be budded on a citrus rootstock from a nursery. Clonal purity, good physiological vigour and yield potential are some of the quality traits considered while choosing the bud material. Though this method has distinct benefits, the adoption of this practice is not the norm. Poor supply of reliable budded saplings from either centralized nurseries operated by Horticulture Department or few private parties is the main reason for such low adoption of good planting material. In some villages of Garo

Hills, we came across farmers who did the budding themselves. While they were very adept at the budding skills, the rootstocks were often obtained from nurseries grown from randomly collected seeds and raised without much care. The nurseries are prone to pathogens such as *Phytophthora.* Containerized nurseries that can reduce this problem, is however quite expensive to set up and therefore very rarely done outside of state horticulture centres.

The sector faced another threat in the form of imports of cheaper but poor quality seedlings into the state. Assam is the main the source and often the saplings are available for a price as low as Rs 5 against Rs 40 to Rs 60 that a budded or grafted Khasi Mandarin Variety of sapling costs locally. This makes it an attractive proposition for farmers while replacing senile trees and in the process compromise the quality of productions for year to come.

The recommended practices of raising nurseries and budding process is given in Annexure 1.

2.2 Soil Management

The second major factor that influences the health and productivity of orange is the soil fertility. In the absence of any significant effort to balance soil nutrition, many parts of orange growing Meghalaya witnesses high acidic nature of soil with pH ranging from 4.6 to 5.5. Most of the farmers we met and interacted with did very little in terms of countering the high acidity. Indeed, no farmer were aware of the impact of acidic soil on nutrition and production of the tree. As a matter of fact, they only knew that the soil is certainly lacking the right chemical-physical composition for good orange production, but knew little or nothing about improving the soil fertility through fertilizer or manure application. Neither did they know that the acidic nature of the soil can be partially neutralized through application of lime. A study by National research Centre for Citrus, Nagpur The table below gives the range of pH monitored by the study team of scientists from NRCC. The table also gives the range of N,P, and K content from the same samples. Annexure 1 gives the analysis of soil fertility constraints, probable causes for it and possible resolutions.

S. No.	Sample details (Location)	pH	Soil fertility status (mg kg^{-1})						
			Macronutrients			Micronutrients			
			N	P	K	Fe	Mn	Cu	Zn
1	Umsing, Ribhoi	4.84	354.4	4.2	527.5	89.05	20.28	1.73	4.14
2	Burnihat, Ribhoi	5.30	330.6	9.7	215.2	91.32	16.45	1.34	1.11
3	Cheiruphi, Jaintia hills	4.64	210.0	4.2	165.5	114.71	12.75	1.69	1.17
4	Lyngkian, Jaintia hills	5.10	244.0	3.9	131.6	126.30	31.60	1.02	1.04
5	Nohwet, East Khasi hills	4.75	308.0	4.3	167.0	151.83	28.87	0.62	3.11
6	Wakhen, East Khasi hills	5.55	350.0	7.0	321.0	107.30	14.87	5.20	3.13
7	Shella, East Khasi hills	5.39	280.0	7.3	138.5	124.02	24.23	1.65	2.46
8	Chandigre, Tura West Khasi hills	4.83	336.0	5.2	178.0	97.01	12.81	1.91	1.41
9	Sukhl-Adhuna, Tura, West Khasi hills	5.12	209.6	7.1	333.5	139.11	29.22	1.22	1.92
10	Sesatgre, Tura, West Khasi hills	5.36	348.0	8.2	334.5	100.50	41.70	2.54	4.93
11	Daribogre, Tura, West Khasi hills	5.13	338.0	7.6	426.0	146.90	23.28	1.02	2.75
12	Williamnagar, West Garo hills	5.10	224.1	6.8	212.0	121.30	18.14	0.92	1.20

2.3 The inputs

The earlier section on planting material discussed the handicap that farmers are saddled with right from the first stage when they use weak planting material. The unorganized supply of seedlings of budded or grafted orange is the major bottle neck. The problems continues even after this. The farmers have an acute need for manure and fertilizers along with plant protection measures, absence of which could mean a reduction in productivity of up to 50% of the potential for the region. A separate section of diseases will deal with the impact of various untreated pathogens have on productivity. The farmers did not show any evidence of use of any pest control measure, let alone integrated pest control that the department is striving to popularize.

Among the critical inputs that are essential for orange crops, the most notable absence in terms of organized input supply is for planting material, lime for tackling acidity, vegetative or farm yard manure for enriching the soil fertility, and pest control consumables and tools. In that sense, the orange cultivation is, with few exceptions, an example of low-input-low-value-low risk agriculture system. This may be a rational choice for small land holders, indebted farmers and those who have other more significant source of livelihood other than orange.

2.4 Finance

Finance is a constraint faced by rural Meghalayans in general and orange cultivators are no exception. However, it will be an unsubstantiated claim that access to finance is a significant bottleneck in the growth and prosperity of the farmers. As mentioned in the section on planting material, it is known that farmers would prefer to buy low cost seedlings brought in from Assam. But it cannot be characterised as a response to lack of finance. Rather it is a poor appreciation of the connection between good planting material and the health and productivity of the tree. Availability of term loans for serious commercial orange cultivation as a main livelihood source may perhaps serve as an incentive for farmers to move from low-cost-low-risk production paradigm to a well-managed optimum input paradigm.

At the farm level the key constraint may not be finance. However, the same cannot be said for other value addition processes and players. Investment in sorting, grading and packing, for example, will not only provide a “pull” factor for the producers, but also leverage competitive markets, reduce spoilage and transportation costs. Entrepreneurs or private sector players, who are keen to undertake transparent post-harvest value addition do not have access to finance. Some of the serious problems that could be alleviated through availability of capital are:

Distress sale by farmers due to poor holding capacity.

High post-harvest costs (both direct and indirect) due to high transportation costs and high spoilage.

Depressed market pricing due to seasonality and glutting of the market.

Exploitative value chain players who benefit from poor value addition in terms of sorting, grading and packing.

3. Production Stage

3.1 Agronomic Practices

The first deviation from the prescribed practice starts from the very stage of planting. The spacing is often 4 meters by 4 meters in most organized orchards with low gradient land. For higher gradients and highly undulating or eroded lands, the spacing is much more irregular with close clustering of trees on plane area and sparsely on undulating or eroded areas. Alternately, we can consider that the effective area under orange cultivation is only about 60% of the total land area. Therefore, despite such high density planting, the actual tree count is only of about 200 per hectare. Considering the nutrients and soil chemistry of the land, a density of only 120 to 150 trees per hectare is prescribed for flat lands. Corrected for the landscape of Meghalaya, the tree count per hectare should be only 75 to 100. The trees therefore start with an unhealthy competition for nutrients right from the sapling stage, compromising its ability to bear fruits for rest of its useful life.

High slope land aggravates this nutrient deficiency when erosion takes top soil away due to poor land management practices. Deep rain cuts and gully formation could be seen on many orchards located on sloping land. Soil conservation measures that not only arrest the soil erosion but also enhance moisture retention has known to give extremely positive results on productivity of all crops including horticultural crops such as orange. However, very few farmers have taken the initiative to build such structures or adopt sound land management practices.

Even though the practice of replacing senile trees with budded or grafted sapling is gradually catching on, it is still way below the required level. As a result, the use of untested and often unhealthy root stocks impacts the gestation period before the tree yields marketable oranges. Until then, the tendency is to give minimal plant care inputs such as soil works, pruning and soil enrichment. Less than 20% of the farmers interviewed did little by way of any of these practices during the gestation period. The outcome is quite unfortunate in that it not only delays the maturing process but also results in grossly stunted growth of the trees and a direct impact on the fruit yields.

Orange farmers almost always do some inter cropping with oranges. While this practice, of itself, is very useful both economically and from nutrient balance point of view, the high density trees does not lend itself to this advantage. On the contrary, the crop that is raised between the trees end up competing with the trees for nutrients and sunlight. With recommended space of 6 meters by 6 meters, intercropping with legumes, coffee and arecanut makes good economic sense.

Less than 5% of the orange farmers contacted for this study provided any kind of irrigation to the trees. This has had notable impact on the productivity and growth of the trees particularly during the fruiting stages. On occasions when the rainfall is deficient, the impact of moisture stress is even more pronounced in terms of productivity.

Provisioning of irrigation is beyond most orange farmers' financial capability. The supply side of the water for irrigation poses special challenge due to the topography and intra year rainfall distribution. Where minor irrigation projects do exist, they are in defunct state and therefore not available for orange cultivators. Under these circumstances, in situ moisture conservation is the most cost effective intervention to mitigate or even overcome the challenges posed during years of weak precipitation. Government sponsored micro-watershed programs make budgets available for precisely this work and therefore should be converged with an orange sector growth plans.

Diseases

The problems gets even more serious when there is a pest attack or afflicted by other pathogens. IN a study conducted in 2009, NRCC identified some of the major diseases that impact the production in a serious way. The table below summarises the main plant protection problems that affects the major citrus varieties including Khasi Mandarin production in Meghalaya.

Table 1. Main diseases affecting orange in Meghalaya

Location/Distt.	Cultivar	**Diseases observed/ remarks**
Umsaitining, Ribhoi	Khasi mandarin	Citrus greening, presence of citrus psylla adults, twig blight
Byrnihat, Ribhoi	Assam lemon, Khasi mandarin, Valencia	-
Cheiruphi, Jaintia Hills	Khasi mandarin	Foot rot, twig blight, powdery mildew
Mynkre nursery, Jaintia Hills	Khasi mandarin nursery plants	Scab (very severe)
Lyngkian	Khasi mandarin	Foot and root rot, Gummosis, Lichens and mosses
Nohwet, East Khasi Hill	Khasi mandarin	Foot and root rot, Gummosis, Lichens and mosses
Wakhen, East Khasi Hill	Khasi mandarin	Pink disease, Lichens and mosses, *Loranthus*
Dhorom Ichamati, Shella, East Khasi Hill	Assam lemon, Pummelo	Bacterial canker
Saikarpa, Shella, East Khasi Hill	Khasi mandarin	Foot rot, Lichens and mosses
Rangram Nursery, Tura, West Khasi Hills	Khasi mandarin – Primary and secondary nursery	-
Chandigre, Tura, West Khasi Hills	Khasi mandarin	Scab, Lichens and mosses
Sakhl-Adhuna, Tura, West Khasi Hills	Khasi mandarin	*Loranthus*, Lichens and mosses
Sasatgre, Tura, West Khasi Hills	Khasi mandarin, *Citrus indica*	Pink disease, Lichens and mosses, citrus greening, *Loranthus*
Dorabogre, Tura, West Khasi Hills	Khasi mandarin, *Citrus indica*	Lichens and mosses, citrus greening

Even though it is one of the main cause for poor productivity and loss of trees, the awareness of diseases amongst the farmers is surprisingly low. Afflicted trees are considered to be a result of only poor soil quality and inadequate management practices. The outreach of the Horticulture department is quite weak and at most places non-existent and therefore, farmers are left to their own devices to observe and interpret the problems posed by diseases. This sets up a situation where ill-informed

people introduce unscientific reasoning. In one village, the farmers were convinced that the trees are wilting because of increased use of cell phones!

The major diseases of citrus in the state were identified as: Fungal diseases viz., foot and root rot, crown rot and gummosis (*Phytophthora spp*.); twig blight (*Botryodiplodia theobromae, Colletotrichum gloeosporioides*); citrus scab (*Elsinoe fawcettii*); powdery mildew (*Acrosporium tingitaninum*); pink disease (*Corticium salmonicolor*); felt disease (*Septobasidium spp*.); sooty mould (*Capnodium citri*) and bacterial diseases viz., Citrus canker (*Xanthomonas axonopodis pv. citri*) and citrus greening (*Candidatus liberibacter asiaticus*).

There are no statistics on annual loss of trees due to senility or irreversible damage due to pests like stem borer. Information gathered from farmers indicate that every 2 to 3 years, the farmer loses 1 to 3% of their trees to diseases and pests such as stem borer. In most cases the farmers manually exterminate the diseased trees from uprooting and destroying them to prevent its spread. Despite these measures it is common experience that, between the pests and pathogens, the trees suffer production loss in the form of poor fruit setting, early fruit drop at the bearing and maturity stage.

Whether or not orange cultivators should embrace modern chemical based pest control and disease management practices may be a moot point. A more environmentally appropriate package may be an approach to be considered in the long run, but the current state of production and problems associated with diseases will require conventional treatment options. Bio-control measures may eventually help orange farmers pitch their produce as more “greener” than their counter parts elsewhere in the country.

Production costs

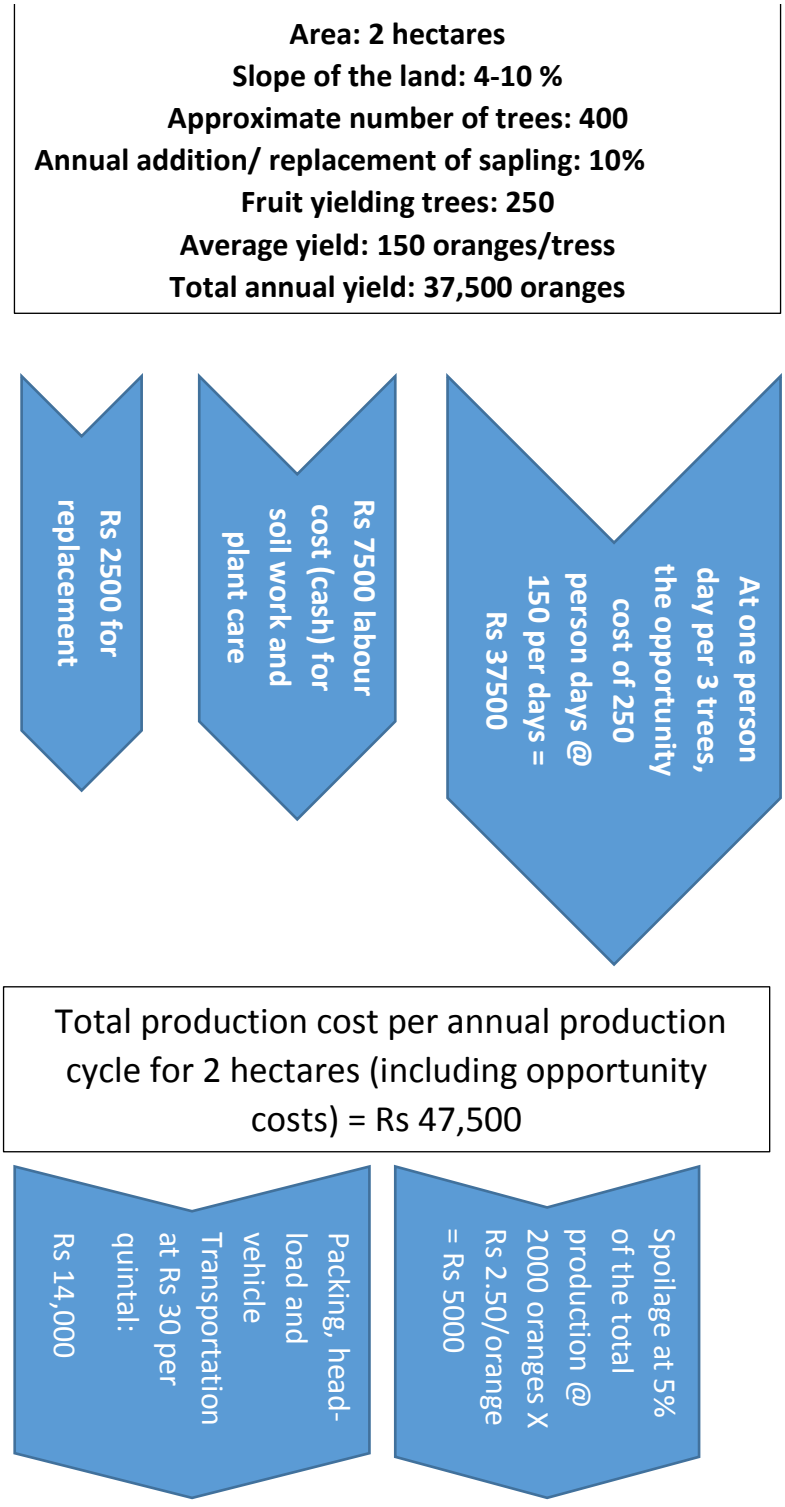
Production costs vary across locations in Meghalaya. In Garo Hills and Khasi Hills, the inputs are almost entirely non-market based. Jaintia Hills has some large farmers who have established orange orchards through planned investment and wage paid labour force. For a vast majority, the external input (i.e labour and material input source from outside their own household and for which the farmers has paid cash or kind). Much of farm level cost estimations have to be done using contingency value methods because a majority of orange farmers are outside any monetized supply chain for material inputs or labour during production stages.

We have seen in the section on diseases that the practice of taking plant protection measures is quite rare. However, farmers who have 500 or more trees do employ wage paid labour for weeding operations and soil work. Some of them do apply farm yard manure and turning over of soil at the root zone. Even rarer are farmers who do some training and pruning of trees in the first 3-4 years of the saplings life.

Between all these operations, a deployment of one person-day can manage 3 trees. Families with more adults members do not hire labour, but instead work themselves. Opportunity costs are factored into the calculations in the illustration shown below in Figure 1. It shows the cost of inputs, the deployment of labour, harvest and marketing costs. These cost figures assume that the farmer undertakes the entire management

operations and sell the harvest to a trader at the end of harvest. When the farmers chose to contract out the orchard, much of the costs are transferred to the contractor and correspondingly a lump-sum amount changes hands.

Figure 1. Cost benefit of orange cultivation (sampled from data gathered in Jaintia Hills)



4.Post Production Stage

4.1 Market Access

Like most of their fellow producers of other agriculture crops, marketing orange too is a costly process. As mentioned in the introduction to markets earlier in this report, a sizable proportion of orange harvest is marketed by contract traders who organize labour for upkeep of the last stages of production and for harvesting and transportation. For those who chose to take the produce directly to the market, the logistics are formidable. In extreme cases, which are not so rare, the farmers who live and farm in deep valleys have to carry sack full of oranges weighing up to 100 kgs on their back or as head load and climb steep hills. Some of the hills have gradient of 60 to 70 degrees and an elevation difference of more than 2000 feet making their arduous climb extremely hard. With the perishability of the produce, the option available to them are limited and therefore they are prone to high level of exploitation and distress sale when they get to the local markets. Even where road accessibility is available the transportation costs cut deep into the final sale price the farmers get. For distances of upto 15 kms, the farmers pay up to Rs 50 per bag of 50 kilograms. In many cases, the farmers have to transfer the bags from one vehicle to another, increasing the spoilage and further cutting into their net profit. One estimate puts the spoilage of up to 5% of the lot. The farmers have little or no time, space and opportunity to remove or disaggregate the damaged oranges from the rest, thereby constraining them while settling the sale price in the market. The Flow chart in Figure 1 above shows the farmer level cost benefit of cultivating oranges. It also gives an idea of the impact of current post-harvest realities in terms of price realization at the market.

4.2 Spoilage

The estimates of wastage or spoilage (as the difference between total production on the tree and the quantity of production for which market price was realized) ranges from 5% to 15% based on the location and the month of the year. There are three main factors that contribute to this:

Harvest practices: plucking oranges off the tree with bare hands and dropping on the ground causes the fruit to bruise. Further prematurely ripe oranges suffer more damage when it is pulled out (trauma to the central column) speeding up the degeneration process. The practices of twist-and-pull for ripened fruits or use of clippers is also not prevalent.

Storage/packing: The most popular packing for transit or storage is jute or plastic woven bags. This causes squishing of oranges at the bottom of the bags and also at the seams when the bag is handled during transportation.

Transportation: Bags are loaded on to hard-floored pick-up trucks and jeeps. Uneven rural roads make the ride very bumpy and there is damage to the oranges. Unloading and loading at the market place is also rough.

4.3 Price volatility

Being a seasonally harvested crop, orange cultivators are grappling with rather widely fluctuating market prices. As the adjoining graph (Figure 2) gives the price offered by wholesale traders in Jowai market for oranges brought in by the farmers at the market.

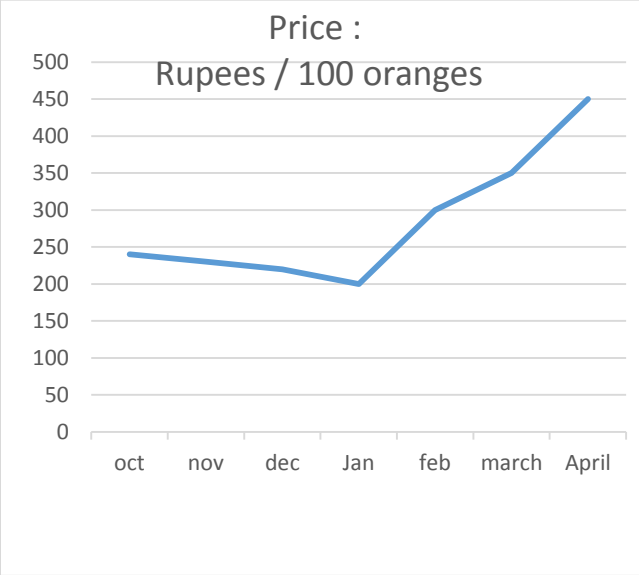


Figure 2. Seasonal prices offered by wholesale traders to the farmers at Jowai market.

As the graph indicates, the price is quite sensitive to the harvest cycle, with depressive tendencies during the month of December and January when the production peaks and results in a market glut. Fortunately, the problems in slightly mitigated because arrival of oranges in the market from within Jaintia Hills is slightly staggered due to climatic variations within the region. Some clusters of villages have early fruiting while others have delayed fruiting. Discussion with Horticulture scientists and review of literature suggests that the micro-climate variation and elevation are factors that allow for this spread of harvest seasons. The same phenomena is observed across the regions of Khasi Hills, Garo Hills and Jaintia Hills. Thus markets outside of Meghalaya too sees arrival of Khasi mandarin spread across December to March.

The advantages of such staggered harvest season notwithstanding, farmers do report high prevalence of distress sales or lease out or contracted. The contracting is done in the month of Late October or November when the contractor is able to make an informed estimate of productivity and market conditions. Typically the contract price offered is about 40% of what the farmer would get if they tended to the crop till harvest and sold it themselves. Of course, the two significant factors that influence the decision are (i) the ability of the farmer to mobilize money to meet the cost of labor for tree care, harvesting operations and marketing operations and (ii) the risk absorption capacity of the farmer in the event of (a) poor yield due to a variety of reasons and (b) market crash. With a poor track record in recent time of both these factors[2], it is therefore not surprising that almost 50% of the farmers from surveyed villages (who are serious orange cultivators) preferred to give their orchard to the contractors.

The vulnerability to price volatility has certainly impacted the attitude of farmers towards orange as a reliable source of livelihood. That is the central cause for the widespread adoption of low-input-low-return-low risk model by farmers. Taking

[2] Orange crop is said to fail at an alarming frequency and regularity once in a 3 or 4 year cycle perhaps due to one or more recurring pathogens. Similarly, market crash has also been experienced by farmers almost in the same frequency due to bumper crops not only in Meghalaya and North East, but also inflow of oranges from traditional belts in Maharasthra.

lessons from successful experiences with other perishable agriculture produces and knowledge base available, this vulnerability can measurably reduced by investing in value chain development and making orange farmer a key player in the process. The following section outline the current value chain and offers a model for improved value chain. The section after that looks at the current and potential institutional players whose role need to be defined or redefined to ensure better and fair returns to farmers.

4.4 Value Chain

The current value chain situation is quite elementary and poorly evolved. As is the case with most such poorly evolved value chain, the returns and control of the value addition and returns rests with players other than the farmers. The traders, the public extension agencies, input suppliers and processors are able to secure their stakes and investments much better than what a farmer can do. Other players are able to hedge their risks through diversifying either their channels or commodities itself. With much shorter investment-risk-return cycle, they are better placed to enter or withdraw from the value chain. Farmers have a much longer investment-risk-return gestation and are locked in once they invest and therefore very vulnerable to unfair terms of trade. The two figures below (Figure 3 and Figure 4) represents the current situation of value chain and a value chain as a result of a proposed institution of orange growers. The value addition and value chain players that farmers link up with immediately, namely input suppliers and farm-gate level buyers have been absorbed by the producers institution thereby increasing their leveraging ability through aggregation and value addition of sorting and grading.

A more detailed discussion the new institutional mechanism is given in the next session.

Figure 3. Value chain of orange as it exists today

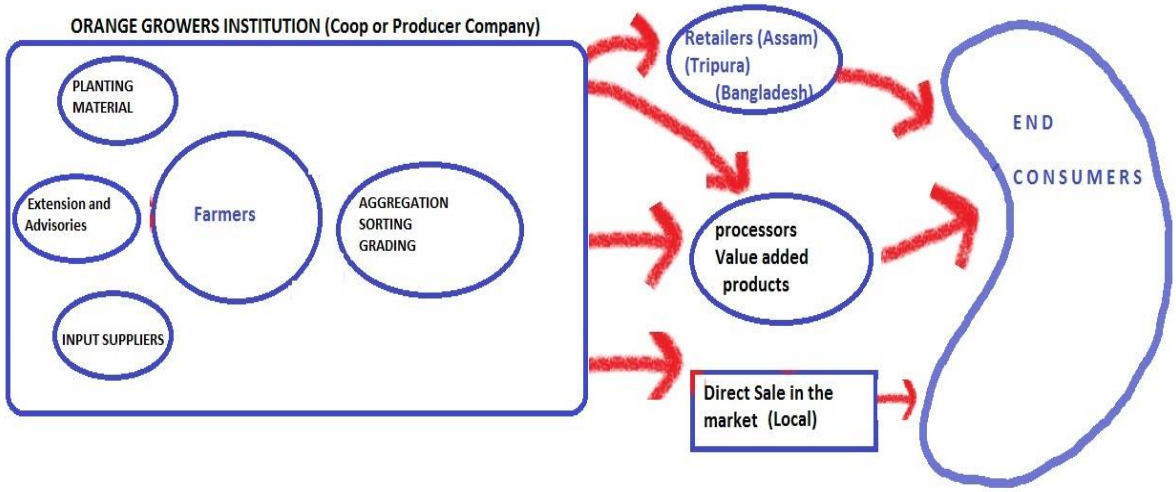


Figure 4. Value chain of orange under a proposed new institutional intervention with producers' institutions

5. Institutional Support mechanisms

Public resource have been deployed by the state Government to address some of the barriers and constraints faced by the farmers. A scheme to distribute subsidized planting materials from their centralized nurseries was intended to improve the quality of the trees as and when new plantations are considered or when farmers need to replace senile trees. However, the supply of these planting material falls far short of the demand and appears to be further held back by tedious bureaucratic processes. This was clear when, during the visit to multiple locations in Khasi Hills, Jaintia Hills and Garo hills by the study team, we came across no farmer who had received any saplings from the nursery. Some of them were, however aware of the scheme and also knew of some farmers who benefitted by it. They also acknowledged that the material from the centralized nursery gaven markedly better quality outputs than their own approach to propagation through seeding or purchased from un-regulated nurseries.

To deal with the low productivity, disease and pestilence, government has a scheme of providing bio-fertilizers, micro-nutrients, bio control agents and pesticides with Rs 120 per tree. Similarly, tools and implements such as sprayers, ladders, pruning implements, poly pipes, tanks and sprinklers are given at 50% subsidies. To impart knowledge and skills regarding package of practices, a grant based program for training makes available Rs 160 per farmer. Besides the state budgets, central funded programs under HMNEH (Horticulture Mission for North Eastern and Himalayan states) also makes available funds to the state horticulture departments to support among other fruit trees, orange cultivation. A scheme for one-time grant of up to Rs 15,000 is available for farmers willing to start a plantation of up to 0.5 hectare under orange.

The adequacy and outreach of these state sponsored and department-implemented schemes is grossly inadequate. The demand for these services far outstrip the supply. Besides the inadequacy of quantum in budget and human resource provisioning and accountability of existing public agencies, there are serious quality challenges too. The

first of the problems come from the lack of an integrated approach to input supply. There is need to closely integrate extension and advisories services of the department with the suppliers of planting and plant protection material. The second deals with the absence of persistent and consistent hand holding support to the farmers when a new package of practices are introduced. It is well known that the relationship between extension messages and adaptation is intrinsically linked to the spatial and temporal consistency in the extension messages. Currently, the supply of materials, advisories and follow up hand holding at the field level do not converge spatially. The events are sporadic, ill targeted and inconsistent for the farmers to really build up all these inputs into a coherent adoption of better practices and material.

Intuitive thinking will suggest that we reform the mandate and operating system of horticulture and other allied departments to make them farmer-centric and result oriented. However, with no precedent of such a transformative reforms in public agencies' functioning in Meghalaya and indeed in most parts of India, it will be almost futile to bank on such systemic changes. Instead, another approach is suggested here – an approach that is finding increasing acceptance among development managers as also producer communities --- that of transferring some of the key components of the value addition chain to formal institutions of producers. As depicted in Figure 4, the role of input supplier, provisioning of extension services and value addition activities such as aggregation, sorting, grading and collective marketing can be created for a farmers' institution with suitable legal status and endorsement of the state.

5.1Orange growers organization

A systematic study, including quantitative and qualitative aspects of orange sub-sector, will generate information that can then be fed into an institution design process and shape the broad parameters of an organization that will promote the interests of orange growers. The spatial distribution of the orange production will decide the size and catchment area of such an organization and its portfolio of services it can offer in an economically and institutionally viable manner. As the graphic representation in Figure 4 suggests, the task of providing input supplies, advisories and support for post harvest value addition can be the beginning. Government schemes currently channelled through state departments can then be made available to such organizations who are known to deliver the services more efficiently and in a more accountable manner.

5.2 Private sector

The involvement of organized private sector is almost miniscule in the orange in Meghalaya. There are two Fruit Preservation units, one in Shillong and another in Tura, which processes fruits including orange through production of value added products like jam, concentrate and ready-to-serve drinks. However the scale of operation is so small and their capacity to cater to the overall production in the state is so small that it has no significant impact on the other players in the value chain. Moreover, the commercial viability of these units appear to be unclear because much of their operating costs are absorbed by government. The volume too is so small that their competitiveness in the market is currently untested. The same goes to the estimate of demand locally as well as outside the state for the value added products.

Undertaking these processing activities is best done by competent private sector players who not only have the wherewithal to estimate supply and demand conditions but also be more efficient in setting up units that will optimise the supply and demand opportunities. The state must ensure that the private players perform their role in the value chain in a transparent and fair manner and comply with not only state laws but also universally accepted safeguards for environmental and labour standards.

Annexure 1

Soils of the areas mentioned above are highly acidic in nature (pH 4.69- 5.55) (Table 2). Under such a low soil pH existing in Khasi mandarin orchards of Meghalaya, the proper nutrition of citrus trees is a big question mark in the total absence of the practice of lime application, the menace of which is further magnified in the absence of any regular fertilizer/manure application (Srivastav and Singh, 2007).

The problem of Al- toxicity in these soils of pH less than 5.0 is another prominent problem as observed at Nohwet, East Khasi hills and Chandigre, Tura, West Khasi hills. The suberisation of walls of roots with corky appearance of root cells which eventually gives root morphologically more thickened in appearance with many dead spot is the major change induced on account of Al-toxicity. Such symptoms can be frequently observed at locations like Cheiruphi, Jaintia hills; Nohmet, East Khasi hills; Chandigre, Tura etc. those having soil pH 4.64-4.83. However, a very few citrus orchards practice fertilization, mainly in the form of organic manure or some Ca based fertilizer (e.g., Khasi mandarin orchard visited at Umsning,

Ribhoi district). Therefore, before any fertilization programme is undertaken, soil amelioration holds the prime concern which needs to be mitigated first.

Based on the above, soils are well supplied with available N content ranging from 210.0 mg kg-1 Cheiruphi, Jaintia hills to as high as 354.4 mg kg-1 at Umsning, Ribhoi with all the sites displaying N sufficiency in available supply level. While, all the orchards except the ones at Jaintia hills under investigation were rated as optimum in available P, suggesting that orchards are being established under the soil conditions featuring sub-optimum supply of P. The deficiency in available P is ascribed to a large scale fixation of P by excess of polymeric Al3+ ions due to highly acidic soil pH. The mineralogical build-up of these soils is predominantly illitic-kaolinitic with adequate available K from as low as 131.6 mg kg-1 at Lyngkian, Jaintia hills to as high as 527.5 mg kg-1 at Umsning, Ribhoi showing a huge variation primarily on account of altitude, which eventually affects the soil depth, ratio of coarse to fine particle size, leaching of nutrients, and proportionate ratio of illite to kaolinite. These factors are further conditioned by the amount of rainfall vis-à-vis slope and soil profile development in relation to altitude. However, potassium is a nutrient which ensures the build up to acidity to total soluble solids, firmness of fruit besides the possibility of influencing the time of fruit maturity, cannot be grossly overlooked.

The key element like K requires to be watched more closely. Therefore, site specific K management is recommended instead of declaring an area or location covering a number of orchards deficient or sufficient in K fertility. Micronutrient nutrition in Khasi mandarin orchards established on acid soils offers an entirely different management strategy to those adapted under alkaline/calcareous soil conditions. Available Fe and

Mn were observed varying from 89.05 mg kg-1 at Umsning, Ribhoi to 151.83 mg kg-1 at Nowhet, East Khasi hills and from 12.81 mg kg-1 at Chandiagre, Tura to 41.70 mg kg-1 at Sesatgre, Tura, respectively. Such limit of Fe is considered to be excess and must pose symptoms of toxicity. The symptoms of Fe toxicity was observed in form of excessive defoliation, thereby, plants remain without well developed foliage during most parts of year. Such toxicity of Fe also imparts reduction in fruit yield unless soil pH is amended gradually from 4.5 to about 5.5 in the first phase and to 6.0 in next phase through an expeditiously followed lime application (Srivastava and Singh, 2005). The other nutrient, Cu is sufficient in all the locations. Zinc is the single most important micronutrient compared to other micronutrients, which not only influence the amount of flowering but their ultimate fruit set intensity. The available Zn in the areas surveyed varied from 1.04 mg kg-1 at Lyngkian, Jaintia Hills to high as 4.93 mg kg-1 at Sesatgre, Tura. However, all the orchards showed high level of DTPA Zn in soil on account of high organic matter content. It remains to be seen that despite such sufficient levels of nutrients like Mn, Cu and Zn in soil, leaf analysis supports these levels.

Soil microbial analysis: Soil microbial population is considered as one of the most sensitive tools of soil fertility evaluation since the microbial load of soil is most affected as a result of any management practice. The total bacterial count was observed maximum (155x104 cfu g-1) at Umsning and minimum (90x103 cfg g-1) at Cheiruphi, Jaintia hills, indicating that former is treated well with manurial application (Table 3). Most of

the locations were comparatively lower in bacterial count despite the fact that on other sites, no regular manurial application is followed. Similarly, fungal count also showed a large variation from 50x103 cfu g-1 soil at Nohwet, East Khasi hills to as high as 191x103 cfu g-1 soil at Umsning, Ribhor. These variations are indicative of soil organic carbon content, which eventually governs the soil microbial build-up and other soil fertility transformations. These bacterial and fungal counts were well correlated with available supply of nutrients like N, P, Zn, etc.

Table 3: Microbial population (0-20 cm) of soils collected from different Khasi mandarin orchards of Meghalaya.

S. No.	Sample details (Location)	Microbial analysis count (x 10^3 c.f.u g^{-1})	
		Bacterial population	Fungal population
1	Umsing, Ribhoi	55*	91
2	Burnihat, Ribhoi	101	68
3	Cheiruphi, Jaintia hills	90	89
4	Lyngkian, Jaintia hills	104	61
5	Nohwet, East Khasi hills	161	50
6	Wakhen, East Khasi hills	210	130
7	Shella, East Khasi hills	200	116
8	Chandigre, Tura West Khasi hills	280	89
9	Sukhl-Adhuna, Tura, West Khasi hills	289	150
10	Sesatgre, Tura, West Khasi hills	98	165
11	Daribogre, Tura, West Khasi hills	289	160
12	Williamnagar, West Garo hills	121	111

* (x 10^4) c.f.u. stands for colony forming units.

Suggested fertilization: Before applying any fertilizer, a regular application of preferably dolomite/lime at the rate of 2-3 kg tree-1 depending upon initial soil pH must be applied in the month of September-October. Efforts should be made to place the dolomite/lime below 10-15 cm to augment the subsoil acidity. After 20 years of orchard age, the amount of lime should be doubled as 4-6 kg tree-1 due to expansion of root zone and concurrent neutralization of soil acidity. The various nutrients such as N, P, and K may be supplied using calcium ammonium nitrate/urea, rock phosphate single super phosphate, andmuriate of potash, respectively. The micronutrients such as zinc sulphate and borax may be used for supplying Zn and B, respectively. Fertilizers should be applied by making full moon terraces. The upper portion of terrace should receive fertilizer to facilitate the movement of fertilizers to the lower half along the gravity. The method such as this lessens the chances of leaching of applied fertilizers. The above fertilizer doses may be split into two, one half to be applied on lime/dolomite treated soil during March-April (just before rain starts) and other half during September-October. The other nutrients such as Mn and Cu need not to be applied, but should be kept under watch using leaf/soil analysis and applied as andwhen necessary.

Annexure 2

Block-wise listing of Markets in the State

Block Name	Market Name	Resubelpara	Bajengdoba
Amlarem	Dawki		Mendipathar
Baghmara	Emangiri	Ronggara	Maheshkhola
	Sibbari	Rongram	Ronggara
Betasing	Ampati		Rongram
Chokpot	Chokpot		Tura
Dadenggiri	Dadenggiri	Samanda	Rongsak
	Romagal		Samanda
Dalu	Dalu		Williamnagar
	Purakhasia	Selsella	Garobadha Regulated Market
Dambo Rongjeng	Rongjeng	Shella-Bholaganj	Shella
Jirang	Jirang	Songsak	Songsak
	Patharkhmah	Thadlaskein	Jowai
Kharkutta	Adokgiri		Khanduli
	Kharkutta		Nartiang
Khliehriat	Khliehriat		Wahiajer
	Umkiang	Tikrikilla	Raksamgiri
Laitkroh	Laitlyngkot		Tikrikilla
Laskein	Raliang	Umling	20th Mile
	Shangpung		Byrnihat
Mairang	Kynshi		Nongpoh
	Mairang		Umden
Mawkyrwat	Mawkyrwat	Umsning	Umroi
Mawphlang	Mawngap		Umsning
	Sohiong	Zikzak	Kalaichar

Mawryngkneng	Mawryngkneng		Mahendraganj
	Smit		
Mawshynrut	Riangdo		
	Shallang		
Mawsynram	Mawsynram		
	Tyrsad		
Mylliem	Iewduh(Shillong)		
	Mawiong Regulated Market		
Nongstoin	Nongstoin		
	Rambrai		
Pynursla	Pynursla		
Ranikor	Balat		