

**Research Project
on
MARKET FEASIBILITY STUDY
FOR JACKFRUIT VALUE ADDED PRODUCTS**



by

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Introduction

1.1 About Jackfruit

The jackfruit is native to parts of South and Southeast Asia and is believed to have originated in the rainforests of Western Ghats of India and is cultivated throughout the lowlands in South and Southeast Asia. Major jackfruit producing countries are Bangladesh, India, Myanmar, Nepal, Thailand, Vietnam, China, Philippines, Indonesia, Malaysia and Sri Lanka. Jackfruit is also found in East Africa as well as throughout Brazil and Caribbean nations such as Jamaica. Jackfruit is the national fruit of Bangladesh and is one of the three auspicious fruits of Tamil Nadu in India along with Mango and Banana.

The Jackfruit is a multi-purpose species providing food, timber, fuel, fodder, and medicinal and industrial products. The primary economic product of Jackfruit is the fruit which is used both when mature and unripe. Every part of the fruit and tree has health and economic value. Jackfruit seeds (nuts) can be roasted like chestnuts, or boiled. The fruit pulp is sweet and tasty and used as dessert or preserved in syrup. The fruits and seeds are also processed in a variety of ways for food and other products. Jackfruit value added products include chips, papads, pickles, icecream, jelly, sweets, beverages like squash, nectar, wine and preserved flakes etc. Additionally, Jackfruit leaves, bark, inflorescence, seeds and latex are used in traditional medicines. The wood of the tree is also used for various purposes. It is a nutritious fruit that is rich in carbohydrates, proteins, potassium, calcium, iron, and vitamin A, B, and C. Due to high levels of carbohydrates; jackfruit supplements other staple foods in times of scarcity in some regions. The flesh of the jackfruit is starchy and fibrous, and is a source of dietary fibre.

Despite the richness, massive market potential, and unlimited number of benefits that Jackfruit provides, it's still an unorganized market, thus leaving many opportunities to foray & expand across India and worldwide with its untapped and innovative products that have a huge market scope and scalability.

Jackfruit remains an underutilized fruit species and deserves to be given the needed thrust for research and development. This report attempts to highlight the importance, benefits, potential, and marketability of select jackfruit products across the country and outside of it. It is also our humble attempt to educate, promote and influence masses, academia and relevant Government and Non-Government bodies/ lobbies to help spread the goodness of yellow, with the sole aim of creating and promoting a "Yellow Revolution" in all earnestness.

With a view to arrive at appropriate strategy for development of Jackfruit farmers and processing for value-addition, a study was commissioned by the National Institute of Agricultural Marketing, Jaipur

1.2. Methodology

Given the ambitious objectives of the study, a 'Market Survey Plan' was prepared covering information needs, data sources and primary data collection. An exhaustive list of information needs was prepared. The same is attached as Annexure I.

The information requirement was classified into primary data and secondary data so that sources could be identified. A matrix indicating the nature of information and its sources is indicated as a part of Annexure I.

Whatever information was available from published materials and websites, the same has been compiled. A list of websites has been depicted as a part of Annexure I.

Data compilation and analysis has been of 'qualitative' terms rather than using statistical tools. For, some data (exports for instance) is in 'aggregate' fashion.

1.3. Presentation:

The report that follows is divided into components as under:

- An Overview of Jackfruit and Value-Added Products
- Manufacturing and Distribution practices
- Domestic and International Markets
- Quality Standards
- Technology Support
- Development Initiatives – some illustrations

The final section of this report deals with building a strong Eco-System and suggestions on policy prescriptions. The report concludes with an outline of 'next steps' to be taken by NITTE.

2.0 Jackfruit & Value-Added Products: Introduction & Overview



2.1 Introduction

The Jackfruit (*Artocarpusheterophyllus*) tree of the mulberry family (*Moraceae*) is believed to have originated in the south- western rain forests of India. India is the second biggest producer of the fruit in the world and is considered as the motherland of Jackfruit. Chakka, its Malayalam name, according to some, has given birth to the English name Jackfruit. In India, it has wide distribution in Assam, Tripura, Bihar, Uttar Pradesh, the foothills of the Himalayas and South Indian States of Kerala, Tamil Nadu and Karnataka.

New technologies, and increasing moves by farmers and some Non-Government Organizations to popularize this fruit, through jackfruit festivals, are helping raise awareness regarding its production and economic value in its home country. While its rind is inedible, this starchy fruit with short spikes can be eaten in many ways, from on its own, when ripe and firm, to be a key component in curries, fried and freeze-dried and made into chips, and as a popular component of desserts. The wood of the tree is used for parts of musical instruments like Indonesia's Gamelan to the Philippines' Kutiyapi, a flute, and even India's Veena. The jackfruit has been ignored by countries where it grows enormously, but it is being used to mint dollars by nations such as China, Vietnam, Malaysia, and others. They are using the humble jackfruit to create value-added products to earn significant foreign exchange while others are happy either wasting the fruit or cutting down whatever Jack trees are remaining there.

2.2 Availability- Demographics

Commercial cultivation of jackfruit is still at a primitive stage in India, primarily because of the difficulty in procuring elite planting materials. In Meghalaya, Tripura, Assam and Arunachal Pradesh, jackfruit is the most popular fruit among the local fruits. The states offer huge potential and scope for jackfruit resource exploitation, production, and value addition owing to the availability of diverse local genotypes for several years and favorable climatic condition.

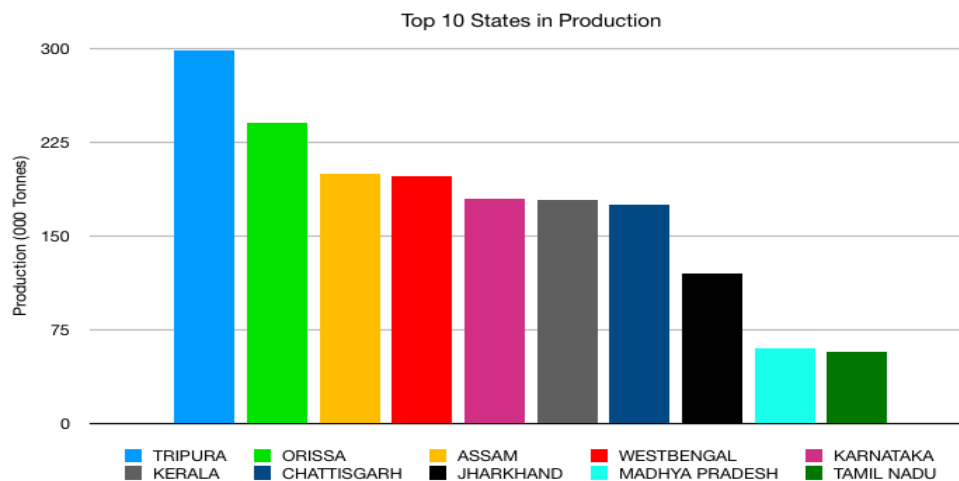
Jackfruit mostly grows as a scattered tree in India. Large-scale commercial cultivation takes place only in Panruti in Tamil Nadu where many people grow jackfruit as a mono-crop. Middlemen buy the fruit and take it to big cities such as Mumbai, Bengaluru, and Hyderabad.

In a few areas—for instance in Idukki district of Kerala and Tumkur in Karnataka it is available for ten months of the year. Though jackfruit is a neglected crop and generally looked down upon as a poor man's fruit, success stories around the fruit are slowly coming to light. Ms Vinutha P. Hegde of Sirsi, a housewife, has produced three tonnes of Jackfruit bar in the past five years. Shridhar Ogale, a Devgad-based farmer, is producing preserved tender jackfruit (phanasbhaji) for making vegetables. He is the first farmer to export

Jackfruit pulp to the UK for making ice-creams. He has recently also started marketing Jack seed. Ms Radhika, who used to be a daily wage earner, is running a very successful Jackfruit papad industry in Moodabidri, Karnataka. Jackfruit pulp making, preserved tender jackfruit - two technologies that are practiced in Maharashtra also have good scope for use in rural Meghalaya.

With these successes, the countdown for Jackfruit development has begun in the country. Kerala has adopted jackfruit as its State fruit. Many civil society groups have started organizing jackfruit festivals. In the past decade, about 75 jackfruit festivals have been conducted in Kerala and Karnataka, two in Tamil Nadu, one in Maharashtra and two in Meghalaya. With the growing awareness of health and nutritional properties of the fruit and sustained efforts of Jackfruit farmers and entrepreneurs across the country, it is anticipated that the Jackfruit will definitely become the most sought after fruit in the coming years.

People of the producing areas normally consume the ripe fruits and seeds locally with some quantity of fruits finding their way to the markets of Assam. However, due to the bulk and weight of the fruit and its perishability, long distance markets are unreachable and most of the fruit is left to rot in the orchards. In the Garo Hills, Jackfruit is a source of pig feed whereby pigs are tied to the Jackfruit tree and fed on the fruits that fall down. In some other parts of the State, the Jackfruit leaves are also used as goat and cattle fodder.



Following table provides data on the production of Jackfruit in Karnataka.

**Production status of jackfruit in Karnataka
(2017-18)**

District	Area (Ha)	Production (tons)	Productivity (t/ha)
Mandya	975	31344	32.15
Dakshinaannada	816	32571	39.40
Chikamagalore	687	25417	37.00
Udupi	533	23889	44.82
Belgaum	519	20760	40.00
Ramanagara	410	7775	18.96
Hassan	295	12618	42.77

Uttara Kannada	270	13554	50.20
Tumkur	191	7831	41.00
Kolar	180	5703	31.68
Chikkaballapura	135	5630	41.64
Chamarajanagara	106	4228	39.89
State Total	5368	200748	37.40

2.3 Uses of Jackfruit

Jackfruit has many uses. Mature Jackfruit can be prepared as a vegetable by boiling or cooking. Ripe jackfruit is a very popular fruit. Both young Jackfruits, as well as Jackfruit seeds, are prepared as a vegetable, while Jackfruit seeds are also cooked to produce delicious traditional dishes. Its many uses have been summarized below:

- a) As a nutritious food - mature Jackfruit, young jackfruit and the jackfruit seeds provide high nutritional value.
- b) Fruit - can be consumed as a ripe fruit
- c) Value-added processed food - dehydrated jackfruit, canned/bottled jackfruit, chips and
- d) Other snacks based on jackfruit.
- e) Timber - Jackfruit tree provides an excellent medium hardwood timber that shows termite resistance. This timber is widely used for making furniture, doors, boats, windows and musical instruments.
Jackfruit wood is widely **used** in the manufacture of furniture, doors and windows, in roof construction, and fish sauce barrels. The **wood** of the **tree** is **used** for the production of musical instruments
- f) Firewood - branches are used as firewood
- g) Ecological and environmental use - provides perennial cover, reducing the impact of raindrops and provides shade and serves as a windbreak.
- h) Medicinal value - various parts of the tree and the fruit are used in traditional medicine in many South-East Asian countries.
- i) Cultural value - chips of heartwood when boiled yield yellow dye, used to color the robes of Buddhist monks. People of Hindu communities use leaves to decorate temples and other places of worship.

2.4 Value-added products:

Following is a pictorial depiction of value-added products that can be produced from Jackfruit:

VALUE-ADDED PRODUCTS

Dried jackfruit flakes



Preserved jackfruit bulbs



Dehydrated jackfruit bulbs



Ready-to-serve jackfruit beverages
Jackfruit Squash
Jackfruit Nectar
Jackfruit Wine



Jackfruit Vinegar



Canned jackfruit products



Candied jackfruit



Jackfruit bar & ice cream



Jackfruit Pickles



Jackfruit Chips



Jackfruit Papad



Jackfruit Sweets



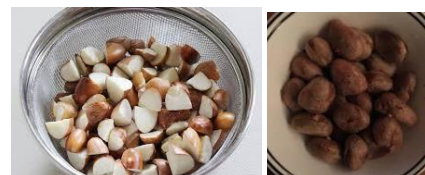
Jackfruit Jelly



Jackfruit Seed Flour



Roasted Nuts



Jackfruit has significant nutritional value as indicated in Annexure II

A brief of the aforementioned products follows:

2.4.1 Dried Jackfruit Flakes:

Dehydrated Jackfruit flakes with a shelf life of one year were standardized by KAU (1999). A farmer family in Sirsi village in India regularly uses unripe dehydrated flakes and flour to prepare pancake for breakfast. Dehydrated Jackfruit flakes have used a vegetable by Vista Company in Sri Lanka. The Jackfruit flour produced by Hardikars Food Processing, Pune (India) can be used as a raw material for several products. The flour prepared from dehydrated Jackfruit flakes was found to be suitable for preparing chapattis, pazhampori and bhaji by replacing 25% wheat flour, maida or Bengal gram flour, respectively with Jackfruit flour.

Dried Jackfruit flakes are prepared by slicing the jackfruit bulbs using jackfruit bulb slicer and subsequently dried in a combo drier. Mechanically sliced Jackfruits can be dried using an efficient blancher-cum- drier.

Blanching is one of the pre-treatment that is used to arrest the enzymatic activities before drying. Mechanical blanchers are usually available for blanching operations. Separate blanching and drying procedure is a time consuming and tedious process. It will also lead to an increased production cost. Efficient drying with minimal time and operation cost is the main attraction of the newly developed blancher cum drier. *The capacity of the blancher cum dryer unit is 18- 28 kg/ batch. Efficient drying and quality dried product can be produced by this combo machine. Approximate cost of the machine is Rs. 2 Lacs.* This machine is highly useful to micro and small- scale Jackfruit processing units for producing safely dried Jackfruit flakes with minimum cost.

2.4.2. Preserved Jackfruit Bulbs:

Fresh Jackfruit bulbs are a consumer-preferred commodity and relished well by all sections of population. Ready-to-eat fresh Jackfruit bulbs along with seeds were preserved under vacuum (760 mm lbs pressure) by treating with 1.5% KMS and 0.5% sodium benzoate. Preserved bulbs depicted negligible changes in the chemical constituents and were organoleptically stable for period of 15 days under refrigeration.



2.4.3 Dehydrated Jackfruit Bulbs:

The recommended approach to produce dehydrated bulbs involves steeping of Jackfruit bulbs in 0.1% potassium metabisulphite solution for 30 min to improve the quality of the dried products. Good quality dehydrated products were obtained (drying ratio 3:1) when sulfured at the rate of 16 lbs sulfur /ton fruit/1000 cft space.

2.4.4 Ready-to-serve Jackfruit beverages:

The ready-to-serve beverages can be prepared from fruits very easily with a composition of 10% of juice, 10% of TSS and 0.3% acidity (Chopra and Chauhan, 2001). Singh et al. (2001) have formulated ready-to-serve beverages from jackfruit pulp with 10% pulp content, 12% TSS and 0.3% acidity.



2.4.5 Jackfruit squash:

As early as 1956, a refreshing beverage with pleasant taste and aroma was developed from the bulbs of ripe Jackfruit. This was found to have a shelf life of 60 weeks when stored at room temperature (24-30°C). Studies indicate that Jackfruit squash could be stored for one year at room temperature without any change in quality except for a slight reduction in vitamin C content.



2.4.6 Jackfruit Nectar:

Fruit nectar is a concentrated form of fruit pulp having honey-like consistency. Nectar is the pulp of the fruit blended with sugars and citric acid to obtain a product of 15-20°Brix with mild acid taste. CFTRI (1977) standardized nectar from jackfruit pulp. Jackfruit nectar was standardized successfully from the two popular varieties of Jackfruit available in Kerala individually and by blending with other fruit pulp. Blending with other fruit pulps resulted in improvement in flavor and taste in the nectars.

2.4.7 Jackfruit Wine:

There is considerable scope for fruit-based fermented beverages in India, especially wine and vinegar. Two fermented products, which can be prepared from jackfruit pulp, are wine and vinegar. Jackfruit in general contains high amount of easily fermentable sugars, which makes it suitable medium for the growth of wine yeasts.

Jackfruit can be a very important source for commercial wine production. pH, temperature and inoculum concentration play an important role during the fermentation of jackfruit wine. It has also been seen that fermentation is faster in Jackfruit, which corroborates to earlier findings by Andre et al. Jackfruit wine possesses good antioxidant activity, owing to its gradual increase in phenolic content as the fermentation progresses.

2.4.8 Jackfruit Vinegar:

Vinegar is another fermented product which can be formulated from Jackfruit. It is observed that Jackfruit vinegar recovered from the ripe fruits yielded 7% alcohol and 6% acetic acid upon fermentation.

2.4.9 Canned Jackfruit Products:

It is well known that canning is widely practiced to extend the period of availability of fruits. Jackfruit bulbs both raw and ripe could be successfully canned for subsequent use in vegetable curries and also for table purpose. The Standardized approach involves canning raw Jackfruit bulbs in brine solution containing 0.5-0.75% citric acid. Canned Jackfruit when stored at room temperature (24-30°C) was found to retain normal color and characteristic taste and aroma. However, the product, when stored at 37°C for 19 weeks depicted deteriorative changes.

In India, canned Jackfruit is a nascent industry and there is no commercialization of the fruit for canning yet. However, some big brands in the West offer some canned jackfruit products in the market. The technology and know-how can be built in India and the product can be marketed with the right impetus

2.4.10 Dehydrated Jackfruit Slice:

Recently, at IIHR, Bangalore (India), a process has been developed for making osmotically dehydrated Jackfruit slices. Osmo-air dried fruits are the dehydrated fruit products based on the novel approach towards dehydration. Suitable fruits are selected at optimum stage of ripeness (hard ripe stage) made into slices and dipped in sugar syrup containing citric acid, preservatives and with and without maltodextrin. After immersion time, slices are drained and dried in cabinet dryer till the moisture content reaches to around 15%. Dried slices are packed in plastic punnets and can be stored at room temperature for one year. The quality of osmotically dehydrated product is near to the fresh fruit in terms of color, flavor and texture. It can be consumed as a snack. Such a product can be used in ready-to-eat type of foods, ice-creams, fruit salad, kheer, cakes, bakery products, etc. About 11-12 Kg ripe fruits are required to make one kg of Osmo-air dried slices and shelf life of product is one year under ambient conditions. However, the technology or the process has not yet been made commercial and there is no known branded product in the market today.

2.4.11 Jackfruit bar and Ice-cream:

Ready-to-eat fruit bars are well-relished products and are being commercially prepared and marketed in our country. Jackfruit ice-cream and Jackfruit mixed mango ice-cream are also becoming popular in India. It is observed that Jackfruit bars stored in modified polypropylene packets (MPP) recorded higher percent of nutrient retention and minimum microbial to have distinct taste and flavor. Blending Papaya pulp with Jackfruit pulp imparted better appearance, color and textural qualities, while blending with mango pulp resulted in better flavor, taste and overall acceptability.



2.4.12 Jackfruit Pickles:

The Central Food Technology Research Institute (CFTRI) had undertaken studies in 1977 on the preservation of jackfruit and reported that tender jackfruit could be preserved in the form of pickles. The important pickle preservations include sweet oil pickle, spiced vinegar pickle, and plain vinegar pickles.

2.4.13 Jackfruit Chips:

Jackfruit chips are prepared using raw bulbs. The oil used for frying influence the shelf-life of Jackfruit chips. Shelf stability of Jackfruit chips could be increased by adding antioxidants like butylated hydroxytoluene and sorbic acid. Gokul brand of vacuum fried chips from Kundapur (India) are very popular. The housewives in Sirsi area Karnataka (India) prepare three different types of jackfruit chips.

2.4.14 Jackfruit papad

Jackfruit bulbs which are neither fully mature nor completely raw, could be used for preparing jackfruit papads. It is observed that jackfruit papads wrapped in a paper had a shelf-life of 4-6 months at room temperature (24-30°C)..Mayura brand of jackfruit papad produced by Kadamba Marketing Cooperative, Sirsi, Karnataka and PonsaAppolopapad in Karnataka are very popular in India.

2.4.15 Jackfruit Sweets

Various sweet delicacies such as Jackfruit halwa (variety), pudding, jackfruit toffee, Jackfruit barfi, elayappam, adda, Muffin and payasam, etc. could also be prepared from Jackfruit bulbs.

2.4.16 Jackfruit Jelly

Jackfruit rind contains fair amount of sugar and pectin could be used for pectin extraction. Siddappa and Bhatia (1956) standardized a method for preparing jelly and suggested an extract-sugar ratio of 1:1 with 0.6 and 0.8 acids preparing a good quality jelly.

2.4.17 Jackfruit Seed Flour:

Jackfruit seeds may be converted into flour after inactivating the anti-nutritional factors by drying. The flour prepared from Jackfruit seeds can be used for making chapattis by blending with wheat flour (25:75). Further, Jackfruit flour produced may be used as thickening and binding agent in food systems.

Jackfruit seed flour is a good source of protein and exhibits low water and fat absorption capacity hence, the flour could be incorporated in the preparation of deep fried products.

Jackfruit seed flour can be used for preparing cereal/pulse based fried preparations like vada, Pazhampori, Bajji and Puri by replacing 50% of flour of cereals/pulses. The products were found highly acceptable in sensory evaluation test. Further, seed flour can be used to produce biscuit. *Jackfruit 365* a new Kerala based company is focused on selling Jackfruit flour and is popularising this product through recipes for a number of food items which are normally prepared with other ingredients.

2.4.18 Roasted Nuts

The roasted jackfruits seeds are reported to resemble chestnuts in nutritive value and flavor and are palatable. However, the shelf life of fried seeds is low, as these cannot be stored for more than a few days at room temperature of 24-30°C.

In addition to the above, raw jackfruit and seed flour of jackfruit are used in making a large number of recipes, namely, biryani, curry, tartetatin, idli, dumplings, unniappam, dosa, etc. Ready-to-cook tender jackfruit is also very popular in urban areas of Sri Lanka and is easily available. The Saras Company in Kerala, India has also developed a new product from tender Jackfruit which is being marketed as a ready-to-cook product.

Annexure I depicts production process of selected value-added products.

2.4 Specialty Products for Niche Markets

It is interesting to note that Jackfruit products extend beyond what we normally come across in OTC stores, e Commerce sites or suppliers.

In the current fast food era, consumers are preferring healthy functional foods. Increased workload, imitation of foreign culture and health awareness made them more addicted to ready to cook and eat foods. Nowadays pastas and noodles are

considered to be the prime food in urban areas. Maida is the major ingredient of these pastas and noodles. Continuous consumption of these products will lead to problems in digestive systems. To avoid such health issues, gluten free pastas could be prepared from Jackfruit seed, raw matured jackfruit etc. These are considered to be the least exploited and are of high medicinal valued (low glycaemic index) foods. Production of pastas by these ingredients will help in fortification and meets the large consumer demands. Pasta machine is the major machinery used for the large scale production purpose. Apart from pasta machine blancher, slicer, cabinet drier, hammer mills, and blenders are necessary for feed preparation.

An over view of production process of some of the value-added products is depicted in Annexure III

3.0 Manufacturing and Distribution



3.0 Manufacturing Scenario-Domestic and International

Small but significant instances of the market potential of Jackfruit and how it has turned around the lives of farming families can be found in Kerala where there is a growing movement around the processing and value addition of Jackfruit led by the Jackfruit Consortium spearheaded by noted farm journalist Mr. Shree Padre. The Jackfruit Company formed by Annie Ryu in 2011 and sourcing from 350+ farming families of Kerala today has a turnover of \$ 24 million dollars and more than 70 retail outlets across the United States. The Artocarpus Food Pvt Ltd Company formed by entrepreneur Mr. Subhash Kurodh from Kerala is one of India's first full-fledged Jackfruit processing company sourcing from local farmers and exporting processed Jackfruit products to the USA and the Middle East.

3.1. International Scenario

Vietnam, with 15 years history of Jackfruit plantations has a whopping 50,000 hectares under Jackfruit cultivation now. Malaysia, Philippines, Cambodia and even Sri Lanka are taking aggressive efforts to promote Jackfruit. Initiatives to promote manufacture of value-added products are taking place in significant way. For instance, in Sri Lanka, agencies under the Ministry of Agriculture have been giving training to homemakers, street vendors and entrepreneurs in minimal processing of the fruit to arrest its wastage and create livelihood in rural areas. Tender Jackfruit in brine and canned tender Jackfruit curries are popular in the country. More than a dozen companies produce a few Jackfruit products for export.

Vietnam is number one in the world in making value-added Jackfruit products. Sixty percent of their production goes to industries—for mainly making vacuum-fried chips. Malaysia has included Jackfruit in its national policy.

China started Jackfruit cultivation only in 1992 but the production has gone up. It encourages Jackfruit plantations and planting the tree on the roadside.

The Philippines is offering e-learning courses on cultivation of Jackfruit. They are investing on research and development of technologies that would be helpful for processing Jackfruit. These countries encourage commercial cultivation. Scientists and activists in Sri Lanka told us proudly that their country would never starve when food become scarce.

3.2 Constraints:

Lack of 'Joint Action'

Each fruit matures at different times and it is not feasible for a farmer to take it to the market, particularly because it is also huge. However, if they are organised and have direct market linkage, they can make derive a earning. There are farmers even in the

perennially-drought-affected Vidarbha in Maharashtra who earn Rs. 5,000-10,000 by selling Jackfruit locally as a vegetable to Nagpur which consumes around one metric tonne of the fruit per day as a meat substitute.

Traders taking a major share of 'pie'

From Kerala, about 50,000 tonnes of raw Jackfruits are sent to cities like New Delhi as a vegetable. Middlemen buy it for Rs. 5-10/- per fruit and sell it to retailers in markets of faraway cities for over Rs. 25 per kg where it is a rich man's vegetable – this despite the fact that Kerala suffers from a huge shortage of vegetables and fruits.

Issues of 'weight' of whole fruit:

In the North-East it is believed that a market for both the ripe fruit and for value added products can emerge and be sustainable provided Jackfruit be made more accessible by giving consumers a convenient packaging, as opposed to having to buy a 7-10 kilogram fruit and through a well thought out and properly executed supply chain and go to market strategy.

Processing—not yet widespread:

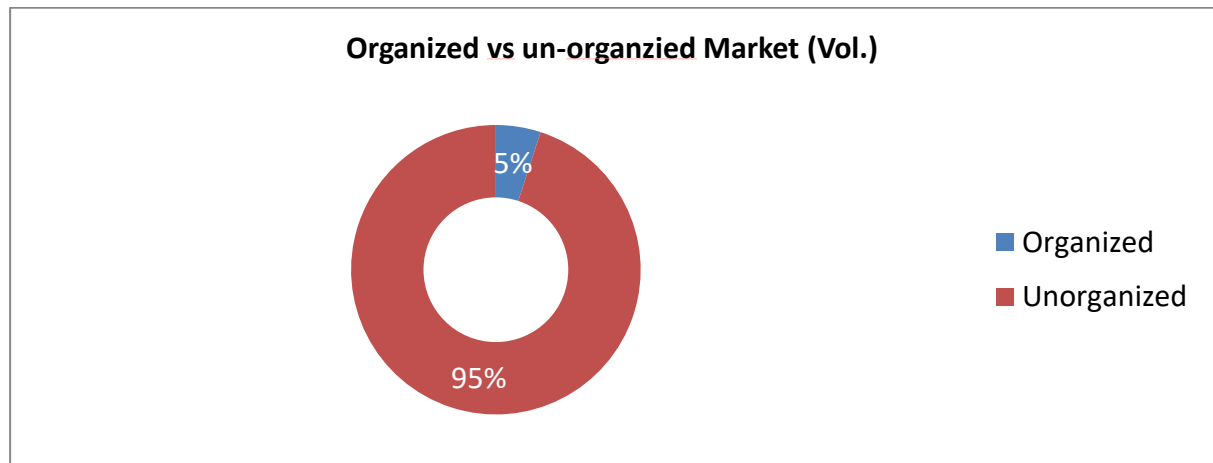
To say that Jackfruit is an under-utilised fruit crop across the state would be an understatement. Beside from scattered home scale pickle and chips making, there is no significant value addition activity happening anywhere in the state with most of the consumption happening at the household level. Despite the fact that there is a demand for Jackfruit value added products in the mainland, fruits are rotting under the trees due to transportation hurdles, negligence and non-availability of value-addition opportunities including awareness about its potential for income generation amongst both the rural and urban communities.

Wastage

It is estimated that the country as a whole could be wasting jackfruit worth Rs 2,000 crore. The actual loss could be much higher. In the Garo Hills region of Meghalaya alone, jackfruit worth Rs. 434 crore was wasted in 2012. Even in progressive states such as Kerala, the fruit is still considered a poor man's crop though the situation is slowly changing due to the efforts of the Kerala based Jackfruit Consortium.

3.3 Manufacturing:

A large part of the value-addition activity takes place in the unorganized sector, as indicated in the chart below:



Availability of processed products in the local market is low due to lack of interest shown by the producers. However, primary processing at the household level using traditional methods was reported only for local consumption but these traditional products are still scarce in the market. Only a few commercial- scale processing plants are available within the country.

Some of the better-known manufacturing firms are:

- a) Thomson Bakery near Mannar in Kerala sells 300 kg of Jackfruit halwa during the Jackfruit season.
- b) Asian Home Products Pvt. Ltd., Thiruvananthapuram, produces 400 Kg of salted chips daily by outsourcing to smaller units. Its proprietor, Mr N.R Pillai, says the chips sell quickly.
- c) Adilakshmi Home Industries in Moodabidri, Karnataka produces 7,000 Jackfruit papads daily.
- d) Kadamba Marketing Co-operative, Sirsi, has for the first time introduced branded Jackfruit papads. They sold 60,000 papads last year. To make papads during the monsoon season, they installed a food grade drier which boosted their production.
- e) There are three units at the micro level manufacturing vacuum fried chips; viz.
 - Crimz
Arshimas Apartment
UK Sankunni Road. Near Jaffaegan Colony
Kozhikoode – 673 001
 - Kozhikoden
Building No. 6/390 A
Opp. Vyaparibhavan
Kozhikode 6730001
 - Jackme
Perinthalmanna
Malappuram district, Kerala

- f) Further, two more units have commissioned at Wayanad and Trivandrum. They have not started the commercial production.
- g) Jackfruit pulp is being manufactured by Artocarpus Foods Pvt. Ltd., Plot No. F, Kinfra Industrial Estate, Thaliparambu, Kannur. Started in 2015, they launched 10 products. Later, Launched “Hebon” brand for Indian market to create identity. Of late, they sell through e-commerce platform – Amazon- as also through their own portal. They have partnered with food retailers across South India with focus on private labelling. They have positioned their products based on health benefits for organized market.
- h) Jackfruit365™ :
It is located at Eastern Corporate Tower, No. 34/137 A , NH Bypass, Edapally (P.O), Kochi, India, 682024. It was launched on October 2nd 2013 with a vision to create an organized market for the mostly wasted jackfruits in India. The Strategy at Jackfruit365™, is to gradually change perception from ‘Ayye’ Jackfruit (ashamed to eat) to ‘AHA’ Jackfruit – Aspirational, Healthy and Affordable.

To make Jackfruit ‘aspirational’, during the first year the focus was on placing Jackfruit365™ on the menu of five star hotels in India. With excellent support from Chefs, many Five Star restaurants became Jackfruit365™ consumers winning great news coverage from media. During the second year, the focus turned on to uncovering the scientific reasons to prove that, Jackfruit is Healthy for various lifestyle diseases. It was discovered that the benefits of raw Jackfruit as good for diabetes bringing forth many cases, where diabetic patients could completely stop or bring their insulin intake levels down by consuming raw Jackfruit as a meal. Various research and studies revealed the benefits of raw Jackfruit for diabetic / pre-diabetic patients. There were clinical reports available citing the benefits of raw jackfruit for diabetic / pre-diabetic patients.

With the help of doctors, diabetologists, nutritionist and research scientists at a globally reputed university we at Jackfruit365™ were able to conduct further research and make breakthrough conclusion that raw Jackfruit is a healthy alternate to rice and wheat to control diabetes and to reduce weight.

- i) Anna Food Products Pvt. Ltd., Meenangadi, Wayanad is manufacturing various products like Jackfruit mixture, Halwa, Jam, Squash, Pickles, Appetiser, Pradhaman, dry jackfruit and jackfruit flour.
- j) Palakkad Social Services Society, Palakkad is manufacturing value-added products in Jackfruit on-demand basis.
- k) Preeminent Farms Agro Producer Company Ltd/. KVK, Pathanamthitta:are

Into the manufacture of Jackfruit Flour and Dehydrated Jackfruit.

- l) Jackfruit Processing Unit, Mala Trichur:
Kerala Agro Industries Corporation Ltd. a company promoted by Government of Kerala has established an integrated Jackfruit Processing Unit. The Unit was commissioned during the year 2018. Following are the products manufactured by them :
 - Jackfruit flour
 - Jackfruit seed flour
 - Jackfruit pulp and down-stream products such as squash, halwa, chakkapayasam etc.

m) In addition to the above, following are the manufacturers of Jackfruit pulp—an intermediate product:

- Anna Food Products, Meenagadi, Wayanad
- Malabar Fresh, Kannur
- Kerala Agro Industries Corporation Ltd

3.4 Medium and Small-scale Manufacturers and Exporters

Most MSMEs have minimal formal channels for marketing and distribution of their value-added products. Since there are no regularised distribution channels and is largely dependent on middle-men, farmers don't get their dues with the fruits fetching them minimal returns in comparison to retail pricing in cities and across other states where the fruits or allied products are distributed. As an example, during the season a single jackfruit could be sold by the farmer for Rs.75 but 100 gms of fresh bulbs from the same jackfruit could be sold in the retail market for Rs.75. This disparity in the pricing is exactly what calls for a correction in the end to end supply chain system so that the farmers are benefitted according to their efforts.

There are three units at micro level are manufacturing vacuum fried chips in Kerala viz.

1. Crimz
Arshimas Apartment
UK Sankunni Road. Near Jaffaegan Colony
Kozhikoode – 673 001
2. Kozhikoden
Building No. 6/390 A
Opp. Vyaparibhavan
Kozhikode 6730001
3. Jackme Perinthalmanna, Malappuram district

Further two more units have commissioned at Wayanad and Trivandrum. They have not started their commercial production.

Jackfruit pulp is being manufactured by ArtocarpusFoods Pvt. Ltd., Plot No. F, Kinfra Industrial Estate, Thaliparambu, Kannur. They are also manufacturing Jackfruit flavouring mix. They export pulp to Middle East.

Anna Food Products Pvt. Ltd., Meenangadi, Wayanad is manufacturing various products like Jackfruit mixture, Halwa, Jam, Squash, Pickles, Appetiser, Pradhaman, Dry Jackfruit and Jaffee flour.

Jackfruit flour is manufactured by the following companies:

- Jackfruit365, Eastern Gou, Adimali, Idukki
- Preminent Farms Agro Producer Company Ltd/. KVK, Pathanamthitta
- Palakkad Social Services Society, Palakkad.

Palakkad Social Services Society, Palakkad is manufacturing value-added products in Jackfruits on demand basis.

Government of Kerala has established an integrated Jackfruit Processing Unit at Trichur. This will be operationalised soon.

3.5 Supply Chain and Logistics-Challenges in the Current Scenario

India is the world's largest producer of many fruits and vegetables but there is a huge gap between per capita demand and supply due to enormous wastage during post-harvest storage and handling caused by improper bagging without crating, lack of temperature controlled vehicles, unavailability of cold chain facilities in various parts of country for preserving the produce, along with significant processing of the agricultural produce which results in immense losses to the nation. Hence a proper supply chain management in fruits and vegetables has to be improved in all the stages of the supply by adopting best global practices in storage, packaging, handling, transportation, value-added service etc to meet the country's demand.

Supply Chain Management represents the management of the entire set of production, manufacturing/ transformation, distribution and marketing activities at the end of which a consumer is supplied with a desired product. Supply chain management encompasses the planning and management of all activities involved in sourcing procurement, conversion, and logistics management. It also includes coordination and collaboration with channel partners, who may be suppliers, intermediaries, third-party service providers, or customers. Supply chain management integrates supply and demand management within and across companies.

Present scenario of the Supply Chain in India:

A study in the North-East has identified six supply chains for jackfruit as indicated below:

- a) Grower–Customer (local) supply Chain: This supply chain represented over a third of total Jackfruit supplied to the market during the survey period. The supply chain was found to be the first in terms of importance.
- b) Grower–local trader–District market–Customer (local): According to survey, this supply chain accounted for 15% of total jackfruit supplied to the market. The supply chain was found to be fourth most important jackfruit supply chain in the study area.
- c) Grower – local trader – Retailer – Customer (local) : Represented about 9% of total jackfruit supplied to market.
- d) Grower–Wholesaler (local)– District Level Trader–Retailer–Customer(Other district):
- e) Grower–local trader-local trader (other district)– Retailer (Other district) –Customer (other district): The supply chain accounted 16 % percent of jackfruit supplied and found third most important Jackfruit supply chain.

- f) Grower-Wholesaler (local)-District market-Customer (local): This supply chain represented 20% jackfruit supplied in the survey area and it placed second most important jackfruit supply chain in the study area.
- g) Thus, about two-thirds of the output is sold through middlemen there by cutting into the margins for the grower.

Following is a pictorial depiction of distribution channel:



3.6 Harvesting and Post Harvesting– Current Practices

Supply, marketing and distribution of Jackfruit remains majorly unorganized owing to its issues right from the time of harvesting until it reaches the market for final consumption.

Time of harvesting

- No scientific standards followed for determination of maturity
- Most based on experience, sometimes attainment of size
- Harvesting before maturity due to sudden market demand (festival) or to get higher price early in the season , avoiding pest incidence after rains etc.

As a result of the above, the fruits are of inferior quality thus resulting in lower prices.

Method of harvesting

A traditional method of harvesting by climbing on the tree is followed. This could lead to accidental falling of fruits, resulting in bruising and cracking of fruits. Mechanical injury allows entry of pathogen thereby leading rotting during operations.

Handling

- Assemble the fruits on the ground—in shade or even without shade
- Informal sorting and grading-removal of highly damaged fruits or very small fruits
- No de-sapping

As a result, there is both physiological and physical loss, low market price, and visibly affected fruits (stains, browning etc.)

Thus, unscientific methods for determining the maturity of the fruit, inadequate /improper grading and handling cut into the margins for the grower

4.0 Domestic & International Markets



4.1 Current Marketing Practices

4.1.1 An Overview:

Marketing of horticultural crops is quite complex and risky due to the perishable nature of the produce, seasonal production, and bulkiness. The spectrum of prices from producer to consumer, which is an outcome of demand and supply of transactions between various intermediaries at different levels in the marketing system, is also unique for fruits. Moreover, the marketing arrangements at different stages also play an important role in price levels at various stages viz. from the farm gate to the ultimate user. These features make the marketing system of fruits to differ from other agricultural commodities, particularly in providing time, form and space utilities. While the market infrastructure is better developed for food grains, fruits and vegetables markets are not that well developed and markets are congested and unhygienic.

4.1.2 Challenges in Marketing Jackfruit and Value-added Products:

a) **Lack of a Marketing Chain:** A stable marketing chain is not in existence for jackfruit. At the village level, collectors from outside as well as those from the village itself purchase the fruits and sell them in external markets, mainly at village fairs and roadside sheds. Transactions at the farm level occur mainly on ready cash payment basis and rarely on credit. Middlemen decide the market prices resulting in the exploitation of the producers. It is estimated that a very low percentage of total production is consumed as food (30-35%) and 70% is lost during pre and post-harvest stages.

b) **Non-existent Post Harvesting Practices:** The usual suppliers again are the middlemen, and they collect orders from exporters, collect crops from farmers/ local markets, and deliver these to the exporters on the day of shipment.

No standard post-harvest handling practices are followed. As a result, post-harvest loss is enormous in particular because the packaging materials are of very poor quality, generally consisting of bamboo baskets or second-hand cartons.

c) **Nature of the Fruit:** Packaging of the fruit is very tough due to the shape, size, and weight which is not uniform. It cannot be packaged in standard-sized crates and boxes like other fruits. Only the firm-fleshed ripe fruit is preferred for eating once it is ripe. This type of fruit is comparatively less common to the soft-fleshed fruit.

Additionally, there is no scientific way to recognize if the fruit is in good condition or rotten from the outside. All these reasons add to the supply chain problems for jackfruit.

- d) **Insufficient Processing Units for Value Addition:** Availability of processed products in the local market is low due to lack of interest shown by the producers. However, primary processing at the household level using traditional methods was reported only for local consumption but these traditional products are still scarce in the market. Only a few commercial-scale processing plants are available within the country. To cite some prominent examples, Thomson Bakery near Mannar in Kerala sells 300 kg of jackfruit halwa during the Jackfruit season. Asian Home Products Pvt. Ltd., Thiruvananthapuram, produces 400 kg of salted chips daily by outsourcing to smaller units. Its proprietor, NR Pillai, says the chips sell quickly. Adilakshmi Home Industries in Moodabidri, Karnataka produces 7,000 jackfruit papads daily. KadambaMarketing Co-operative, Sirsi has for the first time introduced branded Jackfruit papads. There is a lot of demand for chips alone. Customers arrive in their cars and buy jackfruits, as mentioned by AnnappaPai, Director, Ace Foods, a reputed food products exporter in Mangalore.
- e) **Consumer awareness:** Lack of awareness of uses of ripe Jackfruit and minimal known recipes for the fruit especially in North East India causes a lot of wastage. Additionally, there are minimal government initiatives promoting or propagating the fruit in comparison to several South East Asian countries like Vietnam and Philippines. These countries have dedicated initiatives for Jackfruit and have strong government support for value added products and exports. Sri Lanka has more than 5 dedicated institutes for Jackfruit while India does not have even one. In India Jackfruit is still considered a minor fruit and several rural areas consider it a poor man's food.

4.1.3. Distribution Channels:

The channels may vary between large, medium and small farmers. Large farmers sell their harvest to wholesalers, while medium farmers sell their fruits to local markets or sell surplus fruits to neighbours or to village vendors and local retailers.

When the fruits are intended for export, the exporters or their commission agents visit production areas, examine the fruits and buy only those that meet the exporter's specifications. Fruits of the same maturity level are loaded and banana leaves are placed in between them to protect them from damage by direct sunlight. All around the truck, coconut leaves are placed to protect the fruits from sunburn. When fully loaded, coconut leaves are used to cover all around the truck and saw dust and ice sheets are placed to keep the fruits cool so that they will still be fresh at their point of destination. The big trucks are used to transfer the fruits to big cities where major markets are located. Once the truck reaches the destination, fruits are transferred to small trucks and ferried to their final destination. Following is list of the channels

Channel 1. To Central Market by:

- a) Wholesalers through contract sale
- b) Commission agents
- c) Wholesalers who buy directly from orchards/ local markets.

Channel 2. Farmers/Contractors with big orchards send their produce directly to the central market (about 5%)

Channel 3. Farmers/ Contractors bring their fruit to local wholesale markets where many vendors and even some consumers come to trade.

Channel 4. Directly to exporter without passing through any middleman. Exporters assign their agents or collectors to procure fruit of a specific grade.

Channel 5. Directly to processing unit with prior agreement on size, quality, and price.

4.2 Export Markets for Value-added Products:

4.2.1 Overview:

The production of Jackfruit is becoming popular in many countries globally. China started Jackfruit plantations in 1999/ and devoted 180,000 hectares of land for this. Apart from China, the Philippines and Malaysia are countries that have encouraged Jackfruit cultivation. The Philippines also claims to be producing one of the sweetest varieties of Jackfruit on 3,000 hectares. The Philippines takes this fleshy fruit seriously and the government-run Agricultural Training Institute (ATI) has introduced an online course on Jackfruit farming and they have already claimed the production of one of the sweetest varieties of Jackfruit in 3,000 hectares. In Vietnam, about 55,000 hectares of land has been used for Jackfruit cultivation. Even Mexico, a relatively recent grower of Jackfruit, has become an important exporter of the fruit, mainly to the U.S.

Export of Jackfruit



Source: Trade map

Apart from large/organized manufacturers, there are numerous smaller full-fledged companies, especially in Kerala and in Maharashtra which are today shifting focus to the processing of Jackfruit for exports. However, while Jackfruit items like squash, chips, papad, jack flour etc. can be made in the home or in cottage scale units, the newer products like RTCs, dehydrated jack, freeze-dried jack, and pulp can only be

made using high end equipment with strict quality control processes especially for the high end market and exports.

Primary data indicates that export markets and high-end domestic markets prefer appropriately packed Jackfruit products that are otherwise canned. The high cost of canning necessitated exploring an alternative to the canning system. A new packing technology- *Retort Pouch Packaging Technology* is an ideal alternative to metal cans to achieve these goals. It is a flexible, laminated package that can withstand thermal processing temperatures and combines the advantages of both metal cans and plastic packages. Easy bulk packing, less transportation and material cost, rapid heat penetration, easy disposal without environmental pollution and heat seal-ability are the major advantages of retort pouch packaging.

Process protocol for retort processing of tender Jackfruit was developed. The treatment combinations like blanching, thermal processing parameters like temperature, time, preservatives etc. were optimized based on quality analysis and shelf life studies. The retort processed tender Jackfruit is shelf stable for one year without any changes in its nutritive value.

Preserving in brine is also followed commercially on large scale. Polos (tender jackfruit) in brine, jackfruit seeds in brine are some of the commercial products. Sri Lanka has at least a dozen companies that among other products produce value -added products of Jackfruit for export. Ready-to-eat Polos curry in tin/ bottle is a very popular product that is exported to several countries like Australia, California and USA.

4.2.2 Export opportunity to European Markets - Key Markets for Jackfruit as an exotic fruit:

Fresh exotic tropical fruits are mostly grown in developing countries. Although still considered niche products in Europe, the interest in new flavors and special varieties is increasing. Communicating the health benefits of tropical fruit can help increase demand. Jackfruit is also becoming more popular as an export fruit.

In 2016, European buyers imported over 39 thousand tons of exotic tropical fruit from outside Europe, almost exclusively from developing countries. Israel is the only developed non-European country with significant exports to Europe. Since 2012, the import of fresh exotic fruit has shown an upward trend. The total import value reached nearly 114 million euros in 2016.

The main importing markets from non-European countries are Belgium and the Netherlands. These countries have positioned themselves as trade hubs, representing nearly 80% of European imports of exotics. The direct export to France, the United Kingdom, Germany and other markets is much lower. A large quantity of Dutch and especially, Belgian exotic imports comprises lychees and Jackfruit. France absorbs the largest volume of these exotics.

While the Netherlands is a stable and important re-exporter of exotic fruit, with Germany and France as the principle destinations, Belgium has greatly improved its position as a trade hub over the past five years.

The Netherlands trades a variety of exotic tropical products that are sourced throughout the year in, for example, Colombia, South Africa, Zimbabwe, Thailand,

Vietnam and Malaysia. Belgium has significantly increased its re-export of lychees from Madagascar due to logistical choices. It is its principle exotic import, especially during December and January.

According to Trade Data Estimates, Germany and France remain the principal final destination markets for exotic fruits. The United Kingdom follows as third largest final destination market. Most exotic fruit can be best introduced in northern European countries. However, in other countries the consumption is also believed to be expanding. In southern Europe, for example in Spain, specialized shops and street markets have assortments of some of the most exotic fruit varieties

Certification schemes that are in line with the Global Social Compliance Programme (GSCP) have a greater chance of being accepted by European supermarkets. There is a clear demand for organic and fair-trade tropical fruit, particularly in the United Kingdom and Germany.

Figure 1: European import value of fresh fruit and vegetables 2013-2017
In billion €

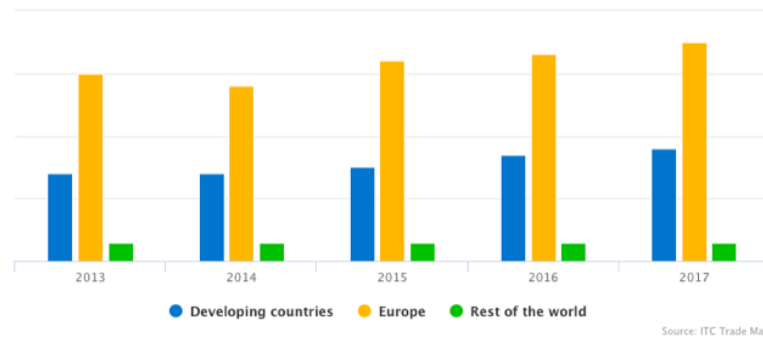
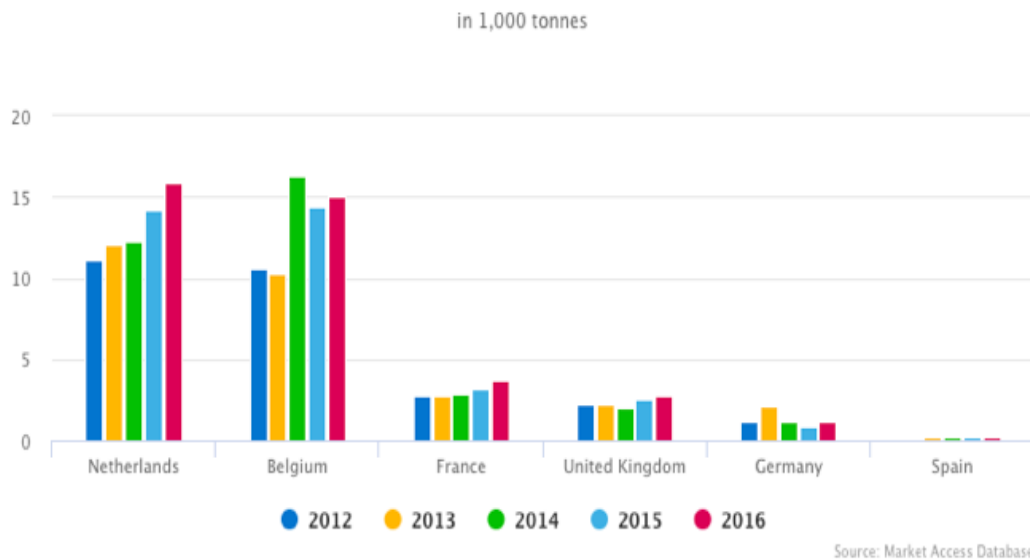


Figure 2: Main European importers of fresh tamarinds, cashew apples, lychees, jackfruit, sapodilla plums, passion fruit, carambola and pitahaya, from non-European countries 2012-2016



4.2.3 Export by India:

India’s Jackfruit market is thriving, in large part, because of the growing demand for vegan meat across the globe. When cooked, unripe Jackfruit has a texture similar to pulled pork or chicken, making it a popular vegan option in countries such as the UK, the US, and Germany. Brands such as The Jackfruit Company and Upton’s Naturals have shown how versatile an ingredient the fruit can be, consistently launching new products such as curry, pasta, and noodle meal kits all based around the meaty fruit. Certainly, Indian exports have risen to 500 tons since 2014 and they’re predicted to keep rising.

Jackfruit India, another major exporter, has also noticed a major boom in the market. Mr.Alex Chacko, the Managing Director of the company: “We have, so far, exported about 7 tons of raw jack and around 12 tons of the seeds.”

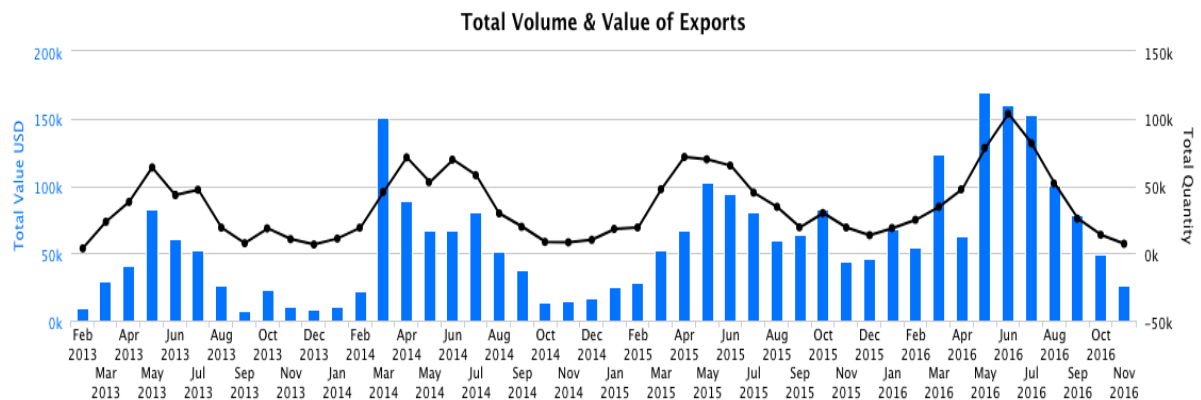
But there could soon be stiff competition for Indian jackfruit companies, with farmers and suppliers in other Asian countries, such as Bangladesh and Thailand, catching on to the rising demand in the West.

The top Indian exporters of Jackfruit are:

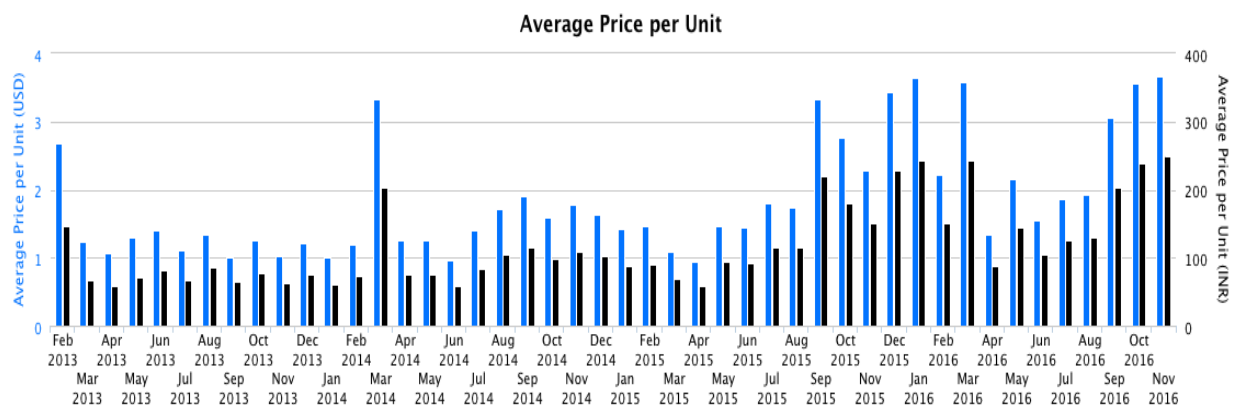
- Parayil Exports Narianganam
- Cadluck Exports Imports
- Farm Gold Impex Pvt Ltd
- Landmark Exports
- Moolans International Exim

The following Table depicts data on export of value-added products:

Average monthly exports for Jackfruit Value-added Products: (2013 – 2016)



(Source- Zauba Technologies and Data Services, year)



Source- Zauba Technologies and Data services

ApproxRs 700 Cr of jackfruit products were exported during 2017-18; Middle east, Australia, USA, Canada, UK and China are top export markets

In Kerala (Cochin and Kozhikkode), there are a number of companies exporting Jackfruit products. Most of them are exporting jackfruit chips. Artocarpus is exporting Jackfruit pulp.

The major destination is Middle East countries. Besides these products are exported to US, UK, France, Australia, Singapore, etc.

4.3 Domestic Market

4.3.1 Overview:

As is the case with other fruits, a large part of the profit margin in selling Jackfruit (without any value addition) is cornered by the distribution chain. Following is an estimation of the same:

Marketing Costs and Margins of Jackfruit Value chain Functionaries

Value Chain Functionary	Rupee per Fruit			
	Purchase Price	Marketing Costs	Selling Price	Net Margins
Producer	-	11	40	29
Aggregator	20	13	50	17
Pre-harvest contractor	40	13	70	17
Buyers from secondary markets	50	23	200	127
Buyers from outside Karnataka (Bordering Bengaluru)	50	23	200	127
Buyers from Karnataka (Sales to Mumbai)	70	40	375	265

Around a dozen branded Jackfruit products are available in India; Majority of them are manufactured in Kerala followed by Karnataka and Tamil Nadu. Jackfruit vacuum fried chips and papads are the top two value-added products. Other main products include flour, jams, preserves, and halwa.

A large part of the produce in un-processed form is sold in the producing state or surrounding states. Private labeling for hyper market brands is key opportunity

4.3.2 Market Size:

a) Market for jackfruit products is valued at INR 1252 Cr in India and projected to grow to approximately Rs.1580 Cr in the next five years.

. In 2016-16, 1826 lakh tonnes of Jackfruit were produced in India. Approximately 25% of the production is channeled into manufacturing value-added products.

a) The major portion of Jackfruit market (both export and domestic) is captured by Jackfruit chips. This is the traditional snacks prepared from fully matured Jackfruit. A number of tiny and household units is manufacturing this chips. They are supplying to domestic retail outlets and other big players. These units are not in the organised sector.

b) There new products which are aiming for export market are :

- Vacuum fried Jackfruit chips
- Jackfruit pulp
- Dried jackfruit slices
- Retort Jackfruit halwa/ *chakkavaratty* (in Malayalam language).
- Jackfruit flour

Basically, these products are costly and to certain extent it is not affordable in the domestic market. Vacuum fried jackfruit chips are costing almost Rs.1000/- per Kg. Jackfruit pulp is costing Rs.300/- per Kg. Jackfruit powder is costing Rs.250 per Kg.

Following is a pictorial depiction of domestic market size:

Domestic Market Size - Growth for 2017-2018

Computation of Market Size of Jackfruit Products (Value):

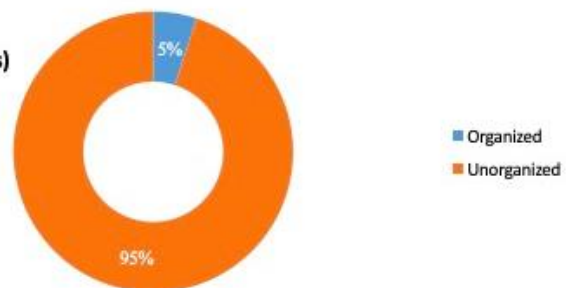


Domestic Production (2017-18 Estimate)

Production = 1917.3 (000'Tonnes)
 Used for Manufacturing ~ 25% = 479.325 (000'Tonnes)
 Effective Usage After Wastage ~ 80% = 95.865 (000'Tonnes)
 Average price per kg of jackfruit products Rs 200
 Domestic Production (Value) = Rs 1,917.3 Cr

Domestic market ~ 60,000 Tonnes annually
 Export market ~ 35,000 Tonnes annually

Organized vs un-organized market (Vol.)



Source: LeadCap Estimate leadcap.net

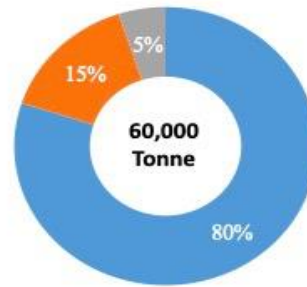
Following charts indicate the market share of jackfruit value-added products by value and by volume:

MARKET SIZE BY PRODUCTS

Market size by Value



Market size by Volume



■ Chips / Vacuum fried chips ■ Papad
 ■ Seed flour ■ Jams/Preserves/Halwa
 ■ Others

■ Chips / Vacuum fried chips + Papads ■ Jams, preserves, seed flour ■ Others

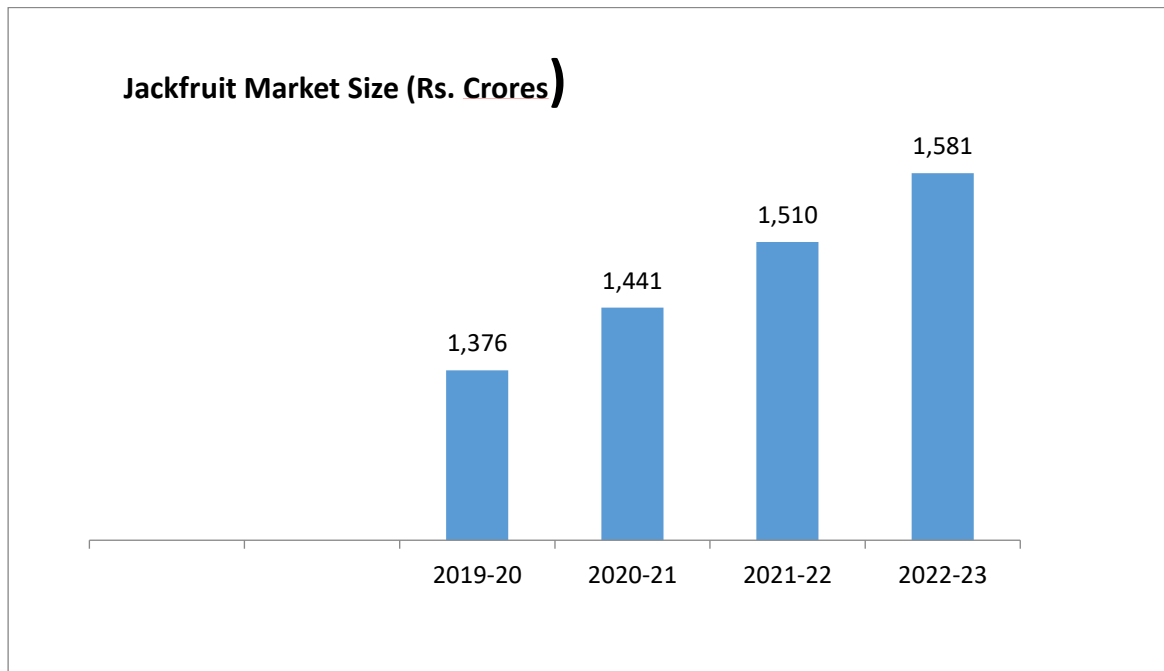
Key Insights

- Almost half market is dominated by jackfruit chips (fried / vacuum fried ~ Rs 600 Cr)
- This is followed by Papad (~ Rs 325 Cr) and Seed flour (~ Rs 150 Cr)
- By volume Chips and papads are main products

Source: Primary Interviews & LeadCap Estimate

leadcap.net

Based on primary data and interactions with knowledge persons, domestic market size has been projections as under:



As per primary data, selling price for various Jackfruit products are as under:

.	Product	Price/Kg (Rs.)
1	Chips	259 - 300
2	Mixture (available in selected shops)	600
3	Vacuum fried hips(available in selected shops)	1200
4	Flour	400 - 500

Pulp can be used as a base raw material for making various products like ice cream, halwa, chakkavaratty, chakkaada, chakamadaku, chakkapayasam, squash, etc. Therefore it has good market in bakery products. Artocarpus Foods Pvt. Ltd. is exporting the pulp to Middle East.

The cost of plant and machinery for a simple pulp making unit will be below Rs. 10 lacs. But a sophisticated plant and machinery will cost around Rs.30 lacs.

4.4 Emerging Areas

The most critical component of any enterprise, packaging, branding and marketing is the culmination of an entrepreneur's hard work, time, patience and sacrifice and deserves perhaps the maximum attention. As discussed earlier, in mainland markets, tender or raw jackfruit is in high demand as a vegetarian meat substitute while the ripe fruit and seeds can be turned into a variety of value added by products like squash, sweets, flour, cakes, chips, papad etc. A recent emerging demand is for RTC (Ready to Cook) tender jackfruit, dehydrated / freeze dried unripe jackfruit chips, Vacuum fried chips and jackfruit seed flour which are being increasingly seen on mid to high end market shelves, retail malls and specialty stores. This demand is being fueled and driven by the growing awareness of jackfruit health, nutritional properties and organic nature amongst a growing number of the health conscious middle and upper class population which is looking for healthier alternatives to highly processed and chemically laden packaged food.

The growing number of nutritional research being done by researchers both in India and abroad and the never ending quest of the food industry for new products and cuisines is also driving this demand upwards especially amongst the diabetic and hypertension afflicted population while the wellness and health food industry is also on the lookout for natural and minimally processed organic produce. All these channels require the product to be certified, tested, packed hygienically and be well branded which makes this component so critical for success.

This demand is reflected in the number of start-ups that are emerging and taking up the processing of jackfruit both for the Indian and export markets. Companies like the Jackfruit Company, Artocarpus Foods Pvt Ltd, and Jackfruit 365 etc. have been making waves in the food industry and are quickly moving into a commanding position in the market

5. Quality Standards

Quality Standards and Certification



5.1 Quality Control / Analysis Laboratory:

As food products, Jackfruit and its by-products are subject to stringent food safety and quality standards mandated by the Government under the Food Safety and Standards Act, 2006. To be able to penetrate and gain widespread acceptance in the markets, it is essential that processed and value-added products meet the standards as defined by the FSSAI. Meghalaya has the Combined Food and Drugs Laboratory located in the Pasteur Institute, Shillong, which was set up 20 years ago and which conducts microbial and chemical analysis of food and water samples. However more sophisticated quality control analysis and tests like nutritional content, the active ingredient, antibiotic residues, heavy metals etc., required under the export regime and higher-end retail markets still needs to be done outside the state which is expensive for small scale enterprises. As the Directorate of Food Processing will be taking up other products besides Jackfruit for processing, it is a necessary requirement to consider setting up of more dedicated quality control / analysis labs accredited to the National Accreditation Board for Testing and Calibration Laboratories (NABL) and FSSAI with assistance from the MoFPI under the Pradhan Mantri Kisan SAMPADA Yojana.

5.2 Legal requirements for Export:

When exporting fresh fruit and vegetables to Europe, it is required to comply with the requirements below. These requirements can be categorized as:

- Food safety.
- Product quality.
- Social, environmental and business compliance.

To avoid health and environmental risks, the European Union (EU) has set maximum residue levels (MRLs) for pesticides in and on food products. Products containing more pesticides than allowed will be withdrawn from the European market.

Note that buyers in several Member States such as the United Kingdom, Germany, the Netherlands and Austria use MRLs which are stricter than the MRLs laid down in European legislation. Supermarket chains are the strictest and demand 33% to 70% of the legal MRL.

More and more buyers ask for upfront information about your pesticide spray programs and records. Shipments are checked before they are sent to the retailer. Pesticide management requires a lot of responsibility on the part of the producer or exporter.

Contaminants are substances that have not been intentionally added to food, but may be present as a result of the various stages of its production, packaging, transport or holding. Similar to the MRLs for pesticides, the European Union has set limits for several contaminants. Especially the limits for nitrate (in spinach and lettuce) and heavy metals such as cadmium, lead, mercury and inorganic tin, are relevant for fresh fruit and vegetables. For most fresh fruit or vegetables the limit for lead contamination is 0,10 mg/kg and for cadmium 0,050 mg/kg.

Supply of pre-cut fruit and vegetables, as well as unpasteurized juices or sprouted seeds, must take into account microbiological hazards such as salmonella and E. coli. These substances should be absent when testing these products.

Food safety and certifications have become leading aspects of the trade of fresh products. GLOBAL G.A.P. has become the standard certification, and the required maximum residue levels (MRLs) are becoming stricter than the legal limits. Experienced buyers resent the fact that more and more fresh fruit professionals only focus on paperwork and lack actual product knowledge.

The paper trail and the strict requirements are a challenge for every producer, exporter, and importer. At the same time, if applied well, they can improve the competitive position of the exporter/ producer.

The Individual Member States of the European Union maintains strict control over the fresh food market. European and Member State decisions can have a significant influence on the market. Examples of European interventions are:

1. Compensation and Subsidies for **farmers in Europe**
2. Phytosanitary restrictions on South African citrus fruit due to the threat of Black Spot.
3. European policy against genetically modified fruit and vegetables

To ensure food safety and avoid environmental damage, all products are subjected to official controls. These controls are carried out to ensure that all foods marketed on the European market are safe and in compliance with all applicable regulatory requirements. There are three types of checks:

1. Documentary checks;
2. Identity checks;
3. Conformity checks to marketing standards.

In case of repeated non-compliance of specific products originating from particular countries, the European Union can decide to carry out controls at an increased level or lay down emergency measures. Controls can be carried out at all stages of import and marketing in Europe. However, most checks are done at the points of entry.

For importers of fresh fruit and vegetables, the traceability of products is compulsory. To fulfill this obligation, European importers will require proof of origin for all fruits and vegetables. In addition to a Bill of Lading, phytosanitary certificate, packing list, and custom documentation, you must also use a unique traceability code such as a lot number or GLOBAL G.A.P. Number (GGN).

As food safety is a top priority in all European food sectors, most buyers request extra guarantees in the form of certification. All buyers in the supply chain, such as traders, food processors and retailers, require the implementation of a food safety management system based on hazard analysis and critical control points (HACCP).

5.3 Global G.A.P:

The most commonly requested certification scheme, essential for exporting fresh produce to Europe, is GLOBALG.A.P. This is a pre-farm-gate standard that covers the whole agricultural production process from before the plant is in the ground to the non-processed product (processing not covered). GLOBALG.A.P. focuses on food safety as well as the environment, labor conditions and product quality. It has become a minimum standard for most European supermarkets.

5.4 BRC

In addition to GLOBALG.A.P., other food safety management systems can be required as well. Almost all buyers on the north-western European market will require you to comply with the BRC Global Standards, which are widely applied as a standard for hygiene and safety.

5.5 IFS, SQF, FSSC 22000:

On the European mainland, buyers sometimes require you to comply with the IFS food standard, Safe Quality Food (SQF) program, FSSC 22000 or other industry-developed standards.

All the above mentioned management systems are recognized by the Global Food Safety Initiative (GFSI), which means that they are generally accepted by the major retailers. Compliance with certification schemes varies between countries, trade channels and market situations. Buyers can be more lenient during supply shortages.

6.0 Technology Support



6.1 Technology Providers for MSMEs:

Traditional methods of Jackfruit processing involve four major unit operations, namely, peeling of fruits, separating the bulbs, frying, and packaging. Each of these unit operations is done manually, especially due to the lack of appropriate mechanical system. At present, the chips are made by cutting and slicing raw Jackfruit by knife and then deep frying in edible oil. The method is unhygienic and does not produce chips of uniform thickness and may cause injury to the persons while slicing. But still, the manual method of slicing is widely used due to the lack of efficient mechanical slicers. To fulfill these requirements, a women-friendly mechanical Jackfruit slicer cum dicer was developed under Centre of Excellence in Post-harvest Technology at Kerala Agricultural University. The new slicer can be efficiently used in both small and large-scale industries for slicing jackfruits with minimum loss of material (8.4%) and can do trouble-free slicing at higher quality and efficiency i.e., two to three times higher than manual slicing.

This machine can slice Jackfruit bulbs into uniformly sized slices. The machine requires only one person to operate. This economically viable machine has the efficiency and capacity of 50 kg/hr. The approximate cost of the machine is about Rs.50,000. Apart from jackfruit slicer, slicer cum dicer was also developed under this scheme which could be used to make jackfruit bulb dices to prepare fruit salads.

For further processing or during the preparation of jam, fruit flours, juices etc. the fresh fruits undergo many unit operations viz pulping or juice extraction, juice pasteurization, fruit juice/pulp concentration etc. Now many user-friendly/ gender-friendly machines are available for these unit operations at affordable prices. Pulping of fruits can be done by mechanical pulping units. Fruit concentrators, juice pasteurisers, pulverizers are available for the production of micro and small scale production of juice concentrates, RTS, and juice flours.

6.2 Latest Technological Innovations Leading to New Products

6.2.1 Intermediate Moisture Foods (IMF)

One of the major traditional practices of preserving ripe Jackfruits is by dehydration. Osmotic dehydration of the fruits is one of the food preservation techniques used for partial removal of water from fruits by immersing them in aqueous solutions of high osmotic pressure viz sugar and salts. Intermediate Moisture Foods (IMF) is one of the major attractions in the current food market as this technology could preserve seasonally available fruits for a long period. This could be prepared by a two-stage

drying process i.e. osmotic dehydration followed by any other secondary drying. Osmo-dried jackfruit is an IMF product, and is not only delicious but also conserves attractive color and nutritional elements. This processed product has a six-month shelf-life, which could reduce wastage of surplus ripened jackfruit. The ripened jackfruit bulbs are deseeded and soaked in sugar syrup for osmotic dehydration and further dried using cabinet dryer.

The processing conditions like soaking time, the temperature of drying were also standardized under the Centre of Excellence in post-harvest technology. The second stage drying could be done either by traditional drying, solar drying, cabinet drying, vacuum drying or any other modern drying methods viz fluidized drying, microwave drying, freeze drying etc. Conventional drying method includes sun/solar drying that requires more time to complete the process and results the poor quality dried product. Improvements in science and technology have paved a path towards the development of new mechanical and electrical driers. Vacuum dryer, microwave drier, hybrid driers, belt dryers, fluidized bed dryer, freeze dryer etc. are the major dryers presently available in food industries. Among these, vacuum dryer is an effective dryer for the production of intermediate moisture foods. Retention of color and uniform drying are the major advantages of vacuum dryers. Though it is a time-consuming process, it can add value to the locally available fruits and vegetables.

6.2.2 Extrusion Technology:

Presently, several RTS products are available in the market and becoming popular by the day due to a change in food habits and their convenience in use. Extrusion technology has a pivotal role in the snack and ready to eat breakfast food industry. Extrusion technology is very useful from the standpoint of the nutritional value as nutrient losses are lower compared to other thermal processing methods. An industrial twin screw extruder is required for large scale production of extruded products. Extruder supporting machineries such as blancher, slicer, pulverizer, industrial mixer and coating machine is required for the successful production. Incorporation of underutilized fruits like matured jackfruit, seed flour, etc., in RTE products, enhances the nutritional value as well as resource utilization.

6.2.3 Vacuum Frying Technology:

It is an innovative technology for the production of healthy fried snack products. Currently, the problem associated with the snack foods is its oil content leading to the immediate rancidity and the health problems due to the carcinogen produced during frying. To resolve these problems, green technology was developed known as vacuum frying.

The advantage of vacuum frying is that the oil quality gets maintained and the oil can be reused more than 50 times. The vacuum fried jackfruit can be stored for more than three months under active modified atmosphere packaging using nitrogen flushing. It is an innovative technology to conserve oil degradation, reduce oil absorption and retain the nutritional quality of the fried product by heating it under negative pressure and low temperature that lowers the boiling points of the frying oil and water in the sample. Other machineries such as slicer for slicing samples in uniform size and shape, vacuum packaging machine for nitrogen filled packaging for better storage are essential for a large-scale production unit.

Vacuum Frying Equipment

6.3 Research and Development

The arena of Jackfruit processing and value-addition is just beginning to catch the attention of the scientific and industrial community across the country beginning with Kerala, Tamil Nadu and Maharashtra. Protocols,



standards and equipment for processing and value addition are still being fine-tuned by institutions and industry. Most equipment in use in these states have either been adapted from conventional fruit processing equipment or imported from countries like Vietnam, Malaysia, Sri Lanka or China. There is a need for demand-driven R&D for product and process development, design and development of equipment, improved storage, shelf-life, packaging etc., suited to the unique conditions of Jackfruit producing States, especially Meghalaya in North East.

6. Leading Technology Providers

Based on the primary data (mainly from CFTRI) and secondary research, the most prominent technology providers in jackfruit processing are DRDO and CFTRI. With their dedicated team of scientists and technologists, we can expect more innovative technologies that will do justice to the jackfruit industry. Following is a brief of these institutions:

6.3.1 Defense Research and Development Organisation (DRDO):

DRDO was formed in 1958 from the amalgamation of the then already functioning Technical Development Establishment (TDEs) of the Indian Army and the Directorate of Technical Development and Production (DTDP) with the Defence Science Organisation (DSO). DRDO was then a small organization with ten establishments or laboratories. Over the years, it has grown multi-directionally in terms of the variety of subject disciplines, number of laboratories, achievements, and stature.

Today, DRDO is a network of more than 50 laboratories which are deeply engaged in developing defence technologies covering various disciplines, like aeronautics, armaments, electronics, combat vehicles, engineering systems, instrumentation, missiles, advanced computing and simulation, special materials, naval systems, life sciences, training, information systems and agriculture. Presently, the Organisation is backed by over 5000 scientists and about 25,000 other scientific, technical and supporting personnel. Several major projects for the development of missiles, armaments, light combat aircraft, radars, electronic warfare systems etc are on hand and significant achievements have already been made in several such technologies.

They have developed technologies for ‘Technology for Structured Fruit Products’. Several pulpy fruits like mango, banana, papaya, guava, musk-melon, apple, tomato, pineapple, Jackfruit etc. are preserved by canning. They can also be preserved by concentration as pulp or subjected to liquefaction and clarification into juice, stabilized by further processing. However, the concentration of fruit pulp to higher levels is difficult and energy intensive because of their being vicious. During juice making, valuable nutrients, pigments, flavor, etc. are lost into the residue after filtration as well as at various stages of processing. DRDO has developed an alternate processing technique to restructure the fruit pulp into textured/simulated fruit gel using hydrocolloids. The restructured product can be stabilized by further processing.

6.3.2 Central Food Technological Research Institute (CFTRI):

CSIR–Central Food Technological Research Institute (CFTRI), Mysore (A constituent laboratory of Council of Scientific and Industrial Research, New Delhi) came into existence during 1950 with the great vision of its founders, and a network of inspiring as well as dedicated scientists who had a fascination to pursue in-depth research and development in the areas of food science and technology. The Research focus of CSIR-CFTRI has revolved around broadly into the following areas:

- Engineering Sciences
- Technology Development
- Translational Research
- Food Protection and Safety

Quality of food is inextricably linked to health. Access to sufficient amounts of safe and nutritious food is the key to sustaining life and promoting good health. The Institute provides analytical services, which include the determination of proximate composition, nutritional analysis (oils and fats, milk and milk products, sweets and confectionaries), analysis of food additives (preservatives, synthetic colours, artificial sweeteners, antioxidants, etc.), analysis of food contaminants (heavy metals, pesticides, Aflatoxins, antibiotics, etc.) and microbiological safety for food products. A wide range of science-based food analytical services is offered to food and allied industries through the customer service cell for compliance under the provision of FSSA 2006, Bureau of Indian Standard (BIS), AGMARK, and other national and international standards. Laboratory accreditation is a hallmark of competence and quality assurance. The facility is ISO 17025:2005 certified and accredited for more than 300 analytical parameters for chemical and biological testing of foods.

It has been designated as the Referral Food Laboratory (RFL) by FSSAI, Ministry of Health and Family Welfare, Government of India and facility functions with provisions of the Food Safety and Standards Act 2006 (FSSA 2006), Rules and Regulations 2011, and it contributes in development and implementation of National Food Standards and Regulations for regulatory/academic organisations and for domestic food business as well as imports. The laboratory also provides consultancy in setting up quality assurance laboratories for food and agricultural commodities.

Jackfruit bulbs are a rich source of vitamins and mineral constituents, especially calcium. Much of the raw jackfruit is consumed locally for curry preparation and after ripening the bulbs are relished as such in India as it is considered to be a good appetizer. Products such as fruit bars, jam, candy, etc. can be prepared from this fruit. However, it has not so far been fully exploited by the fruit preservation industry.

One of the technologies developed is of 'Osmo air-dried Jackfruit'. The Osmo-air dried product prepared from jackfruit bulbs may be consumed as snack. It can also find use in military rations in suitable packing. The Osmo-air dried fruit products can be used in ready to eat type of foods, ice-creams, fruit salad, kheer, cakes, and bakery products. The raw material required is ripened Jackfruit, Sugar, Citric acid and Water. The process involves separation of seed, from the bulb, cutting and Osmotic-treatment followed by drying and packing. The capital cost for a plant of 'minimum economic size' is estimated at Rs 22 lakhs .approximately.

6.6.3 University of Agricultural Sciences – Gandhi Krishi Vigyan Kendra (GKVK)- Bangalore: (Source- Dr. Shyamala Reddy)

The University is commercializing the technical know-how on "Jackfruit Based Value-Added Products" developed by the Post-Harvest Engineering and Technology Division, University of Agricultural Sciences (UAS), Bengaluru under the All India Coordinated Research Project.

The focus of the university is on identification of elite Jackfruit genotypes for various value added products preparation. A germplasm bank has been established at GKVK, Bengaluru campus.

The following are the technologies developed by GKVK technical know-how for a variety of Jackfruit-based value- added products are now available for commercial exploitation:

- a) Tender Jackfruit for use as Vegetable
- (b)Ready to Serve Jackfruit Juice
- b) Jackfruit Squash
- (c) Jackfruit Bulb flour and its products
- (d)Jackfruit Seed flour and its products
- (f) Jackfruit Peda
- (I) Jackfruit Ice-cream
- (J) Jackfruit Shrikand
- (k) Jackfruit Chips
- (l) Jackfruit Jam.

The technologies are available to entrepreneurs for a down payment of Rs.1.00 lakh to Rs.2.00 lakhs plus Rs.20,000 as training fee.

6.3.4 KrishiVigyanKendra (CARD KVK) – Pathanamthitta- Kerala(Source- Dr. C.P Roberts)

Since there were no commercially viable technologies available for making best use of jackfruit, KVK Pathanamthitta has worked for over a decade to find a viable solution so that these locally neglected fruit could ensure food security and employment opportunity to the rural population. KVK made a substantial leap in developing many jack based products which can be set up for home-scale production at a commercial level. Under the value addition program of Department of Agriculture, Government of Kerala, KVK was sanctioned a project on "Establishment of Primary Processing hub for Jackfruit" which also includes developing some products worth commercialization.

The University has specialized in dehydration technologies and has over a dozen technologies which have the potential to employ to rural youth and women.

Below are the key products which are commercialized by CARD KVK

Product title: Dehydrated tender jack

Shelf life: 10 months

Moisture content: 8-10%

Product highlights: Cost effective technology, No Additives, No Preservatives, Less rehydration time, Optimum sensory and nutrient properties. Ideal for both 'koozha' and 'varikka' varieties.

Product title: Dehydrated raw jack bulb

Shelf life: 10 months of Moisture content: 8-10%

Product highlights: Cost effective technology, No Additives, No Preservatives, Less rehydration time, Optimum sensory and nutrient properties. Ideal for both 'koozha' and 'varikka' varieties, Rich in dietary fiber. Efficient to manage the glut, Good raw

Product Name: Dehydrated jack seed

Shelf life: 10 months

Moisture content: 8-10%

Product highlights: Cost effective technology, No Additives, No Preservatives, Less rehydration time, Optimum sensory and nutrient properties, Ideal for both 'koozha' and 'varikka' varieties Good raw material for bakery industries.

Product Name: Dehydrated jack seed

Shelf life: 10 months

Moisture content: 8-10%

Product highlights: Cost effective technology, No Additives, No Preservatives, Less rehydration time, Optimum sensory and nutrient properties, Ideal for both 'koozha' and 'varikka' varieties Good raw material for bakery industries

Product Name: Dehydrated ripe jack fruit

Shelf life: 4 months

Moisture content: 10%

Product highlights: Optimum sensory and nutrient properties, High-value snack product, Concentrated source of nutrients, Ideal for 'Varikka' variety, Good raw material for

Product Name: Dehydrated ripe jack fruit

Shelf life: 4 months

Moisture content: 10%

Product highlights: Optimum sensory and nutrient properties, High-value snack product, Concentrated source of nutrients, Ideal for 'Varikka' variety, Good raw material for

7. Development Initiatives–Some illustrations



7, Development Initiatives–Some illustrations

Following is a brief of some interesting development initiatives that provide a good picture of what can be accomplished with appropriate interventions:

7.1 Farmers' Co-operative

In Toobugere village in Karnataka, farmers started earning Rs. 100–200 per fruit after they formed a jackfruit growers' association, the first and only such association in the country, and built direct connectivity to the market. This was facilitated by Bengaluru's University of Agricultural Sciences.

Similarly, Odisha's Indian Institute of Horticulture Research has trained tribal women in minimal processing procedures of the fruit and given them small, handy machines to peel the outer rind which has helped them increase their income.

7.2 Research

Across the country only two agriculture universities (UAS, Bengaluru and IIHR, Odisha) and the CARD-KVK ((KrishiVigyan Kendra), Thiruvalla, have done pioneering work on jackfruit despite jackfruit being classified as a "minor fruit" and doesn't have a mandate for research. In Meghalaya, the College of Home Sciences, Tura, under the Central Agriculture University, has been conducting training of farmers and some basic research on identification of processing cultivars under a Mission sponsored by the Ministry of Science and Technology. Though there is need for lot of Rand D on Jackfruit and on the potential of jackfruit as food security and climate change adaptation crop, nothing concrete has been happening as compared to other producing countries.

7.3 Entrepreneurship Development:

The Meghalaya Institute of Entrepreneurship (MIE) had conducted three workshops on Jackfruit in Shillong and Tura including an Interactive Workshop on Jackfruit in the

Indian Institute of Entrepreneurship (IIE) Guwahati, in collaboration with the University of Agriculture Sciences, Bengaluru and the CARD-KVK, Kerala, to create awareness on the livelihood and enterprise potential of Jackfruit.

Hundred farmer entrepreneurs were sent for training on ‘‘Value Addition of Jackfruit’’ to ICAR-CARD KVK, Kerala and University of Agricultural Sciences (UAS), Bengaluru. While the efforts of the MIE is focused on skilling and capacity building of such farmer entrepreneurs to value add Jackfruit, its capacity to scale up the value chains is limited due to the unavailability of required facilities for training and skilling within the State. To this end and to address this perceived need, the Mission proposed to set up three Techno Incubation centres in Shillong, Tura and Jowai, to cater to a wider audience of farmer entrepreneurs who may not be able to travel to either Bengaluru or Kerala for training. Keeping in view the size of the market there is enough potential for large numbers of small enterprises to be incubated and to link them to a centralised marketing channel through the incubation centres.

7.4 Training

As a classic example of government support, the Meghalaya has initiated training, skilling and incubation. The training are usually residential with each training spread over 6 days. Modules for the trainings are developed by the Directorate of Food Processing and MIE in consultation with the UAS, Bengaluru, CARD-KVK, Kerala, IIHM, Shillong and COHS, Tura. Master trainers of the TICs are trained by the COHS, Tura, the UAS, Bengaluru and the CARD-KVK, Kerala. Necessary manuals of operation and processing are developed by the Directorate of Food Processing and Meghalaya Institute of Entrepreneurship (MIE) with inputs from all the concerned institutions.

The training are structured to emphasise more on the practical aspects of processing, packaging, handling of machinery and equipment, food safety and hygiene. To this end, the module is tentatively structured to impart 2 days of theory cum practical and 4 full days of hands on processing practice. During the trainings, an evaluation of the entrepreneurial competencies of the partners will be conducted by the MIE using socio economic and psychometric tools like the Focused Behavioural Event Interview (FBEI) to shortlist potential entrepreneurs for further facilitation in setting up their enterprises.

7.5 Agribusiness Incubator

7.5.1 Kerala Agriculture University:

Agri-business Incubator (ABI), a pioneering incubation centre, promotes entrepreneurship development in jackfruit processing sector in Kerala. The host institution is Centre of Excellence in post-harvest Technology, Kerala Agriculture University, Vellanikara, Mannuthy, Trichur. The incubation Centre promotes growth through innovation and application of technology; and support economic development strategies for small business development based on jackfruit processing. This incubator provide facilities for enterprise support services component and other agribusiness information resources on all value added products from jackfruit, their process protocols and related machineries. This center is organizing hands-on training on Jackfruit processing machineries, value-added products from jackfruit, project report preparation on jackfruit processing units and other related professional assistance to make the enterprise successful and achieve higher growth.

Major technologies developed by the Incubation Centre are :

- Canning and retort pouch packaging of tender jackfruit
- Retort processed jackfruit halwa/ chakravarty
- Vacuum fried jackfruit chips
- Intermediate moisture food – dried jackfruit
- Dried fruit slices Jackfruit seed powder and its value addition

7.5.2. Techno Incubation Centre – Meghalaya

The Techno Incubation Centre has been conceived of as Centres for Training and Technology Support for local entrepreneurs and groups interested in the business of promoting jackfruit. As part of the 'Mission Jackfruit', the Centre is equipped with the necessary essential equipment /facilities and training by the partner Universities and would be a place where prospective entrepreneurs can get an idea of and be trained on the essential infrastructural requirement for setting up a processing unit for jackfruit based value-added products. Training is a major activity under the Techno-Incubation Centre, so that a large number of people could derive benefit from it. This benefit could be translated into an income generating activity not only for the entrepreneurs, but also for the jackfruit farmers through backward integration. The TIC also functions as Common Facility Centres (CFCs) for entrepreneurs, Self Help Groups and Cooperative society members who can utilise the facility to process their produce by paying a nominal user fee and earn profits from sale of the produce, without investing in machinery and equipment.

The TICs will provide training and incubation on the following value added products of Jackfruit:

1. Jackfruit Chips
2. Ripe jackfruit Preserve
3. Jackfruit pulp
4. Jackfruit Mixture
5. Dehydrated Ripe jackfruit: Bites
6. Dehydrated Ripe jackfruit pulp: Chew
7. Ripe Jackfruit Squash
8. Jackfruit Pickle
9. Dehydrated Tender Jackfruit
10. Dehydrated raw Jackfruit
11. Ripe Jackfruit Jam
12. Ready to cook tender jackfruit
13. Jackfruit seed flour
14. Raw jackfruit flour

The current status of the incubator could not be ascertained.

7.6 Jackfruit 'Fest'

In India, The International Symposium on Technology Intervention for Effective Utilisation and Marketing of Jackfruit (Jackfest 2018) was held in Kerala Agriculture University (KAU), organised by Department of Agriculture Development and Farmers' Welfare and KAU. As the official state fruit, Kerala produces 10% of the total jackfruit in India. It provides countless avenues for employment and income

generation for farmers in Kerala. Jackfest 2018 aimed to promote jackfruit, improve value-addition and marketing, and create a forum to develop strategies for commercialisation.

It was expected that Jackfest would lead to the adoption of best technologies for the fruit, especially through the creation of practical and farmer-focused supply chains that boost the internal revenue of the state. The organizers also planned to establish a network for the production and distribution of grafted jackfruit plants from select varieties. Aside from the symposium, Jackfest 2018 also included a 5-day training program for women on jackfruit processing, a jackfruit feast, three 1-day training workshops on jackfruit recipes, various exhibitions, and competitions, and cultural performances.

7.9 Developing Jackfruit Cultivation and Processing through ‘Mission Mode’

With a view to leverage and make use of this tremendous and abundant natural resource, which is currently being wasted, a five year MISSION JACKFRUIT is proposed by Meghalaya Government with the following objectives.

1. To catalyse and promote sustainable rural and urban livelihoods through the processing and value addition of Jackfruit by small scale and nano enterprises.
2. Creation of a value chain for Jackfruit products and generating employment opportunities along the value chain for unemployed youth.
3. Addressing food security and nutritional issues of the state in the long run.
4. Protection and preservation of catchment areas through promotion of the widespread cultivation of jackfruit for its food, timber, health and soil amelioration benefits.
5. Providing an additional source of income for rural and urban families through the commercialization of its processing and value addition.
6. Developing the markets for Jackfruit and its value-added products through a focused and professional go to market and field to fork strategy.
7. The Mission aims to achieve the above through the adoption of the following implementation strategy.
8. Action Research programme for Local Varietal identification, germplasm survey, technology sourcing and transfer.
9. Varietal improvement through the introduction and propagation of improved varieties /grafts via nurseries in both public and private sectors
10. Demand has driven R&D for product and process development, design and development of equipment, improved storage, shelf-life, packaging etc
11. Establishment of a Food Testing Laboratory with NABL / FSSAI certification
12. Promotion of Jackfruit cultivation in 2000 hectares of catchment areas and promoting the formation of Jackfruit collection, aggregation, agro processing clusters & FPOs
13. Establishment of 3 Techno-Incubation Centres (TICs) one each in the Garo, Khasi and Jaintia Hills for providing hands on training, technical assistance and incubation to entrepreneurs and to also to act as a common processing facility for jackfruit.
14. Promoting the establishment of 50 SMEs in jackfruit processing through a credit linked start-up fund
15. Promoting the establishment of 200 Nano jackfruit processing/brining enterprises at village level through a credit linked Nano start-up fund
16. Conduct of Hands on Training for 10,800 entrepreneurs/master trainers in the incubation centres over the next 5 years.

17. Conduct of Village level Go Mobile trainings on plant management and minimal processing for 69,300 partners over the next 5 years.
18. Development and creation of IEC materials, training manuals, publications, Z-cards etc
19. Organization of Jackfruit Melas / awareness camps in all 11 (eleven) districts every year for the next five years.
20. Organization of a State Jackfruit Festival to celebrate the fruit every year for the next five years.
21. Training cum Exposure visits on Value Addition of Jackfruit for around 2100 partners over the next five years.

8, POLICY INITIATIVE SUGGEST

- **Mission Jackfruit’–Improving the Eco-system for Cultivation and Value-addition:**
- **National Institute for Jackfruit Development**
- **Next Steps:**

An Integrated Approach to Development of Jackfruit Farming Community



Mission Jackfruit

An Overview:

The Jackfruit industry is at a very nascent stage in India and has a long way to go to reach its potential. There are a number of challenges facing the industry right from the cultivation stage to the retail and marketing of value added products. Such challenges can be tackled through a ‘mission mode’.

8.1 ‘Mission Jackfruit’

On the lines of ‘Mission Jackfruit’ proposed by Government of Meghalaya, various development initiatives be clubbed to adopt a ‘mission mode’. Such a ‘Jackfruit Mission’ could lead to enhancement of productivity and consequently, of margins accruing to jackfruit farmers. Further, it will facilitate emergence, sustenance and growth of value-addition activity.

8.1.1 ‘Mission Jackfruit’– Objectives:

Following objectives could be the objectives of the *Mission Jackfruit*

- a) To facilitate enhancement of income accruing to jackfruit farmers through:
- Encouraging ‘grafting’ with that high-yielding varieties of jackfruit
 - Promoting appropriate ‘package of practices’
 - Facilitate adoption of appropriate harvesting practices and post-harvest technology
 - Encourage the practice of ‘grading’ at farmer’s level

- b) To reduce wastage of the fruit and enhance value-addition through:
- Promotion of ‘nano’ enterprises for ‘minimal’ processing of jackfruit
 - Supporting existing tiny units by way of re-training and ‘clustering’
- c). To facilitate transition from ‘minimal processing’ to higher value addition through:
- Facilitating emergence of new entrepreneurs wanting to take up jackfruit processing going beyond ‘minimal’ processing
 - Strengthening existing SMEs through a variety of interventions such as ‘Management Development’, Technology Upgradation, Export Promotion and the likes
- d) To make Jackfruit processing an attractive proposition to entrepreneurs through:
- Market development interventions such as ‘Jackfruit Fest’
 - Incubation facility for tech start-ups wanting to produce high value-added products for ‘niche’ markets (health food for diabetics for instance)

8.1.2 Mission Components

Following are some of the key components of ‘Mission Jackfruit’.

- a) Cultivation: Setting up ‘Germplasm Bank’ and Promoting Scientific Farm Management
- b) Harvesting and Handling Techniques
- c) Transport and distribution–Need for an Information System
- d) Retail & Wholesale Marketing–Need for dedicated jackfruit promotion cell
- e) Support for Training and Marketing
- f) Promoting Jackfruit utilisation as a vegetable
- g) Promoting Jackfruit cultivation in arid zones
- h) Facilitating production and adoption of ‘Improved machines’
- i) Transforming ‘tiny’ processors into full-fledged Entrepreneurs
- j) Facilitating emergences of tech-savvy ‘Start-ups’
- k) Promoting Farmers’ Co-operative for Jackfruit Marketing
- l) Private labelling for hypermarket brands and on-line marketing
- m) Positioning Jackfruit products as ‘Health Food’
- n) Exploring Export Markets
- o) Application of ICT for Marketing and Networking
- p) Cluster Development Approach

It is suggested that a consultative group be formed to draft the ‘Mission Jackfruit’.

Steered by NITTE group be mandated to draft the Mission. The group could consist of experts from the State Department of Horticulture, well-known growers and

processors, Indian Institute of Horticultural Research, Entrepreneurship Specialists and other stakeholders such as NABARD, KVIC, NSTEDB and the like.

The next few pages outline a brief of the aforesaid components across each stage of value addition for creating a strong ecosystem for the industry to thrive.

8.2 Cultivation:

8.2.1 Setting up ‘Germplasm Bank’:

Focus on Jackfruit should begin from the cultivation stage itself so as to reap the rewards of the fruit holistically. UAS Bengaluru has been doing pioneering work in this field through its R&D into the best cultivars which are in demand by consumers. This also includes work on germplasm to tap into the genetic potential of the fruit. The soft flesh variety which is grown in more quantities and in areas are not as popular as the firm flesh fruit which are endemic to only certain geographies of India. The research also focuses on pulp characterization and high yield of crop. Additionally, UAS is researching nutrient content of the fruit which will help to further popularise it and increase the demand. Through research it has already been identified that jackfruit is very good to reduce the glycaemic content in blood and diabetics in Kerala eat the fruit during the season as an alternative to taking pills on a regular basis. Similarly, it has been identified that jackfruit seeds can act as a substitute for cocoa seeds for manufacturing chocolates. This opens up huge potential and vast markets for India in pursuit of a good alternative for expensive sourced materials internationally.

Several jackfruit producing countries have attempted sporadically to collect germplasm. The collection, characterization, documentation and evaluation of accessions (or provenances) from the region of origin and centre of diversity are far from complete. There is an urgent need to establish targeted collections from the Indian sub-continent and also from Southeast Asia. Several jackfruit producing countries have attempted sporadically to collect germplasm. The collection, characterization, documentation and evaluation of accessions (or provenances) from the region of origin and centre of diversity are far from complete. There is an urgent need to establish targeted collections from the Indian sub-continent and also from Southeast Asia. A major effort has been made to initiate selection by carrying out standard characterization and identification of trees with desirable characteristics. This was done under the auspices of UTFANET (Underutilized Tropical Fruits in Asia Network) in a participatory mode. Annexure IV depicts the characteristics of some of the varieties in India. Some of the cultivars/ varieties released by different countries along with their distinguishing characters are presented in Annexure V.

Genetic studies and molecular characterization are to be done for exploiting the wide range of variability available in jackfruit and efforts in this direction will help in breeding superior varieties for the benefit of jack growers and lovers.

8.2.2 Promoting Scientific Farm Management – Need for collaboration :

Farm Management techniques for jackfruit has not been explored so far in India. However, several countries in South-east Asia are practising jackfruit farming on large hectares of land similar to plantation farming of other crops. There is an urgent need to set up active collaboration with countries like Vietnam, Philippines, Sri Lanka and China and learn best practices and techniques in jackfruit cultivation. Organisations

like Asia - Pacific Association of Agricultural Research Institutions (APAARI) can be used as the forum for such exchanges. Another challenge that can be addressed through collaboration with other countries is lack of uniformity of cultivation which leads to each fruit ripening at different times which makes it difficult to harvest all fruits at the same time.

A mobile 'training' facility that reaches the doorstep of Jackfruit growers as experimented in Meghalaya could be put in place. The facility can go to each cluster of growers and demonstrate the following:

- Best practices in jackfruit cultivation (package of practices)
- Improved harvesting techniques (sapping for instance)
- Approach to grading
- 'Minimal' Processing

8.3 Harvesting & Handling Techniques:

8.3.1 Harvesting – Need for Innovation:

The Jackfruit does not lend itself to standard mechanised harvesting techniques as each fruit tends to be of a completely different size and shape. This problem is unique to the jackfruit and durian with no solution yet identified to overcome this problem. One solution which can be explored by Research Institutions is to restrict the fruits' shape, similar to experiments which have been done in the Japan to change the shape of the watermelon from round to square which aids in packaging and transportation. While the price of these melons is more expensive than the standard ones, innovative techniques like these which can be commercialised could become an important component in the success story of the Jackfruit. Mechanised harvesting of the fruit is not yet widely practised- in fact in the current scenario there is minimal mechanisation in harvesting. Hence the most suitable approach to identification of innovative harvesting and handling practises would be to study similar fruits which grow high on trees and require extensive care. The durian in South-east Asia could be one similar fruit where India can exchange notes on current practises.

8.3.2 Promoting Sorting and Grading Practices – Need for Training Interventions:

The huge advantage that jackfruit has over most other fruits is that it can be consumed in five different stages of growth – hence we have potentially five different raw materials in a single cultivation –

- a) Tender Jack
- b) Slightly grown as the 2nd stage
- c) Mature unripe
- d) Mature ripe
- e) Seeds

Each of the above is consumed in a different way and has multiple uses across value added products as well as the retail market. This core advantage will need to be utilised while harvesting the fruit through sorting and grading techniques.

The immediate need in post harvesting techniques is for rural youth to be trained in sorting, grading and packing fruits for storage and distribution. This will stem the

wastage at source and aid in increasing the shelf life of the fruit. The training could take place through a 'mobile' facility.

8.4 Transport and Distribution – Need for an Information System:

Transport requirement can be divided into two types; Local operators and Multi-modal channels. The relevant system is one of using local operators. *This could involve use of local small-capacity collection trucks visiting farmers at periodic intervals based on the season and requirement. Here too, utilization of a good information network where farmers can phone into collection centers to request for collection of crop, can aid in reducing wastage and improving farmer revenue while employment to rural youth.*

In the long run, a complete overhaul is required in the current transport and distribution system which is at best, minimal in terms of large scale professional players. Indian agricultural and manufacturing processes need to take advantage of the advanced technology and information systems software available in India, which is the IT hub of the world. The entire logistics and supply chain has to be integrated centrally to enable close monitoring and tracking of fruit cultivation production and storage data. This will need to be reverse integrated with incoming demand estimates and forecasts from manufacturers and retail and wholesale marketers. This will assist to calculate what quantity of fruit is required at which destination at any point of time. The immense potential of data analytics in this field is yet to be tapped and can minimize wastage to a very large extent.

8.5 Retail and Wholesale Marketing – Need for Dedicated Jackfruit Promotion Cell

Government investment in an end-to-end marketing strategy for the domestic and export markets is one of the most critical building blocks which will sustain and expand the commercialization of Jackfruit and its value-added products. *Support at the apex level through a dedicated cell for jackfruit promotion aided by support structures at the state level which can ride on the same agricultural support schemes will not only enable utilization of existing government resources but will also provide the oversight and commitment required from the dedicated focus of the cell.*

The proposed Jackfruit promotion cell can also facilitate partnerships between research and industry to fast track the time from new product development to market consumption with incentives provided to manufacturers for first adoption of new technology or new products.

Data was compiled from secondary and primary sources to (retailers, consumers, manufacturers, technology providers) to assess the potential of various products in the domestic and export markets. Based on the current stage of technology availability, shelf life of the value-added products, consumer awareness, ease of availability of the product in retail stores and current small scale manufacturing by MSMEs/ cottage industries, the market potential has been derived as under.

Customer Preference & Potential for Large Scale Expansion

Value added product	Consumer Awareness	Consumer preference	MSMEs	High end technology required for large scale	Avg Retail Price (INR)	Potential for Domestic Market	Potential for Export Market
Fresh peeled Jackfruit	High	High	Yes	No	75 (200 gms)	Yes	No
Dried Jackfruit flakes	Low	NA	Yes	No	529 (250 gms)	Yes	Yes
Preserved Jackfruit bulbs	High	High	Yes	No	32 (300 gms)	Yes	No
Dehydrated jackfruit bulbs	Low	NA	No	Yes	520 (250 gms)	Yes	Yes
Squash	Medium	Medium	Yes	Yes	235 (500ml)	Yes	
Wine	Low	NA	No	Yes	NA	Yes	Yes
Jackfruit vinegar	Low	NA	No	No	NA	No	No
Canned jackfruit products	Low	NA	No	Yes	210 (500 gms) 280 (500 gms- Organic	No	Yes
Jackfruit bar	Low	NA	No	Yes	160 (150 gms)	Yes	Yes
Jackfruit icecream	Medium	High	No	Yes	125 (1 litre)	Yes	No
Jackfruit pickles	High	High	Yes	No	125 (300 gms)	Yes	
Jackfruit chips	High	High	Yes	No	300 (200 gms)	Yes	Yes
Jackfruit papad	Medium	High	Yes	No	150 (25nos)	Yes	No
Jackfruit jam	Medium	High	Yes	Yes	140 (300 gms)	Yes	Yes
Jackfruit halwa	Low	NA	Yes	Yes	250 (200 gms)	Yes	No
Jackfruit seed flour	Medium	High	Yes	Yes	130 (400 gms)	Yes	Yes
Roasted nuts	Low	NA	Yes	No	30 (200 gms)	Yes	Yes

8.6 Government Support for Training & Marketing:

Some of the key players operating in the global Jackfruit market are Anna Food Products, Tropical Fruit Stand, Nam Viet Foods and Beverage Co., Ltd., Grandma’s Food Products, Madum Sun, Farmer Tree, Neelgiri Herbals, Artocarpus Foods Pvt. Ltd., ThiptipaCo.Ltd. and Thekkumkattil Herbal Products among others. Promotional activities carried out by manufacturers and quality certifications being provided and practiced by manufacturers will help in creating awareness about Jackfruit and its various benefits as well as reach out to customers globally.

Following is an illustration of such support by Meghalaya Government:

8.6.1 Start-up Funding for Jackfruit SMEs:

MSME’s are incubated under various state and central government initiatives. The enterprises incubated are linked to buyers and markets nationwide. While the support is to provide credit linked start-up funds, working capital, human resources and raw material will have to be met by the enterprises through their own investments or through bank linkages which ensure greater stakeholder participation, ownership, continuity and sustainability of the enterprise. As a prominent example, in Meghalaya, the Directorate of Food Processing and MIE facilitate the establishment of the enterprises in coordination with the Departments of Commerce and Industries, Cooperation, Labour, Legal Metrology, the FSSAI, financial institutions, insurance brokers, market strategists and brand designers to ensure a smooth take off.

8.6.2 **Start-up Funding for Nano Processing / brining units:**

Jackfruit also lends itself admirably to home scale or Nano processing either as chips, pickles, Kurkure, sweets, jams, papad etc. which is yet another avenue for additional livelihood and income support especially for housewives, marginalised and vulnerable sections of society. The processes are simple and with very little training and using commonly available household utensils, women can easily make such products at home which can then be sold in the local shops and markets. There is great potential under this component to target large numbers of households that can benefit from the jackfruit trees that grow in their own backyards. An example is that of Shri. K. Narashimaiah, a Farmer cum Teacher in Kachahalli village of Karnataka who earns around one lakh rupees per annum from only 6 trees in his backyard. To trigger off such nano enterprises, a start-up fund of Rs. 2 lakhs per enterprise for purchase of basic equipment is proposed under the mission either as a form of patient capital or linked to the credit under MUDRA, WEEFI, RMK, STEP, Mahila E-Haat or similar schemes.

8.6.3 **Meghalaya Initiative:**

In view of the market potential for both low and higher end Jackfruit products, government organisations are continuing to make substantial investments in packaging, creation of a Jackfruit brand and promotion of trade for jack products of the enterprises incubated in Meghalaya. To achieve this, they work with the TICs to hand hold enterprises in ensuring that quality, testing and certification norms are met and to develop a common brand for Jackfruit products, both for the low and high end market segments including exports. Road shows, advertising campaigns, buyer-seller meets, vending kiosks, online presence, trade fairs, B2B meetings, electronic and social media are leveraged to reach out to consumers and markets. They plan to engage the services of reputed design houses, national institutions like the Indian Institute of Packaging (IIP), National Institute of Design (NID) and experts for shelf life certifications, packaging design and brand building as well as the extensive competencies /resources of the PMU to achieve this. Tie-ups with other jackfruit processors and buyers across the country and abroad are being explored along with logistics, warehousing, distribution and cold storage operators.

8.7 Promoting Jackfruit Utilization as a Vegetable¹:

Jackfruit is generally used in North India as a vegetable, not as much in other States. Utilizing jackfruits for the vegetable purpose has two advantages.

- Reducing dependency on other vegetables
- Healthy option to meat
- Enhancing farmer's income
- Tackle 'seasonality' through adoption of off-season varieties

A Karnataka farmer, Mr'Channegowda of Hassan district has already experimented this idea. His twenty acre plantation has carefully selected cultivars that give fruits at different months. Net result : He will have any time in a year when he has no fruits to pluck!

One of the easiest ways to make Jackfruit a popular vegetable is Minimal Processing. Or turning it into RTC (Ready To Cook) form. Srilanka today is the fore-front country in using Jack- fruit as a vegetable. It is probably next only to Indonesia in highest

¹Technical Bulletin No.: 41 S. Priya Devi Sunetra Talaulikar Mathala Juliet Gupta M.Thangam N. P. Singh Value Addition A Guide on Jack Fruit

percentage of utility of Jackfruit as a vegetable. Go to any town in Srilanka, jackfruit is available in ready form almost round the year. Horticulture department has been giving training in this since the last one decade. An estimated number of 5,000 people are eking out their livelihood by what they call as ‘fresh cut’ jackfruit.

8.8 Promoting Jackfruit Cultivation in A arid Zones:

Jackfruit is an under exploited crop capable of giving very high yields. Jackfruit is a hardy crop and the tree grows very well even under neglected conditions and in poor and marginal lands. It is grown mainly on homestead farms and produces multiple products for food, feed and industry as well as contributing towards soil management for sustainable development.

Climate change, farm labour issues, drought and dwindling water sources have made farmers to go for Jackfruit cultivation as a natural option, Shree Padre, Executive Editor, AdikePathrike, a farm monthly and a crusader for jackfruit and its value-added products, told The Hindu.

About 2,000 hectares of jackfruit orchards have come up in the Karnataka since 2010’ Jackfruit, a wild fruit that once grew naturally in the countryside, is now cultivated in orchards in Karnataka as a mono crop.

From a minimum of two hectares to a maximum of more than 10 hectares, they are concentrated mainly in Bengaluru Rural, Ramanagaram, Hassan, Tumakuru, Kolar, Chickballapur in addition to some areas in the Malnad belt. About 40 grafted Jackfruit varieties are available now in nurseries in the State. Bairachandra, Toobugere Red, Swarna, Lalbagh Madura and Sadananda are some of the premium varieties which are in high demand. Value addition is required for such types whose quality is not up to the mark. Shivanna of Sakharayapatna, who is from Parivarthana, an NGO in Chikkamagaluru district, and who has been making ‘Jaffe’ health drink from jackfruit seeds and pulp from the fruit, said that a farmer, Nagendra, planted jackfruit plants on four acres in his village. The trees on the more than 10-acre orchard of Channe Gowda in Arkalgud in Hassan district began yielding from this year. Mr. Vishwas, a farmer near Hassan, planted jackfruit as a mixed crop with mango and sapota on 10 acres, he said.

Mr. Padre said that the orchards are coming up in the State without the government’s campaign for it. “They are coming up as a result of the farmers’ own movement.” A National Jackfruit Research Station is needed in the State, Mr. Padre said. “Promote sale and transport of peeled ready Jackfruit from production area to processing centre so that both industry owners and farmers get benefited,” he said. *Following are suggested actions with State support:*

- a) Establishing the feasibility of jackfruit orchards (either stand-alone or as ‘intercrop’)
- b) Publicizing the same thru a variety of means such as:
 - Where ever feasible, organizing experience-sharing sessions for growers by successful orchard owners
 - Preparing audio-visuals of orchards already in existence and benefits there off – to be displayed inappropriate for a such as ‘Kisanmela’
- c) Financial support to those wanting to set up full-fledged orchard taking advantage

- of existing funding schemes or formulating a new one
- d) Technical support, specially related to adoption of a mix of jackfruit varieties and use of better 'package of practices' through existing apparatus of Agriculture/Horticulture Department of the State government
 - e) Facilitating a 'mentoring' system wherein a grower already successful in tending an orchard acts as mentor to a newcomer

8.9 Facilitating Production and Adoption of 'Improved Machines':

Traditional methods of Jackfruit processing involve four major units operations namely peeling of fruits, cutting of fruits into slices, frying and packaging. Each of these unit operations are done manually especially due to the lack of appropriate mechanical system. At present the chips are made by cutting and slicing raw jackfruit by knife and then deep frying in edible oil. The method is unhygienic and does not produce chips of uniform thickness and may cause injury to the persons while slicing. But still the manual method of slicing is widely used due to the lack of efficient mechanical slicers. To fulfil these requirements a women friendly mechanical Jackfruit slicer cum dicer was developed under Centre of Excellence in Post-harvest Technology at Kerala Agricultural University. The new slicer can be efficiently used in both small and large scale industries for slicing Jackfruits with minimum loss of material (8.4%) and can do trouble free-slicing at higher quality and efficiency i.e., two to three times higher than manual slicing. *The facilitation mechanism could include:*

- a) Identifying new /improved machines suitable for minimal processing
- b) Demonstrating the same through a 'mobile' facility as discussed earlier (See Para8.1.2)
- c) Offer technical training, where ever necessary, to those already engaged in 'minimal processing'.
- d) Providing credit linkages

8.10. Transforming 'Tiny' Processors into Full-fledged Entrepreneurs:

Jackfruit is highly perishable in nature due to its inherent composition and textural characteristics. Some estimates peg the wastage to about 70% to 80% of the output. Hence efficient processing methods and storage facilities are required for its preservation. Various gender friendly machineries which are suitable for jackfruit processing are developed by the Kerala Centre. Many new process protocols for the production of ready to eat and ready to cook products are also standardized by the Centre. These energy efficient equipment and viable technologies will be a boon to the micro and small scale processing industries to reduce the wastage of Jackfruit. These new trends in Jackfruit processing technology will certainly boost the entry of entrepreneurs to this sector and improve the socio-economic security of the jackfruit growers and processors of our state.

The transformation process could involve the following components:

- a) Identify 'tiny' processors: All tiny manufacturers or home-based minimal processors may not be in a position to absorb improved / new technology. Further, not all of them possess competencies required to manage the increased activity level. Therefore, it is necessary to identify tiny processors who exhibit entrepreneurial skills and facilitate their transformation to 'for-profit' ventures going beyond home-based subsistence-level processing.

- b) On a sample basis, carry out a 'need assessment' study (includes learning needs and support needs)
- c) Facilitate identification of value-addition opportunities
- d) Offer technical training
- e) Providing provide 'entrepreneurship' inputs
- f) Provide simple and pragmatic 'knowledge' inputs to help them manage increased activity level consequent upon transformation
- g) Facilitate credit linkages (to meet the cost of new equipment and allied facilities) through formal banking channels or through a 'micro credit delivery mechanism'
- h) Encourage joint action: One of the key factors that impact the transformation of 'tiny' processors operating at 'subsistence' level into full-fledged entrepreneurs is size. Small enterprises have limitations by virtue of their size (limited bargaining power for instance). One way to overcome this limitation is to promote 'joint action'. This could be by way 'common' procurement of materials, common branding and the likes. This calls for a dedicated cluster development professional who can organise tiny / home-based ventures into vibrant 'groups'

8.11 Facilitating Emergences of Tech-savy 'Start-ups':

Centre of Excellence in Post-harvest Technology at Kerala Agricultural University promotes entrepreneurship development in Jackfruit processing sector in ours.

This Center is organizing hands-on training on jackfruit processing machinery, value-added products from jackfruit, project report preparation on jackfruit processing units, and other related professional assistance to make the enterprise successful and achieve higher growth. Some of the potential innovative technologies and related machineries used in jackfruit processing industries are briefed below:

8.11.1 Dried Jackfruit Flakes :

Dried Jack Fruit flakes are prepared by slicing the Jack Fruit bulbs using Jack fruit bulb slicer and subsequently dried in a combo drier. Mechanically sliced jackfruits can be dried by means of an efficient blancher-cum- drier. Blanching is one of the pre-treatment that is used to arrest the enzymatic activities before drying. Mechanical blanchers are usually avail- able for blanching operations. Separate blanching and drying procedure is a time consuming and tedious process. It will also leads to increased production cost. Efficient drying with minimal time and operation cost is the main attraction of the newly developed blancher cum drier. The capacity of the blancher cum dryer unit is 18- 28 kg/ batch. Efficient drying and quality dried product can be produced by this combo machine. This machine is highly useful to micro and small scale jackfruit processing units for producing dried Jackfruit flakes with minimum cost.

8.11.2 **Extrusion Technology:**

Presently, several RTE products are available in the market and becoming popular day by day due to the change in food habits and their convenience in use. Extrusion technology has a pivotal role in the snack and ready to eat breakfast food industry. The development of new value-added products like expanded products would enhance their food, and economic value. Extrusion technology is very useful from the standpoint of nutritional value as nutrient losses are lower compared to other thermal processing methods. An industrial twin screw extruder is required for large scale production of extruded products. Apart from extruder supporting machineries such as blancher, slicer, pulverizer, industrial mixer and coating machine are required for the successful production. Incorporation of underutilized fruits like matured jackfruit, seed flour, etc., in RTE products, will enhance the nutritional value as well as resource utilization.

8.11.3 **Vacuum Frying Technology:**

It is an innovative technology for the production of healthy fried snack products. Currently, the problem associated with the snack foods is its oil content that leading to the immediate rancidity and the health problems due to the carcinogen produced during frying. To resolve these problems a green technology was developed known as vacuum frying. The advantage of vacuum frying is that the oil quality gets maintained and the oil can be reused more than 50 times. The vacuum fried jackfruit can be stored for more than three months under active modified atmosphere packaging using nitrogen flushing. It is an innovative technology to conserve the oil degradation, reduce the oil absorption and retain the nutritional quality of the fried product by heating it under a negative pressure and low temperature that lowers the boiling points of the frying oil and water in the sample. Different other machineries such as slicer for slicing the samples in uniform size and shape, Vacuum packaging machine for nitrogen filled packaging for better storage are essential for a large scale production unit.

8.11.4 **Intermediate Moisture Foods (IMF):**

One of the major traditional practices of preserving ripe Jackfruits is by dehydration. Osmotic dehydration of the fruits is one of the food preservation techniques used for partial removal of water from fruits by immersing in aqueous solutions of high osmotic pressure viz., sugar and salts. Intermediate moisture foods (IMF) are one of the major attraction in current food market as this technology could preserve seasonally available fruits for a long period. This could be prepared by a two-stage drying process ie; osmotic dehydration followed by any other secondary drying. Osmo-dried Jackfruit is an intermediate moisture food product, and is not only delicious but also conserves attractive color and nutritional elements. This processed product has six-month shelf life, which could reduce wastage of surplus ripened Jackfruit. The ripen jackfruit bulbs which are deseeded and soaked in sugar syrup for osmotic dehydration and further dried using cabinet dryer. The processing conditions like soaking time, the temperature of drying were also standardized under Centre of excellence in post-harvest Technology. The second stage drying could be done either by traditional drying, solar drying, cabinet drying, vacuum drying or any other modern drying methods viz; fluidized drying, microwave drying, freeze drying, etc.

Conventional drying method includes sun/solar drying required more time to complete the process and resulted the poor quality dried product. Improvements in science and

technology pave path to the development of new mechanical and electrical driers. Vacuum dryer, Micro- wave drier, hybrid driers, belt dryers, fluidized bed dryer, freeze dryer, etc. are the major dryers presently available in food industries. Among this vacuum, dryer is an effective dryer for the production of intermediate moisture foods. Retention of color and uniform drying are the major advantage of vacuum dryers. It is a time-consuming process and can add value to the locally available fruits and vegetables.

8.11.5 Canning of Tender Jackfruit:

Processing of tender Jack- Fruit a vegetable can give a quality product that fetches a better price in the market and thus help to improve the financial status of the jackfruit growers in the state. Processed Jack fruit products have excellent market in the domestic and export front. The tender Jack fruit was cleaned and cut into pieces, blanched and canned in three piece cans. The canned jack fruit have a shelf life of 2 years. The shelf life of canned tender Jack fruit obtained was under atmospheric condition. The canned tender jack resembles as fresh Jack fruit and available to the consumers in ready to eat form throughout the year.

8.11.6 Retort Pouch Packaging Technology:

The high cost of canning necessitated exploring an alternative to the canning system. Retort pouch packaging system is an ideal alternative to metal cans to achieve these goals. It is a flexible, laminated package that can withstand thermal processing temperatures and combines the advantages of both metal cans and plastic packages. Easy bulk packing, less transportation and material cost, rapid heat penetration, easy disposal without environmental pollution and heat sealability are the major advantages of retort pouch packaging. Process protocol for retort processing of tender Jack Fruit was developed. The treatment combinations like blanching, thermal processing parameters like temperature, time, preservatives etc. were optimized based on quality analysis and shelf life studies. The retort processed tender Jack Fruit is shelf stable for one year without any changes in its nutritive value. Traditional foods such as fish curries, fruit pulps etc. could also be preserved by this method. This is a blooming technology in food industry and a promising technology that is accepted by the consumers.

Because of its heaviness and large size, transportation and packaging are huge impediments for the successful marketing of jackfruit. Therefore, value-added products have more relevance for commercial utility rather than the whole fruit. Entrepreneurship based on latest developments in jackfruit processing has the potential to contribute to a range of social and economic development such as employment generation, income generation, poverty reduction and improvements in nutrition, health and overall food security in the national economy. The growth of this industry will bring immense benefits to the economy, reducing post-harvest losses, creating employment and raising life-standards of a large number of people across the state, especially those in rural areas or production catchment.

Therefore, it is recommended that following steps be taken to promote tech-savvy 'Start-ups' or 'technopreneurs':

- a) Identify local youth who possess the entrepreneurial potential and have access to resources for investment

b) Train them offering the following inputs:

Classroom Inputs and One-on-one Counseling:

- Basics of entrepreneurship
- Business opportunity identification process including exposure to high value-added processing opportunities
- Information inputs covering procedures and formalities for setting up a small venture and facilities available from the support system
- Development of soft skills / entrepreneurial competencies
- Business plan preparation
- Pragmatic aspects of managing a small scale venture

Practicum:

- Exposure visits to relevant manufacturing firms
- Technical training /orientation in association with technology providers like GKVK and CARD-KVK

Implementation Support:

- Assistance in business plan preparation
- Linkages with financial institutions
- Business counseling

8.12 Promoting Farmers' Co-operative for Jackfruit Marketing:

Weight, spoilage and high transportation costs are the major constraints related to marketing of jackfruit coupled with a lack of reliable price information at the farm gate level. The price per fruit varies from market to market. The fruits are bought from the farm gate at very low prices by middlemen in comparison to retail prices even after accounting for cost of transportation and retailing. They are then sold through retail outlets/vendors. *Therefore, 'joint action' by farmers involving direct marketing through formation of 'Farmers' Co-operative' helps fetch margins to farmers. Further, the 'joint action' could include assistance for following 'sapping' system to reduce post-harvest losses and promote grading.*

8.13 Private labeling for Hypermarket Brands and On-line Marketing:

Given that there is a new class of young urban consumers wanting to access ready-to-eat and hygienic fruits, there is potential for promoting 'private labels' (carrying sellers brand) of bulbs. This calls for farmers to separate bulbs from seeds in a hygienic manner and pack them in an eco-friendly manner. No single farmer can accomplish this. For, there is a need to adopt an entrepreneurial approach to tie-up with hypermarkets / retail chains. Also, 'cold chain' for storage and transportation needs to be developed. Once this is accomplished, it is possible to market through E-commerce platforms. Thus, it calls for 'joint action' on the part of the farmers.

Applying 'minimal processing' approach, the proposed 'joint action' could also include production of chips, roasted seeds, and seed flour.

8.14 Positioning Jackfruit products as 'Health Food':

In collaboration with big retail chains / hyper markets and with State support, products such as vacuum dried chips and seed flour could be positioned as health food given the inherent health benefits of Jackfruit. This calls for following an *appropriate communication strategy to facilitate consumer awareness the health benefits of the fruit*. Given that no individual farmer can take up such an exercise, 'joint action' is called for.

8.15 Exploring Export Markets:

Countable few Indian manufacturers are now exporting Jackfruit products. There is scope to enhance the share of Indian Jackfruit products in global markets. Interactions with knowledgeable persons/exporters indicate the following products have good potential for exports:

- Frozen Jackfruit.
- Vacuum fried chips
- Jackfruit pulp
- Dried Jackfruit bulbs
- Dehydrated canned unripe Jackfruit

When cooked, unripe Jackfruit has a texture similar to pork or chicken, making it a popular vegan option in countries such as the UK, the US, and Germany.

The efforts could be targeted at existing manufacturers that have potential to tap export markets. They can be assisted through a variety of schemes available under the aegis of the Directorate of MSME.

8.16 Application of ICT for Marketing and Networking:

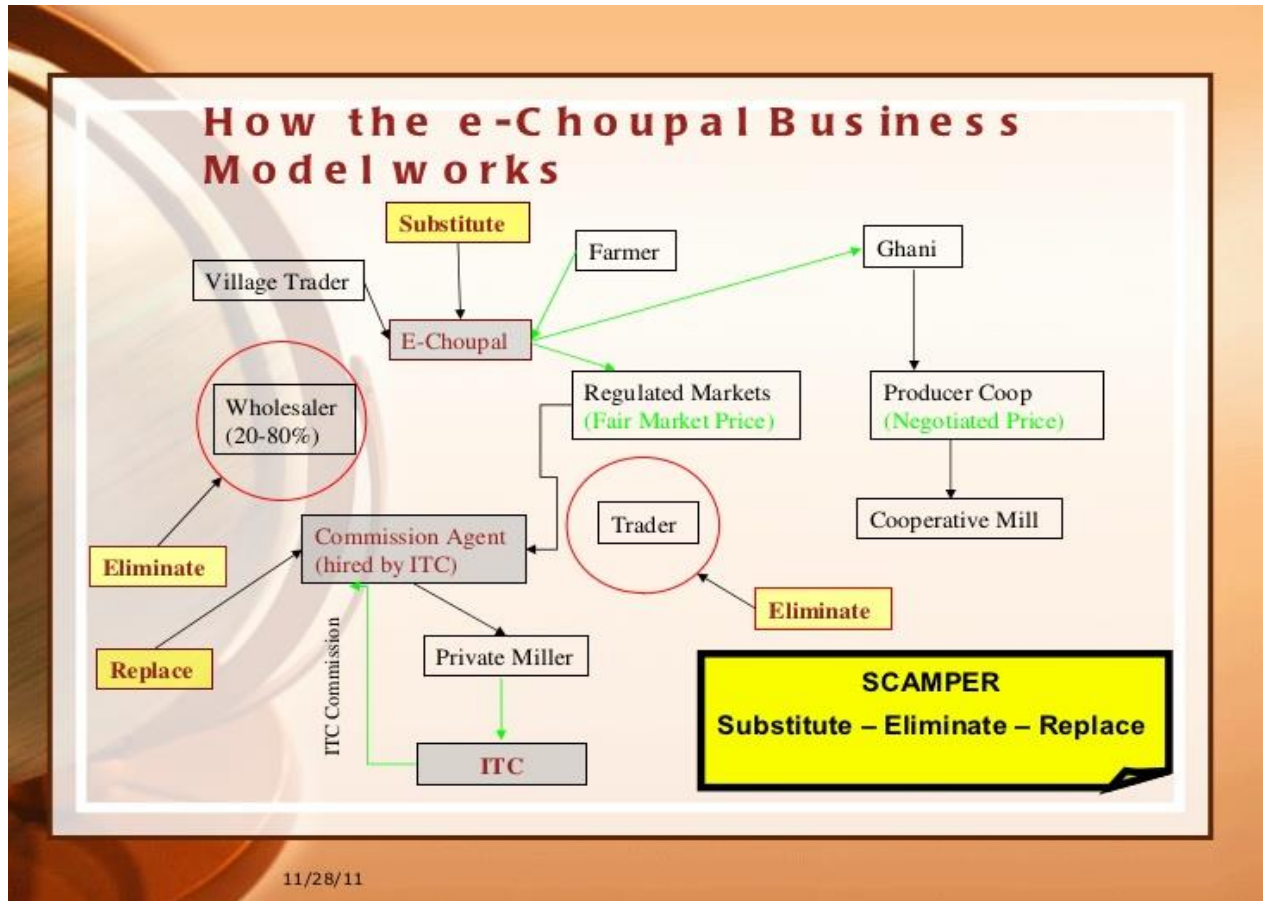
ICT has the potential to make significant inroads in a traditional agrarian economy like India. Indian agro-sector has been exploiting the benefits to ICT. Innovative ICT application platforms are being created by private sector players in conjunction with local farmers. One such private initiative – 'eChoupal' - has been by ITC Ltd in the state of Madhya Pradesh. It has helped the farmers in many ways, such as developing of local leadership, shared ownership of the assets created in this initiative, access to the latest knowledge for the agro-sector, sustainable income levels and skill development for productivity improvement. Several best practices can be learned from this initiative, namely:

- Ease of replicability and scalability
- customization to meet the specific local needs and
- organizational commitment.

On a pilot basis, it is suggested that at least one 'e-Choupal' be set up. It is a computer with internet facility that allows users to access the e-Choupal website run by ITC. A

local farmer acting as a coordinator or 'Sanchalak' runs this amenity. He receives a small commission from farmers who wish to use this facility. A local commission agent or 'Samyojak' assists the Sanchalak by providing logistical support. Launched in June 2000, 'e-Choupal', has already become the largest initiative among all Internet-based interventions in rural India.

Noted below is a pictorial depiction of the business model of a typical e-Choupal:



8.17 Cluster Development Approach:

Major Jackfruit producing areas could be divided into distinct clusters. One could then follow an integrated approach leading to development of the clusters. The basic prerequisite for cluster development is the availability of a cadre of trained cluster development executives to be in place. Ideally, professionals with Agriculture or Horticulture background could be trained for the purpose. *To start with, a pilot project could be launched in one of the clusters. Later part of this section provides further details on the cluster development approach.*

8.18 Proposed Go-to-Market Strategy for Domestic Market:

In the domestic market, the following products have good potential:

-
- Jackfruit chips
- Jackfruit mixture
- Jackfruit Halwa / Chakka variety

All these products could be manufactured at ‘Small’ scale.

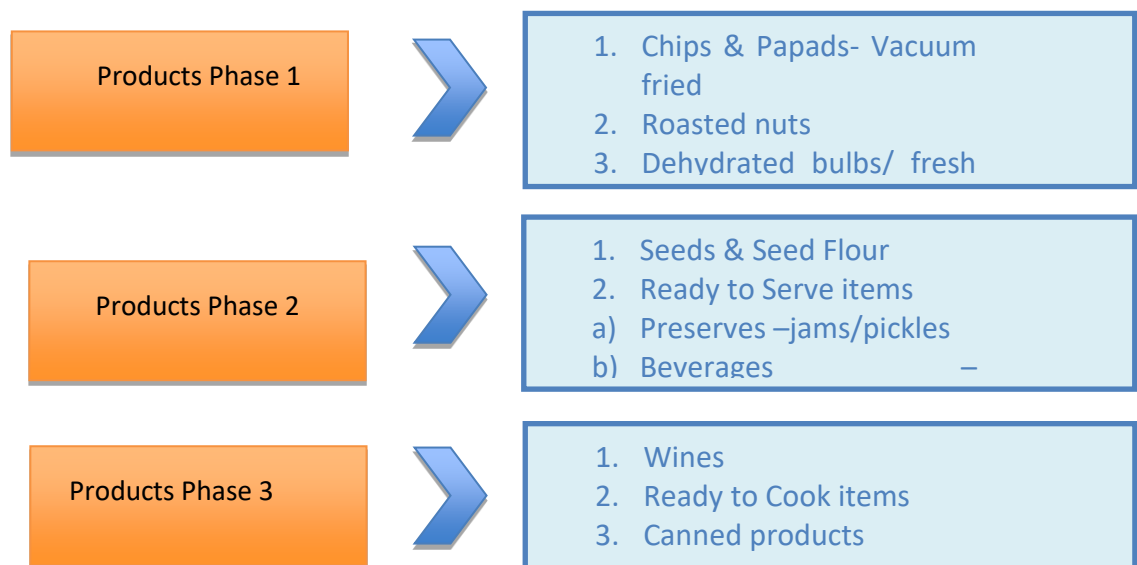
Jackfruit flour has multiple uses. Since it is delicious flour, it can be mixed with wheat flour for making chapathies. It can also be used for making cookies. However, it is observed that the market penetration is slow. This product can be targeted at health-conscious urban consumers and those with lifestyle illnesses, especially for people with diabetics.

As gathered from knowledge persons /manufacturers in organized sector, the initial market development efforts could focus on Jackfruit vacuum fried chips and papads initially as they are top two value-added products in terms of sales value. Second phase can include seed flour, jams, preserves, and halwa; Remaining products like wine can be explored at a later stage.

The Go-to- Market strategy has been proposed based on the below factors:

- a) Existing customer awareness and product availability in retail stores – these products can be described as the low hanging fruit which makes it an easy target for an increase in sales and demand. These products will require a core investment in good packaging technology and targeted marketing.
- b) Ease of production and retail distribution based on the shelf life of the product along with consumer awareness of similar products from other fruits – these products will require building consumer awareness and need a stronger branding and advertising strategy as consumers will need to be attracted to try the product as a first Promotional events and free samples along with sale of other jackfruit products can be provided to attract consumers.
- c) Requires investment in high-end technology, an incubation period, large scale manufacturing and intensive branding advertising and marketing to build sales volume. The ROI on this phase requires a longer term. However, once established this can be a market dominant area as a first mover.

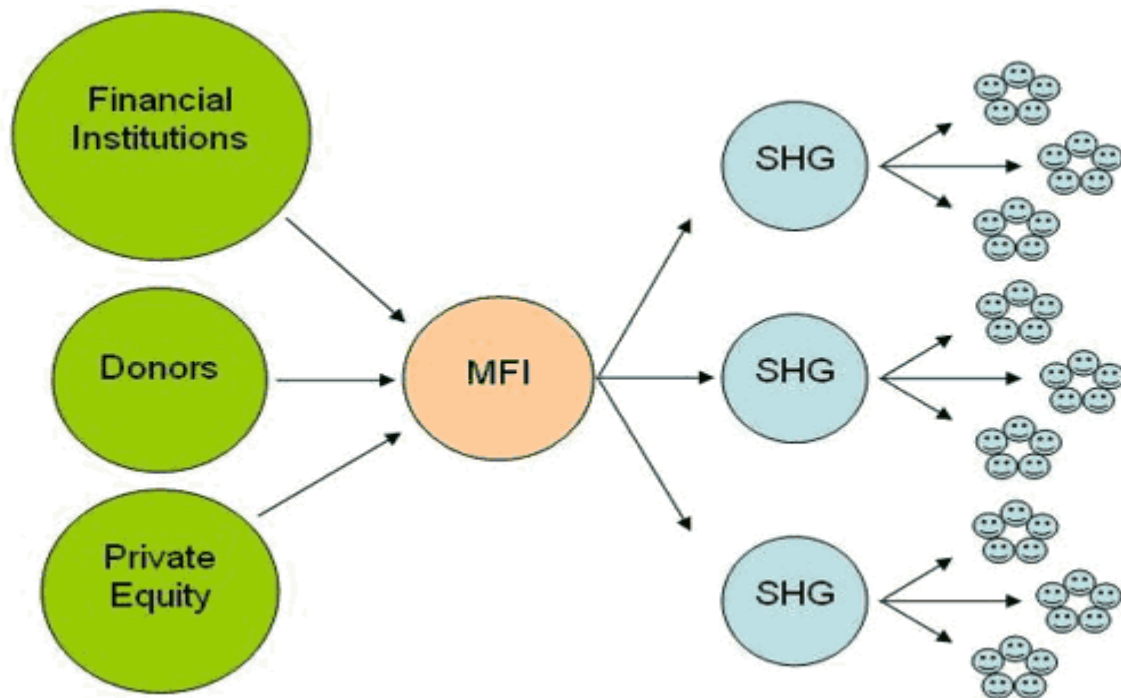
The three-phase approach is depicted below:



Such an approach be kept in view while implementing some of the initiatives discussed in this section.

8.19 Micro -Finance – An Integral Part of the Development Process:

Any effort to improve a lot of small /marginal farmers engaged in growing Jackfruit mainly for subsistence and those engaged in tiny / household –level processing has to provide for financial support. Since they have very little access to institutional finance through conventional banking channels, there is a need to provide 'micro credit' through an appropriate mechanism. Following is a pictorial representation of atypical MFI:



The origin of microfinance dates back to 1984 when Mysore Resettlement and Development Agency (MYRADA) , a NGO engaged in rural development based in Karnataka promoted several Co-operative Societies that extended loans to their member. As of now, some of the well-known MFIs are SKDRDP (Dharmasthala) , IDFFSPL, Spandana, GrameenKoota . The important milestones in the journey so far is the SHG Bank Linkage movement spearheaded by NABARD with the support of Reserve Bank of India and the G.O.I.

While it is difficult to say whether an exclusive Miro Finance Institution (MFI) is required to support small growers and processors , there is a need to involve one or more MFIs in any development initiative targeted at them. For instance, MFIS could be a part of cluster development. They could also be a part of the proposed working group for formulating Mission Jackfruit.

National Institute for Jackfruit Development

8.20 Overview:

As indicated above, a variety of interventions are proposed to develop Jackfruit cultivation and value-addition. For enhanced effectiveness and co-ordination of the proposed interventions as also those being undertaken by institutions such as GKVE, Bangalore; CARD – KVK, Kerala; IIHR and others, it is proposed to institutionalize the process through setting up of a dedicated institutional mechanism. A brief of the same follows:

8.20.1 Objectives:

The proposed Institute could have the following objectives:

- a) Promote effective use of a natural resource: As per some estimates, it is to be said that a large part of the fruit is currently wastage for want of necessary infrastructure to collect, transport and process the fruit.
- b) Enhance farmer's income through better value-realization
- c) Facilitate value-addition in organized as also un-organized sectors
- d) Promote 'commercial' cultivation
- e) Employment generation consequent upon enhanced output and processing
- f) Promote Jackfruit as an 'arid zone' crop given that many varieties of the fruit survive under tough conditions

8.20.2 Activities:

Given the said objectives, the Institute could undertake the following activities:

- a) Training: The institute could take up training to:
 - Enhance the productivity of tiny /home-based processors
 - Adoption of appropriate processing technology
 - Lessen 'drudgery' through hands-on training in use of simple equipment for 'minimal processing'.

b) **Extension:**

- a) Help the growers through the adoption of an improved package of practices
- b) Facilitate adoption of new varieties that could enable year-round availability of the fruit
- c) Act as 'clearing house' (collect, collate and disseminate information) for new ideas in cultivation, harvesting, post-harvest technology and processing: For instance, GKVK has a repository of project profiles on value-addition. Likewise.

- d) Identify research areas and facilitate the 'market driven' approach to research in conjunction with existing institutions engaged in Agriculture / Horticulture research.
- e) Promoting Jackfruit cultivation in arid zones: As indicated earlier, Jackfruit is an underexploited crop capable of giving very high yields. Jackfruit is a hardy crop, and the tree grows very well even under neglected conditions and in poor and marginal lands. It is grown mainly on homestead farms and produces multiple products for food, feed, and the industry as well as contributing to soil management for sustainable development.
- f) Business counseling: Set up 'Business Counseling Centres' in conjunction with Entrepreneurship development Institutions and related NGOs. The service is to be targeted at MSMEs already engaged in processing
- g) Facilitate setting up of a 'Germplasm Bank' in association with relevant institutions
- h) Provide real-time market data to growers through 'e-Chaupal'
- i) Facilitate market development for the fruit and the value-added products through a variety of measures such as 'Jackfruit Fest'
- j) Facilitate setting up of a National Body on the lines of the National Egg Coordination Committee: Set up in the year, NECC is unique in many ways. With a membership of more than 25,000, it is the largest single association of poultry farmers in the world. Most of today's egg production in India comes from NECC members. In the past two decades, NECC has played a significant role in the betterment of the poultry industry in general, and the egg industry in particular, through its various programmes like market intervention, price support operations, egg promotion campaigns, consumer education, market research, rural market development and liaisons with the government on vital issues concerning the industry.
- k) Incubation: Facilitate the emergence of start-ups with significant

In short, the proposed Institute could be the 'Secretariat' for implementing 'Mission Jackfruit' in partnership with various stakeholders such as the State Department of Agriculture, IIHR, GKVK and the likes that have domain expertise. Initially, the Institute could focus on formulating and implementing development interventions in the State. Over some time, the Institute could act as a 'National Resource Agency' support development initiatives in the other Jackfruit-growing States.

8.20.3 **Institutional Arrangement:**

Considering that there are already a variety of institutions at National level as also at the State level, there is no need to have full-time professionals to start with, on the roles of the proposed Institute. The institute has to take advantage of domain expertise (technical aspects including R & D) available with other institutions. For instance, the proposed Institute need not have on its roles, technical experts on processing and need not have a technical training Centre to start with. Centre of Excellence in Post-harvest Technology at Kerala Agricultural University has related facilities that could be availed on need-basis. Such an approach will help kick-start the proposed Institute without the elaborate process of facility planning and acquisition.

Considering the above, it is proposed that the Institute have a 'lean' staff focussing more on development professionals rather than on 'technocrats' to start with. In terms of legalities, it is crucial that the Institute operates independently akin to a 'social enterprise'. For, in order to promote entrepreneurs, the Institute freedom needs to have a freedom of 'thought'. This in turn, would mean financial independence that can be achieved through an approach of self-sustenance in its operations. Thus, it is suggested that the proposed Institute be set up as a 'Section 8 company'. Further... the Institute needs to have a corpus fund from its promoters. The income from corpus fund is to be applied, initially, to meet organizational overheads, the operational expenses to be met through 'sponsorship' of its operations. For instance, the Institute could set up an incubator raising funds from DC, MSME or NSTEDB or others agencies.

The working group proposed for drafting 'Mission Jackfruit' could be mandated to facilitate preparation of a feasibility study for the Institute. With a view to kick-start the process of formulating and implementing 'Mission Jackfruit', a progressive institution like NITTE with credibility and social responsibility could host a 'cell' that could constitute the working group, conduct its proceedings and implement certain interventions as indicated in below (Section 8.21)

8.21 Next steps – An Integrated Approach to Development of Jackfruit Farming Community:

While some of the action points as indicated above could take place in the medium term and some (brand building/positioning as 'heath food' for instance) in the long term, an integrated approach on a pilot scale that can be steered by *Institutions like NITTE* is proposed. One such approach involves *Cluster Development on a pilot scale with the following components:*

- a) Selecting a limited geographical area (within a radius of 20 to 25 Kms.) where there is a concentration of Jackfruit farmers
- b) Conducting a baseline survey to understand the current situation related to Jackfruit production and processing
- c) Encouraging a group of progressive minded farmers to come together as a cluster to promote :

- Application of appropriate post-harvest technology (sapping system for instance),
 - Grading
 - Consortium approach to marketing fruits
 - Boost 'Minimal Processing' (chips, roasted seeds, seed flour for instance) to start with ,later moving enhanced value addition
- d) Taking up a diagnostic study of the cluster
- e) Preparing an action plan bringing on board all the cluster 'core member-farmers /small-time processors' for development of the cluster
- f) Establishing appropriate linkages among all actors of the cluster

While the cluster development process mandates that the action plan has to emerge from the 'core member-farmers /small-time processors', *certain interventions that prima-facie , appear relevant* as noted below, can be initiated:

8.21.1 **Go Mobile' Village Level Training:**

To take the concept and awareness about jackfruit value-addition to the masses, and based on the success of apiculture training, a concept of village level 'Go Mobile' training is proposed. A similar initiative has been taken up by Meghalaya Government wherein Master Trainers move to village clusters and stay there for 3 to 4 days to train farmers in the basics of plant management and minimal processing at the Nano enterprise /household level. The training is usually conducted for 6 hours daily so that farmers can go about their daily work with minimal disruption while availing training at their doorstep. Under this approach, they can reach out and train twice the number of farmers in half the time and cost. As a pilot, a total of 585 batches of 100 farmers /batch are targeted for two years which would enable the government organizations to reach out to about 58,500 farmers. Training materials, manuals, Z-Cards etc, are provided as part of the scheme.

8.21.2 **Awareness Campaigns / Melas:**

To further add a fillip to the awareness and trainings and sensitive people and society at large about Jackfruit, meals / campaigns to spread awareness about the fruit and its potentialities, are organised to sensitise and draw the attention of policy makers and practitioners, government officials, farmers, civil society, citizens and entrepreneurs to the potential of Jackfruit and encourage them to take up the Jackfruit cause. This meals could be organized in association with Directorate of Food Processing.

The meal is a platform in which entrepreneurs and processors can not only showcase and sell their products but they are also given an opportunity for them to interact with buyers. The meals feature Jackfruit shows, Jackfruit exhibitions and jackfruit competitions and are an ideal opportunity to carry out the process of varietal identification and classification of the jackfruits on display by a team of experts drawn from the Universities and research institutions.

8.21.3 **State Jackfruit Festivals:**

Awareness about Jackfruit, its many benefits and opportunities amongst buyers, consumers, entrepreneurs, makers and practitioners of policy, civil society, thought leaders etc. is also an important aspect to mobilize and shape public perception of the fruit and ensure their buy-in into the jackfruit cause for the benefit of farmers. To this end, state-level Jackfruit festivals are important showcases and opportunities for entrepreneurs incubated to showcase and market their products to a wider audience and interact with buyers, experts, scientists, source leads, negotiate deals, explore markets, technology options and gain knowledge from fellow entrepreneurs and processors etc. Such festivals constitute an integral part of awareness campaigns to showcase farmers, entrepreneurs, products & technology.

8.21.4 Exposure Events:

Exposure visits are an essential part of any training and incubation programme in order to open the minds and eyes of our entrepreneurs to the growth and business opportunities available outside of their village, block, district or state and to afford them an opportunity to interact and see how people of other states or even districts go about their livelihoods. An exposure visit is an inspirational experience and offers partners a chance to experience another culture, see different places, meet different people, see new and different technologies, eat different kinds of food, all of which opens up their minds to new ideas and increases the adoption rate of improved technologies and teachings. The exposure visits are organized by the Directorate of Food Processing and anchored by the partner Universities and organizations.

8.21.5 Common Branding and Marketing:

Currently, value-added products such as chips, roasted seeds, seed flour that call for minimal processing and simple technology and relatively low investment, are produced largely the unorganized sector. Individual producers are too small to access markets beyond their neighborhood. Such producers will derive benefit through a 'consortium approach' whereby they join hands to sell their products under a common brand deriving advantage of 'scale', better bargaining power and higher realization through the elimination of some, if not all, middlemen.

8.21.6 Private Label for Bulbs:

As indicated in the previous section, the possibility, especially from the angle of enhancing shelf life, could be explored. If found feasible, a group of progressive farmers from the proposed cluster could adopt a consortium approach to separate bulbs from seed, pack the bulbs in a ready-to-eat manner and sell through large retail chains.

8.21.7 Common Facility Centre:

There are some interesting value-added products such as Jackfruit slice, vacuum-fried chips and jackfruit flakes.

Dried jackfruit flakes are prepared by slicing the Jackfruit bulbs using Jackfruit bulb slicer and subsequently dried in a combo drier. Mechanically sliced jackfruits can be dried by through an efficient blancher-cum- drier.

Recently, at IIHR, Bangalore, a process has been developed for making osmotically dehydrated Jackfruit slices. Osmo-air dried fruits are the dehydrated fruit products based on the novel approach towards dehydration

Subject to feasibility, Common Facility center could be set up to facilitate producers to move up the value-chain.

8.21.8 Entrepreneurship Development Programme:

To facilitate the emergence of new entrepreneurs taking up high value-added product manufacturing, at least one Entrepreneurship Development Programme could be organized with about 150 to 200 hours of inputs (See Para 8.11 for details).

9.0 Conclusion

Jack fruit is often called as miracle fruit and has got great potential for value addition. More than 200 items can be prepared from jack fruits right from immature stage to well ripened stage. Each item has its own virtues in terms of taste, preference, storing quality etc. Therefore there is good scope for setting up jackfruit processing units in jack fruit growing areas.

The demand for jackfruit value added products in India is increasing both in urban and rural areas. Jack fruit is becoming increasingly popular in mainstream and ethnic markets in the US and UK as well as in some Asian and Middle Eastern countries. Notably, jackfruit is the most expensive fruit on sale in Britain

In the increasingly competitive market situation, there is need for analyzing of value chain; legal policies and market capacity both in India and abroad, market structure, market segmentation, competitive situation, market trends and other detailed analysis, to understand characteristics of the market for Jackfruit value added products, so as to give reference and guidance to NGOs and startups in producing jackfruit value added products

The Report on Market feasibility study for jackfruit value added products provides detailed information on the following issue

1. Market Size Estimation – Segment / Product wise Estimate
2. Who are the buyers of product?
3. What are the current demands for product?
4. How the market segment is selected?
5. What prices are the customers willing to pay?
6. In what basis the differentiation of product will be made as compared to different brands?
7. How the products will be distributed to customers and what costs are incurred for it?
8. Export and import trends
9. Policies, Laws and Regulatory Initiatives in the Industry
10. Branding – Brand Positioning
11. Go to Market Strategy – Distribution Structure & Sales Team
12. Strengthen the existing Marketing Channels by SWOT Analysis
13. Overall Cost analysis – Per Unit cost / Break even analysis / Gross & Net Margins
14. Capturing best practices in processing jackfruit processing and distribution both at National and International level
15. Propose a Marketing System with value chain for jackfruit value added products
16. Interlink Farmers, Industry, Policy makers, Technology developers and Institutions for developing Econ system for adding value to jackfruits

It is interesting to note that even though jackfruit is a miracle fruit and every part of jackfruit trees is useful to mankind in many ways, only 30 percent of jackfruit is processed for value addition. The main reason for this is lack of awareness about the health and nutrition benefits of jackfruit and non-ability of technology at the farm gate. Lack of policy initiative from both Central Govt and state Governments is another reason for low non utilization of jackfruits as alternate food item.

The development of good eco system to add value to jackfruit can contribute for adding income to farmers, provide employment and nutritious food to people

The present study on Market feasibility for Jack fruit value products was jointly undertaken by Justice K.S.Hegde Institute of Management, Nitte in association with National Institute of Agricultural Marketing, Jaipur is pilot study provides only broad spectrum of market potential for jackfruit value added products. Future study on this area may focus on specific issues related to dynamics of market for jackfruit value added products.

Annexure I

Market Study Plan – Jack Fruit products

Information Needs:

1. List of possible value-added products that can be made from Jack fruit
2. Latest technological innovations in Jack Fruit (**JF**) leading to new products
3. List of possible value-added products relevant to micro / rural and small enterprises
4. Export markets: which JF products are exported, to which destination; 5-years' time-series data on quantum of product-wise and destination-wise exports; the product-wise value of exports (3 years' time series data if possible)
5. Current manufacturers and exporters of JF products
6. Current marketing practices (in terms of trade channels) of JF products for exports (manufacturers exporting directly, stand-alone exporters, Other channels (eg., Consortium of small manufacturers exporting through an NGO)
7. Support schemes from State/Central Government and its agencies for promoting exporters
8. Technology providers for MSMEs for processing JF
9. Product-wise quality standards, if any, for exports as prescribed by the government
10. Quality Certification requirements for domestic marketing
11. Current trade channels for domestic marketing with reference to MSME JF products

12. Medium and large scale manufacturers of JF products (names , locations, product mix, brand names)
13. Profile of domestic buyers/end-users of JF products: Rural/Urban; income categories
14. List of specialty JF products for niche markets (such as health conscious buyers, buyers looking for primarily medicinal value)
15. Why a particular (for instance JF Jam) is preferred by consumers over substitutes (for instance apple jam)
16. Most popular JF products in terms of their market size and the reasons there off
17. Less popular JF products and the reasons there off
18. Most commonly produced JF products and the reasons there off
19. Product-wise competitors of JF products: Competitors to be characterized as small, un-organized producers; large producers with regional or national brands
20. Current distribution practices in domestic markets (emphasis on small, local or regional producers)
21. Current trade practices in domestic markets (emphasis on small, local or regional producers)
22. How are JF products promoted by individual producers (focussing small and micro enterprises)?
23. Retail and wholesale price range of each of the JF product focussing on regional markets
24. Drivers of demand (domestic): What prompts a consumer to buy a given JF product over competing substitutes?
25. Reasons for preferring a particular brand of a given JF product over other brands of the same product – Info required for each JF product
26. Top three most expensive brand (from consumer angle) of a given JF product – Info for each of the JF product
27. Which brand or brands of a given JF product is fast moving? For what reasons?
28. Any collaborative efforts in production/marketing of JF products anywhere in the country?
29. Any cluster of producers of JF products? - Location, size, product range
30. Range of retail and wholesale price of each of the JF product across brands
31. In terms of turnover (quantity), rank the top five JF product
32. In terms of turnover (Value), rank the top five JF product

33. In terms of profit margin for producers, rank the top five JF product
34. In terms of profit margin for retailers, rank the top five JF product
35. In terms of profit margin for wholesalers,, rank the top five JF product
36. For each of the major JF product, what is the basis of competition? Retail price, appearance / packaging, perceived quality, brand name,
37. Packaging: General practices of packaging a given JF product (cover Info for each of the JF product)
38. Instances of using innovative packing – (shrink packing for instance): Name the product/products and related packing
39. Any JF product/s which is not branded and the reasons thereof
40. Any JF product/s for niche market – (for instance, specific product for children / diabetics)
41. Domestic market size of a given JF product in terms of quantity /value
42. For a given JF product, what is the target market (in terms of consumer profile – Income, age, education...) (Info for each of the JF product)
43. Is there a particular JF product which is targeted at all market segments (in terms of income level) but with differentiation for each market segment? For instance, JF chips can be sold in plain plastic bag without branding or in plastic bags with a brand name or in nitrogen-flushed metallized polyester pack (like uncle chips)
44. Any JF product/s manufactured largely by micro enterprises (branded or otherwise)
45. Any JF product/s manufactured largely and exclusively by the organized sector? If so, reasons for unorganized sector not manufacturing such product/s
46. How manufacturers in the unorganized sector attract customers (promotion)
47. How manufacturers in the organized sector attract customers (promotion)
48. Availability of Jack Fruit – Seasonality, origin, variety, price range
49. Do the JF product producers in the unorganised sector as also in organized sector have their plantation? If so, what percentage of the manufacturers have their plantation?
50. Instances of a given producer taking advantage of the health benefits of a given JF product

Annexure I (continued)
Information Gathering Instruments - Primary Data

Info Sources Info Needs*	From Manufacturers	From wholesalers	From Retailers	From knowledgeable sources	Customers
2	--	--	--	√	--
3	√	--	--	√	--
4	√	√	--	√	--
6	√	√	√	--	--
8	√	--	--	√	--
11	√	--	--	√	--
13	√	√	√	--	√
14	√	√	--	√	--
15	√	√	√	--	√
16	√	√	--	√	√
17	√	√	--	√	√
18	√	--	--	√	--
19	√	√	√	--	√
20	√	√	√	--	√
21	√	√	√	--	--
22	√	√	√	--	√
23	√	√	√	--	√
24	√	√	--	√	√
25	√	√	√	--	√
26	√	√	√	√	√
27	√	√	√	--	--
28	√	--	--	√	--
29	√	--	--	√	--
30	√	√	√	--	√
31	√	√	--	√	--
32	√	√	--	√	--
33	√	√	√	--	--
34	√	√	√	--	--
35	√	√	--	--	--
36	√	√	--	√	--
37	√	√	--	--	√
38	√	--	--	√	√
39	√	--	√	--	√
40	√	√	--	√	--
42	√	--	--	√	--
43	√	√	--	√	--
44	√	√	√	--	--
45	√	√	--	√	--
46	-	√	√	√	√
47	√	√	√	--	√
49	√	--	--	√	--
50	√	--	--	√	--

The numbers refer to the ones appearing in the section on Information Needs

Secondary Sources

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- ix. apeda.in/agriexchange/India%20Production/India_Productions.aspx?cat=fruit
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Nutrition and Health Benefits of Jackfruit

(Nutritive Value per 100 g)

Principle	Nutrient Value	Percentage of RDA
Energy	95 Kcal	5%
Carbohydrates	23.5 g	18%
Protein	1.72 g	3%
Total Fat	0.64 g	3%
Cholesterol	0 mg	0%
Dietary Fiber	1.5 g	4%
Vitamins		
Folates	24 µg	6%
Niacin	0.920 mg	6%
Pyridoxine	0.329 mg	25%
Riboflavin	0.055 mg	4%
Thiamine	0.105 mg	9%
Vitamin A	110 IU	3.5%
Vitamin C	13.7 mg	23%
Vitamin E	0.34 mg	2%
Electrolytes		
Sodium	3 mg	0%

Source: USDA National Nutrient Data Base

Annexure II (continued)

Phytoconstituents in Jackfruit

Sl. No	Phytoconstituents	Plant Part
1	Carbohydrates: Starch, Sugar, Dietary fiber	Fruit, Seed
2	Minerals: Calcium, Magnesium, Phosphorus, Potassium, Sodium, Iron	Seed, Fruit
3	Fatty Acids: Capric, Myristic, Lauric, Oleic, Stearic	Fruit
4	Organic Acids: Malic acid, Citric acid	Fruit

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5	Carotenoids: β - Carotene, α - Carotene, β - Zeacarotene	Seed, Fruit
6	Flavonoid: Artocarpine, Artocarpetin, Artonins A, Morin	Fruit
7	Lectin: Jacalin	Seed
8	Volatiles: Isopentyl isovalerate, Butyl isovalerate, Butyl acetate	Seed, Fruit
9	Tannins	Stem, Leaf
10	Vitamins: Vitamin A, Thiamine, Riboflavin, Vitamin E	Fruit

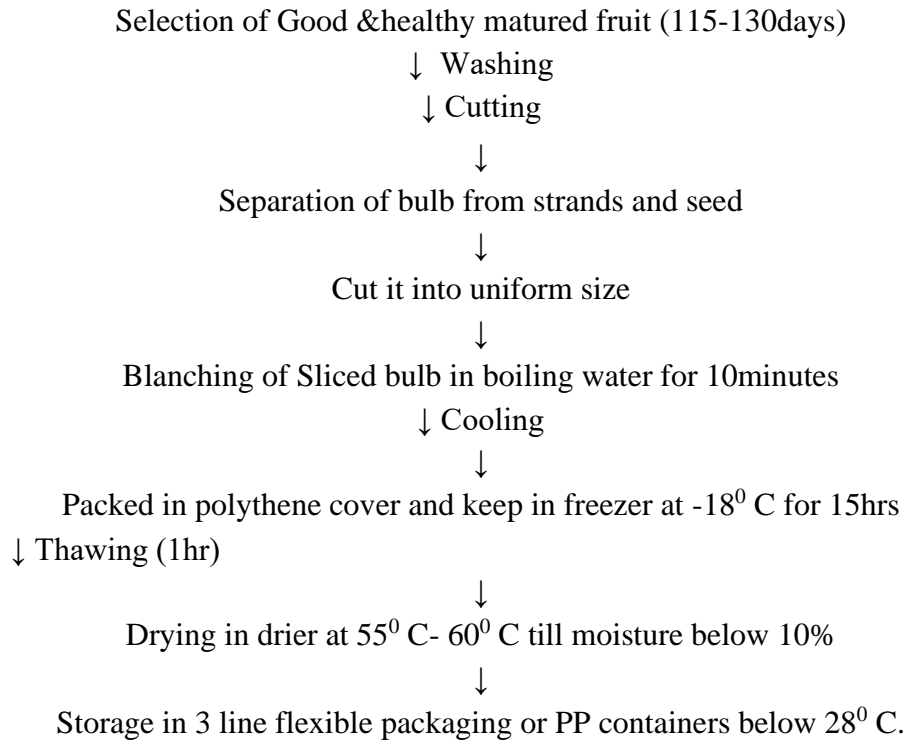
Annexure II (continued)

Nutritional Composition

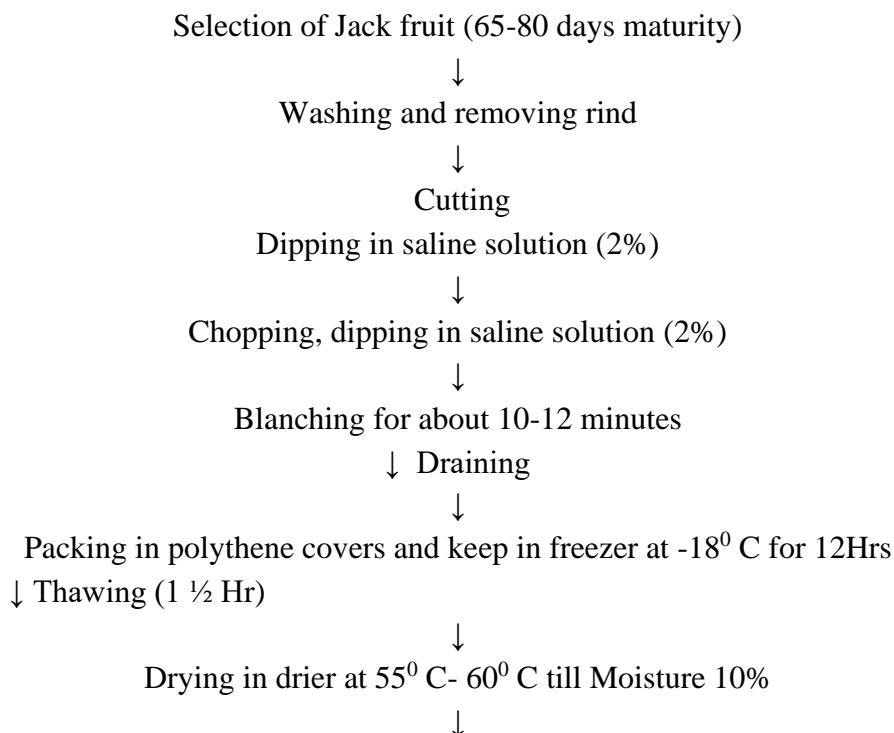
Composition (Per 100g)	Young Fruit	Ripe Fruit	Seed
Water (g)	76.2 to 85.2	72.0 to 94.0	51.0 to 64.5
Protein (g)	2.0 to 2.6	1.2 to 1.9	6.6 to 7.04
Fat (g)	0.1 to 0.6	0.1 to 0.4	0.40 to 0.43
Carbohydrate (g)	9.4 to 11.5	16.0 to 25.4	25.8 to 38.4
Fibre (g)	2.6 to 3.6	1.0 to 1.5	1.0 to 1.5
Total sugars (g)	-	20.6	-
Total minerals (g)	0.9	0.87 to 0.9	0.9 to 1.2
Potassium (mg)	287 to 323	191 to 407	246
Vitamin A (IU)	30	175 to 540	10 to 17
Thiamine (mg)	0.05 to 0.15	0.03 to 0.09	0.25
Riboflavin (mg)	0.05 to 0.2	0.05 to 0.4	0.11 to 0.3
Vitamin C (mg)	12.0 to 14.0	7.0 to 10.0	11.0

Process Flow for Some Jackfruit Value Added Products

Dehydrated Raw Jackfruit



Dehydrated Tender Jack



Storage in 3 line flexible packaging or PP containers below 28° C.

Annexure III (Continued)

Jackfruit Mixture

Select matured fruit either koozha or Varikka with optimum maturity (105- 125 days)

↓ Washing

↓ Cutting

↓

Remove rind and separate each part of jack

↓

Cut in to fine thin pieces including centre core (Optional) Avoid delay in handling of fruit

↓

Fix a raw material ratio (bulb+ strand+ seed+ core) and follow this for every lot

↓

Deep fry in edible oil (each part separately) till it is crispy. (Avoid overheating and repeated usage of oil)

↓

Drain out excess oil from fried pieces

↓

Mix all fried items well along with spices

↓

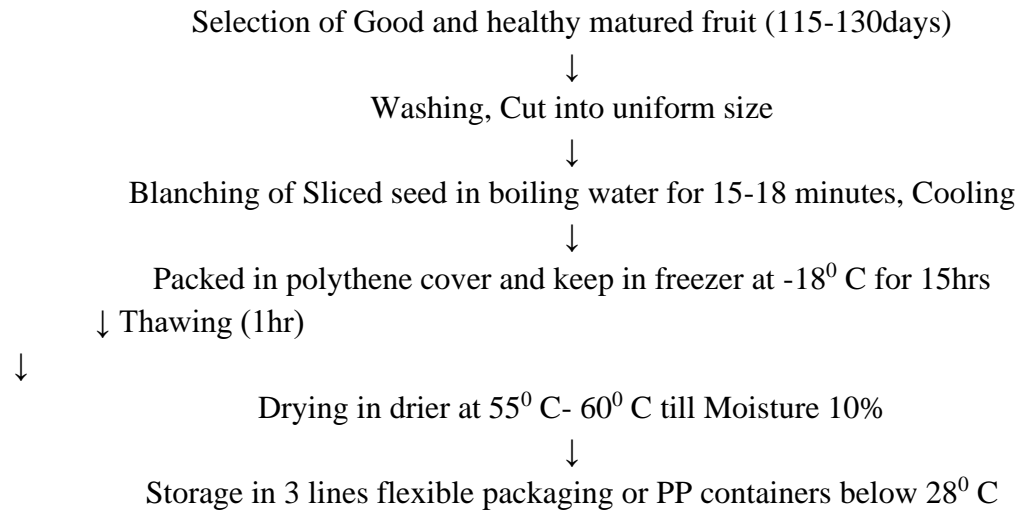
Fix a composition/ratio for ingredients
(garlic ginger paste, asafoetida, Chilly and pepper powder and salt)

↓

For better shelf life, pack in laminated polyester pouches with nitrogen flushing for Increased shelf life or air tight containers. Keep the fried items separately and mix along with spices during the time of marketing(Optional)

Annexure III (Continued)

Dehydrated Jack Seeds



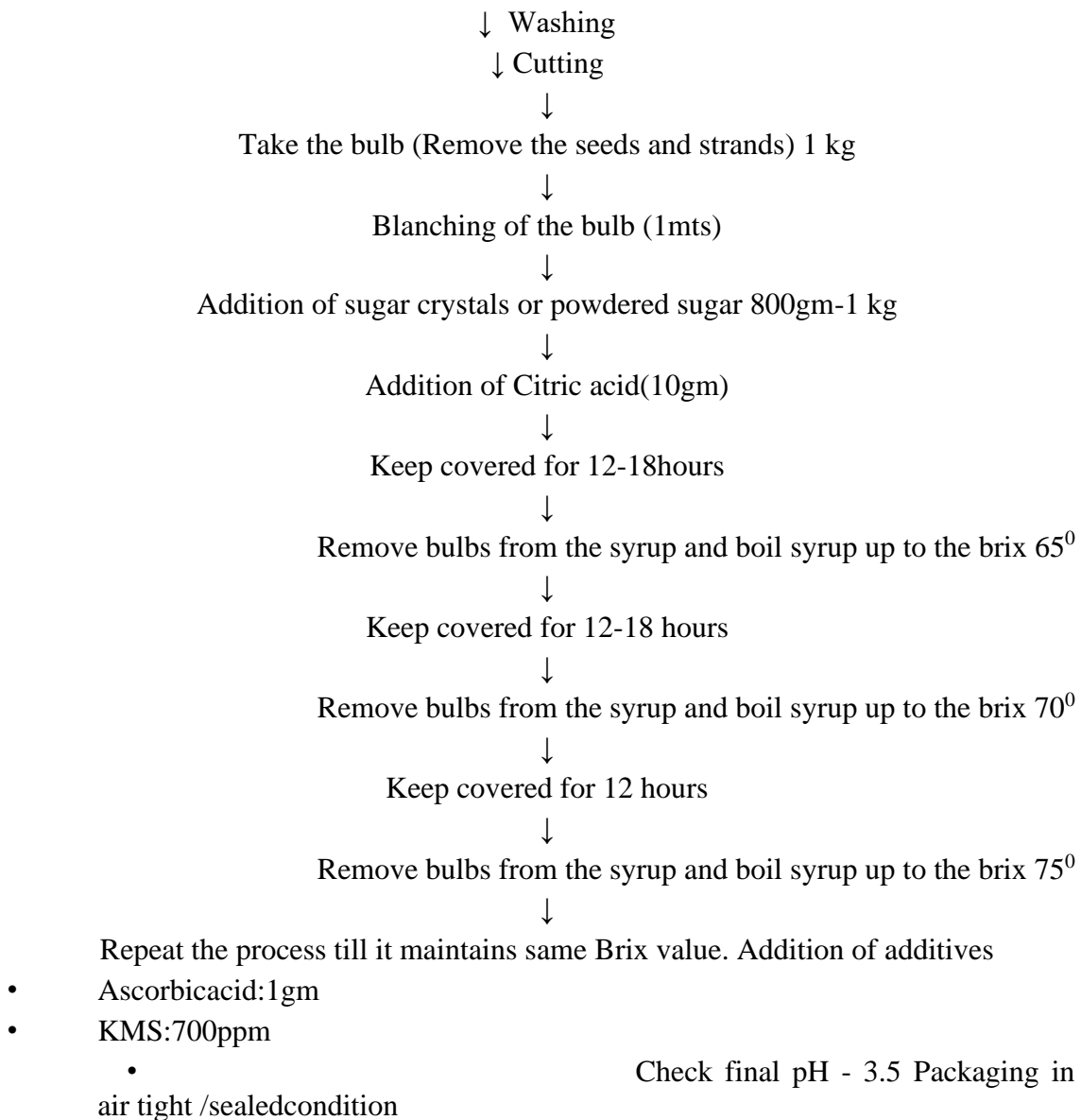
Annexure III (Continued)

Jackfruit Preserve

Minimum fruit: 55%

Minimum Total Soluble Solids: 68% Substances allowed: Fruit Juice/Pulp, sugar, citric acid, ascorbic acid, permitted color, flavor, and preservatives.

Selection of good healthy fruits (Koozha) with optimum maturity (120- 150 days)



Annexure III (continued)

Jackfruit Chips

Select matured fruit either Koozha or Varikka with optimum maturity (105- 125 days)

↓ Washing

↓ Cutting

↓

Remove rind and separate bulb and seed

↓

Remove two edges of jack to ensure uniform slicing for unique product appearance

↓

Cut bulb and seed into uniform size, Blanch seed (10min) Avoid delay in handling of fruit

↓

Fix a raw material ratio (bulb+ seed) and follow this for every lot

↓

Deep fry in edible oil (each part separately) till it is crispy.
Avoid overheating and repeated usage of oil

↓

Drain out excess oil from fried pieces

↓

Mix fried bulbs and seeds well along with spices Fix a composition/ratio for ingredients

(Garlic- ginger paste, asafoetida, Chilly and pepper powder and salt)

↓

For better shelf life, pack in laminated polyester pouches with nitrogen flushing for increased shelf life or air tight containers. Keep the fried items separately and mix along with spices during the time of marketing(Optional)

Jackfruit Bar/Chew

Product specifications as per FSSAI:

Moisture- Not more than 15% Total Soluble solids- 75% Minimum Fruit Content- 25%

Selection of good healthy fruits (120-150 days) Both varieties

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Washing, Ripening (up to semi-ripe), Cutting

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Take the bulb (Remove the seeds and strands)

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Blanching of the bulb (20 - 30seconds)

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Extraction of pulp, Check TSS

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Addition of powdered sugar(175gm) (May vary according to the variety)

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Addition of Citric acid (7gm) (May vary according to the variety), Ascorbic acid(1gm)
and Potassium Meta bi Sulphate (700ppm)

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Addition of additives

Colour – 1ml (solution 9:1), Essence- 1ml

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Filtering (1mm sieve), Balance pH 3.5 TSS to 25 o

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Evenly spread it in trays (1mm-2mm thickness)

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Drying in drier at 55⁰ C- 60⁰ C till it is dry (Moisture 12-15%) Storage – 3 line polyester
laminated pouches and keep below 30⁰C

Verities of Jackfruit in India and their Characteristics

State	Variety	Characteristics
Kerala	MuttomVari kka	Firm fleshed, sweet scented variety
	Singapore jack or Ceylon jack	High yielding early bearing variety, a tree many yields as many as 250 fruits
	Sindhoor	Highly sweet variety with attracting sunset orange colored flakes, bear medium-sized fruits (11-12 kg) twice a year
	T Nagar Jack	Large fruits with good quality
Tamil Nadu	Palur jack or PLR -1	Average fruit weight of 12 kg with 115-120 flakes,off -season fruiting, TSS 19°B, golden yellow firm flakes
	PPI Jack	Average fruit weight of 17 kg,fruit-bearing occurs twice in year, flakes are sweet and tasty with pleasant aroma suitable for commercial planting and home gardens
	PLR (J) - 2	Average fruit weight of 16-19 kg, edible flakes fetches more price due to attractive characters and good keeping quality
	Burliar-1	Flakes thick, crisp, juicy with golden yellow color
Uttar Pradesh	NJC 1, NJC 2, NJC 3	Small to medium size fruit with thin rind were found to be better for culinary purpose
	NJT 1,NJT 2,NJT 3, NJT 4	Large fruit and excellent pulp quality, have been identified for table purpose
	Swarna	Medium sized fruit 6-8 kg, fruit color golden brown, TSS 25-26 °B
Karnataka	Gumless type (Pre-released)	Medium to low latex is the specialty, average fruit weight 6.4 -9 kg, flakes color light yellow, sweet having TSS 26 -30 °B
	Kachehalli jackfruit (GI status)	Fruits are ellipsoid/elongate shaped, weighing 20 -25 kg having 300- 350 flakes/fruit, flakes are deep coppery red color, TSS of 32 °B
Maharashtra	Konkan prolific	Average fruit weight 5.7 kg, flakes golden yellow, TSS 25 °B

Jackfruit cultivars/varieties in different countries

Country	Cultivars/varieties	Distinguishing characters
Sri Lanka	Father Long	Oblong, large size fruits (10-15 kg), perianth is attractive dark yellow color, thick crispy and sweet
	Maharagama	Oblong, large size fruits (10-15 kg), perianth is yellowish orange, crispy and sweet
	Kothmale	Oblong, large fruits (10-15 kg), large perianth, yellowish orange, crispy and sweet
	Hirose (Rosa Kos)	Oblong, large fruit, large perianth, yellowish orange, crispy and sweet
	Mandoor	Round medium-size fruit (8-10 kg), large perianth, dark yellow color, crispy and sweet
Indonesia	Nangkamerah	Red orange (<i>merah</i>) colour
	Nangkasalak	Thick fruit flesh, soft, strong flavor, fruit flesh is similar to salacca fruit
	Nangka durian	Fruit flesh is similar to durian
	Nangkacempedak	Thin flesh fruit, having good and specific flavor
	Nangkaburur	Thin fruit flesh, soft, strong flavor
	Red nangka mini/ round nangka mini	Mini jackfruit
	Nangkakunir	Officially released as a national superior variety
	Tabouey	Fruit round, flesh yellow, firm, pleasant flavor and very little aroma
Philippines	<i>Sinapelo</i>	Fruit is oblong, average fruit weight 10 kg, the flesh is yellow- orange, firm and very sweet
	<i>Cervantes Gold</i>	Fruit is ellipsoid, average fruit weight 10 kg, the flesh is golden yellow, sweet, crispy with a strong aroma
	<i>EVIARC Sweet</i>	the Fruit is ovoid, average fruit weight 12 kg, the flesh is golden yellow, sweet (25 °B), crispy with a strong aroma
	<i>MMSU SRO</i>	Fruit is ellipsoid, average fruit weight 8 kg, flesh is yellow -orange, very sweet (30°B), firm with mild aroma
	<i>Mabini</i>	Fruit is oblong, average fruit weight 15 kg, flesh is yellow- orange, sweet (20.4 °B) with strong aroma
Malaysia	J2	Flesh taste sweet with a ting of acid and is slightly fibrous, moderate aroma and poor shelf life
	J27	Medium size fruit, thick fleshed, orange in color, sweet taste
	J28	Thick flesh, golden yellow in color, sweet taste
	J29	Medium to large fruit, round in shape, pulp yellow, thick, sweet and good for fresh consumption
	J30	Elongate fruit, flesh yellow, thick, sweet with a moderate aroma

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	J31	Yellow flesh, medium thick, crispy, sweet, strong aroma with fine texture, dual purpose, suitable for canning
Australia	Black Gold	Pulp deep orange, soft, sweet and aromatic
	Cheena	Pulp deep orange, soft, excellent quality and very aromatic
	Cochin	Pulp yellow to orange, firm, quality good and mild aroma
	Chompa Gob	Flaks orange, firm, mild flavor
	Golden Nugget	Flak's deep orange, soft to medium firm, excellent flavor
	Lemon Gold	Flaks lemon yellow, firm, sweet and aromatic flavor
Bangladesh	Topa, Hazari, Chala, Goal, Koa, Khaja	
Myanmar	Talaing, Kala	