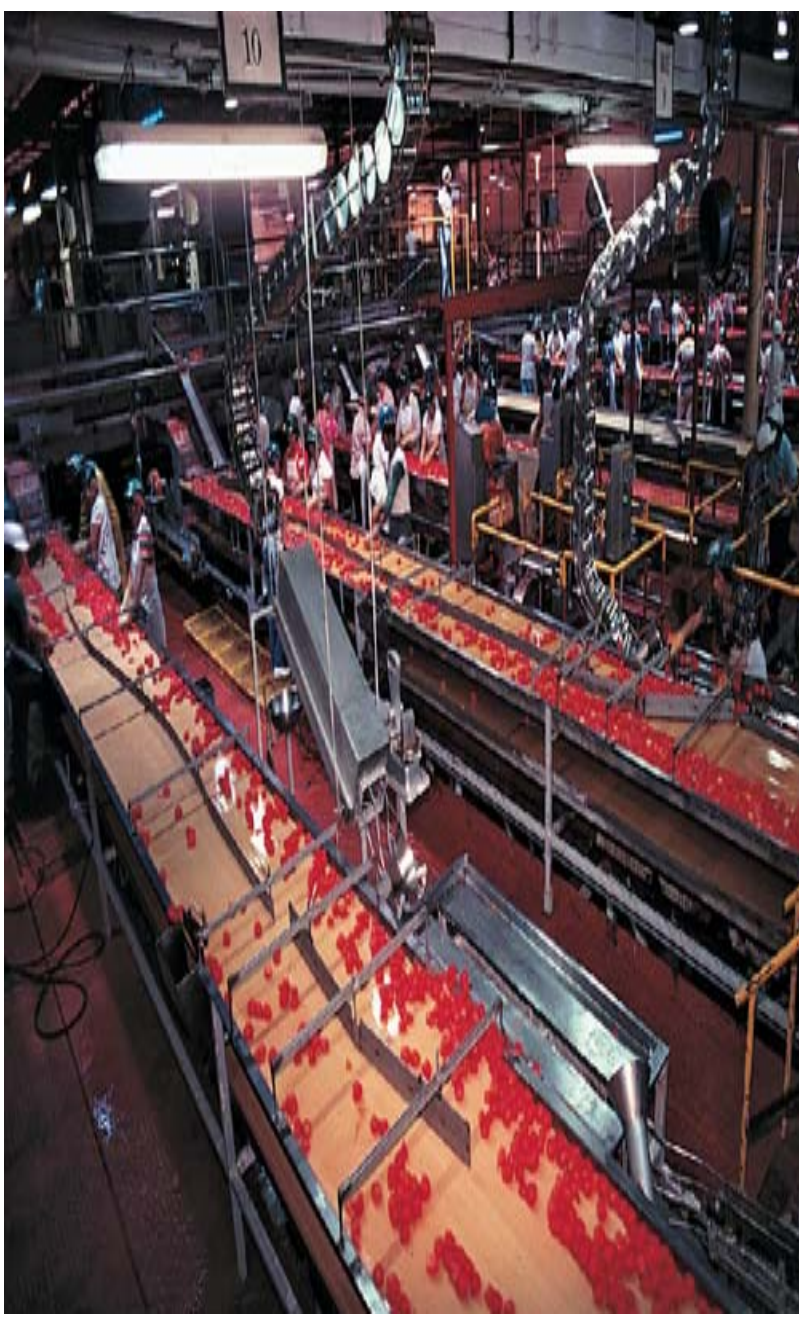
Siliguri Jalpaiguri Development Authority

SJDA

2013

Report on Revenue Projections, P&L Projections and Financial Analysis for Selection of Partner for Development, Operation and Management of Universal Vegetable Processing & Training Centre at Jalpaiguri



RITES
THE INFRASTRUCTURE PEOPLE
A Government of India Enterprise

The following report is a report on the Revenue Projections, P&L Projections & Financial Analysis for the Project " Development of Universal Vegetable Processing & Training Centre for Tomato Powder and other Allied Products at Jalpaiguri, West Bengal". Hereinafter it will be referred to as "The Report".

Project at a glance

Implementing Organization	Siliguri Jalpaiguri Development Authority (SJDA)	
Project	Development of Universal Vegetable Processing and Training Centre for Tomato Powder and other Allied Products	
Location	Mouza: Berubari, JL no 23, PS: Jalpaiguri, Disrict Jalpaiguri	
Operation	Through PPP model	
Project Cost	Fixed Cost:	Rs. 1700.75 lakhs
Capital Employed	Fixed Capital:	Rs. 1700.75 lakhs
Land	10 acres	

1. Terms of Reference

By their LOA No 3290/III/Plg/787/13 dated 16/07/2013 Siliguri Jalpaiguri Development Authority (SJDA) assigned RITES Ltd., a Transaction Advisor empanelled with Government of West Bengal, the work of *"Selection of Partner for Development of Universal Vegetable Processing and Training Centre for Tomato Powder and other Allied Products at Jalpaiguri, West Bengal"* which will be operated and managed on PPP mode. SJDA has assigned RITES to prepare the RFP/RFQ and take all necessary steps to select the PPP partner.

SJDA has prepared and approved the Detailed Project Report on the project. This DPR had been handed over to RITES by SJDA. Various gaps were found in the DPR, and so this Report was prepared to identify those gaps and address them. The profitability statement and other financial analysis are done in this Report to ascertain the returns to the PPP Partner.

2. Objectives

The objectives behind setting up a vegetable processing training centre and tomato powder manufacturing unit at Jalpaiguri are detailed hereunder.

1. The district of Jalpaiguri is identified for setting of Agri Export Zone (AEZ) by Agriculture and Processed Food Export Development Authority (APEDA), Department of Commerce, Government of India.

2. The entire region of Jalpaiguri in general and Haldibari in particular, in Cooch Behar district, at a distance of about 20 kms from Jalpaiguri have owned various agro climatic atmosphere suitable for growing tomato and other vegetables.

3. It is estimated that every year about 50% tomato are getting spoiled during peak season due to lack of proper logistic facility and distribution network and consequently selling price of tomato drops down below the cost of cultivation.

4. Earlier tomato was a seasonal product but now tomato can be cultivated throughout the year. But the yield of tomato is maximum in winter. Storage life of tomatoes is very small. viz., Mature Green 21 to 28 days, Pink 7 to 14 days, Red 2 to 4 days. In Jalpaiguri district the infrastructure for tomato processing is not properly developed and organized. Therefore, due to the scattered cultivation of tomato and lack of proper processing facilities, wastage of fresh products is very high.

5. It is expected that the proposed project will help the local farmers get a reasonable price for their produce, the wastage of tomato will reduce and the value added product from processing of tomato will fetch good margin for the processing unit. The location of the project is identified near the source of tomato.

6. The use of tomato powder is increasing every year. Due to high global demand the final product will get the scope of export in many countries especially in the Middle East.

7. SJDA will be the Promoter for this project.

3. Scope of the work

SJDA has decided to develop a project on Universal Vegetable Processing & Training Centre for Tomato Powder and other Allied Products at Jalpaiguri, West Bengal.

The scope of work as defined by SJDA is given hereunder

1. Evaluating and updating (if required) of the Detailed Project Report (DPR) already prepared and approved by SJDA.

2. Carrying out the financial viability analysis of the project including revenue projections and profit and loss statement analysis of the project for a period of 25 years to ascertain returns to the PPP Partner.

3. Preparing the RFP/RFQ in respect of technical and financial aspects

4. Arranging pre – bid meetings and drafting the replies to queries.

5. Evaluation of bids and selection of PPP partner

4. Marketing of Tomato Powder

Before preparing this Report a market survey was conducted to understand the existing market of Tomato Powder with special emphasis on the production market. The study conducted includes interviews with the leading manufacturers of tomato powder in India and industry experts. A secondary research was also conducted on Tomato production and Tomato Powder.

This top-line report is prepared from the analysis of the information gathered from the interviews conducted and secondary research based on which this Report has been prepared. The sample size covered in conducting the face to face interviews is as given below

Segment	**No. of interviews**
Manufacturer of tomato powder	5
Industry expert	1

The manufacturers contacted and interviewed comprise of the leading producers and exporters of tomato powder in India. viz.,

1. G G Foods
   N.h. 76, Village- Vana, Via- Kheroda, Dist. Udaipur (raj.) Udaipur, Rajasthan – 313602
   Ph: +91-2957-227023+91-2957-22702391-9829232723 / 9829611823
   Contact Person: Mr. Pankaj Paneri

2. Sahajananda Foods & Agrotech
   274 Kalathiya Corporation 2, Diamond Nagar, Surat Kamrej Highway
   Surat, Gujarat - 394190
   Ph: +91-98981-34674
   Contact Person: Er. Mr. DRB Parasana

3. Aarkay Food Products
   C - 1107 / 1108, 11th Floor,
   Titanium Square, Thaltej Cross Road,
   S. G. Highway, Thaltej,
   Ahmedabad - 380054. Gujarat
   Phone No. 079 - 40053301 / 02

4. Farmvilla Food Industries Pvt. Ltd.
   76, Shivam Industrial Park, Opp. Rotomac Pens, Sarkhej-Bavla Highway, Moraiya, Changodar, Ahmedabad - 382213, Gujarat
   Mobile : +919725504425, +919727737799, +918866702525
   Contact Person: Mr. Mahendra Thummar

5. Venkatesh Natural Extract Pvt Ltd
   Opposite State Bank Of Indore, Gandhiganj, Chhindwara - 480001, Madhya Pradesh, India
   Phone: 09827235078

Interview was also conducted with Professor H N Mishra (PhD) of IIT Kharagpur Agricultural & Food Engineering Department. Dr. H N Mishra is the professor of Food Technology at IIT Kharagpur. His research areas include the following

- RTE Health Foods & Nutraceuticals
- Innovative Food Processing Technologies
- Horticultural & Plantation Crop Products Processing
- Food Safety & Quality Control
- High pressure processing of high value perishables
- Algal Food Biotechnology

4.1 Top-line report based on analysis of information gathered from the interviews

1. *Indian market size*

   Domestic market consumption
   Based on the total Indian consumption of tomato powder the Indian market size for tomato powder is approximately 500 tons. The Indian consumption of tomato powder is fulfilled by Indian production. Therefore, no major import of tomato powder is done in India.

   Indian production
   Total yearly production of tomato powder in India is approximately 1000 tons. This includes the produce for domestic market consumption as well as the export market. 50% of the total Indian production of tomato powder is exported. The major countries of export include USA, Europe, South Africa, Australia & New Zealand, South East Asia and the Arab Countries.

2. *Sale Price of Tomato Powder*

   In the domestic market, sale price of tomato powder varies depending upon the category of raw tomato used for the production. Raw tomato is divided into 4 categories by the Indian Standards Institution viz., Super A, Super, Fancy, Commercial. The first 3 categories are mainly used for manufacturing tomato powder. For powder manufactured from the best categories of raw tomato i.e. Super A or Super the price per kg is approximately Rs. 350/-. Sale price per kg for tomato powder made from Fancy and Commercial category raw tomato are approximately Rs.200/- and Rs.75/- respectively.

   Export category tomato powder is primarily manufactured from the best category of raw tomatoes i.e. Super A and Super. The export market price of Indian produce of tomato powder is approximately Rs.850/- to Rs.1000/- per kg.

3. *Growth rate*

   The yearly growth rate of domestic and export market for tomato powder is almost the same. This growth rate is estimated at 13% per annum.

4. *Usage Areas*

   Tomato powder is mainly used in the following food sectors

   - Hotels
   - Restaurants
   - Food product manufacturers like Nestle, HUL, Parle, ITC, Fritolays, etc

5. *Yield of tomato powder*

The yield of tomato powder depends on the quality of raw tomato used in the manufacturing process. For Super A and Super category of raw tomato the yield of tomato powder from 1 Kg tomato is approximately 100 – 150 gms i.e. almost 10 - 15% yield
For Fancy and commercial category of raw tomato the yield of tomato powder from 1 Kg tomato reduces to less than 10%.

6. *Manufacturing process*

Tomato powder manufacturing processes include

- Spray drying
- Dehydration
- Drum Drying
- Vacuum Drying
- Freezing drying

Commercial production of tomato powder is done using the spray drying process. The broad stages involved in spray drying process are

- Crushing the tomato
- Separating seeds from pulp
- Spray drying pulp
- Removing moisture from dried pulp to make the powder moisture free

The spray drying process is largely practiced by the manufacturers considering its benefits viz.

- Low production cost
- Good quality of powder
- Maximum utilization of raw materials i.e. high yield ration
- In this process some other product like paste, ketchup etc. can also be made

7. *Use of Maltodextrin in manufacturing of tomato powder*

Maltodextrin is an oligosaccharide that is used as a food additive. It is produced from starch by partial hydrolysis and is usually found as a white hygroscopic spray-dried powder. Maltodextrin is easily digestible, being absorbed as rapidly as glucose, and might be either moderately sweet or almost flavorless.

Maltodextrin addition improves hygroscopicity (equilibrium moisture content of a powder after being exposed to air humidity under given conditions), caking, and solubility of tomato powder whereas it slightly deteriorates its moisture content and density. To make powder from any vegetables & fruits using spray drying method, Maltodextrin use is mandatory as this helps to overcome the lumping or crystallization of the powder. The production of free flowing powder by spray drying of sugar-acid rich foods requires an appropriate carrier. High molecular weight materials such as maltodextrins are commercially used as a drying aid because of their high glass transition temperature (Tg).

For making tomato powder from Super A or Super category tomato, the proportion of dextrin to be added in 1 kg pulp is not more than 10 – 15%. i.e., in 1 Kg pulp 100 – 150 gms maltodextrin is to be added.

However in case of lower category of tomato i.e. fancy or commercial category, this proportion might go up to maximum 15 - 25% depending upon the water content of pulp.
The price of Maltodextrin is Rs.60 – 80/- per kg.

4.2 Market Position

In view of the importance of tomato both fresh and processed in Indian households owing to its high nutritive value, there is good potential to develop this industry in the country in the small scale sector. During the glut season, when tomatoes are cheap, a number of tomato products such as juice, soup, paste, ketchup, sauces can be prepared commercially to meet the increasing demand of hoteliers, restaurants, clubs, railways, air lines, defence canteens, super bazaars etc

Owing to the high demand for ready to use food products, the market for tomato powder is increasing rapidly. In recent years, there have been encouraging enquiries from the socialist and middle east countries for the export of tomato-based products like tomato paste, puree etc. Tomato powder is, now, of great demand in the said countries. Hence, there is a wide scope countrywide as well as in foreign countries i.e a great potential for export of tomato powder.

The advantages of tomato powder are its higher stability against deteriorative microbial, chemical and biochemical reaction; low handling, packaging and transportation costs and negligible energy requirements during storage. Retention of color, flavor, vitamins (particularly the ascorbic acid) and other nutritional characteristics in the product are the main attraction of the process technology. The product is free from any scorched odor / taste, has good nutritional and satisfactory shelf life. It reconstitutes well, remains free flowing during storage.

Earlier, dehydrated tomato powder was not available in the market. Although tomato products rank first among the processed vegetables, the fact remains that this industry has not progressed well in India with only about ½% of its total produce being processed and marketed in the form of traditional products like puree, paste, ketchup, sauce, pickles, chutney etc. Further, these products continue to be produced by traditional methods involving energy intensive thermal processes, which generally degrade their quality. Also because of their moisture contents, these products involve high packaging, handling, transportation and storage costs.

Tomato is the second largest growing vegetable crop in India. With an annual production of 5 million tones, India contributes about 7% to the world production. Being highly perishable in nature, tomato has limited shelf life. It creates glut during production season and becomes scanty during off-season. Short shelf-life coupled with inadequate processing facilities results in heavy revenue loss (about Rs. 5 crores per annum) to the country. Thus, a need exists to develop suitable technology for processing and preservation of this valuable produce in a way that will not only check losses but also generate additional revenue for the country.

In this context, the dehydrated tomato powder holds a promise. It has the potential to meet the increasing demand for quality vegetable juices in India and abroad. The tomato powder can be

reconstituted into juice or used as a starting material for the preparation of products like sauce, ketchup, chutney etc. It can also be used as a flavouring agent / nutrient supplement in food mixes, baby foods, health foods, etc *(Source: EIRI report)*

4.3 Tomato Powder

Nowadays consumption of tomato powder is also gradually increasing in developed countries. The tomato powder benefits in the same way as the other processed tomato products benefit the human body system.

Tomato powder is fine, dull red. It has a mild tomato flavor. Tomato powder can be used as coloring and flavoring substance in food such as fresh pasta, noodle, bread dough, yeast bread, muffins and several other food items. Tomato powder can be used in a variety of vegetable soups.

Tomato powder can be sprinkled on pizzas, breads, salads and sandwiches or for tomato flavor. The tomato powder can be used to thicken the sauces, and other products in kitchens and restaurants.

Once people use the tomato powder for their kitchen recipe, they will feel more comfortable using the tomato powder over tomato sauce and tomato paste or whole tomato.

Like the milk powder used in making original milk to make diverse food items; tomato powder can be used in a variety of vegetable and food items. The tomato powder can be used in soups, baby foods and flavorings too. The tomato powder is hygroscopic. In other words, the tomato powder absorbs water present in the atmosphere and becomes semi-solid in shape when the powder comes in contact with the air moisture. As the result of this the quality of tomato power declines. So high-tech tomato powder is better than the traditionally grinded tomato powder.

In large commercial tomato products making factory, tomato powder is made from tomato paste. The machine that is used to make tomato powder from tomato paste is tomato dryer.

The processing with the processes of heating, grinding, mixing and drying increases the nutritional value and medicinal value of vegetables. The medicinal value of the tomato powder is such that that it prevents the incidence of cancer in several organs including prostate gland in men.

Quality of tomato powder depends on the technology used to prepare tomato powder from tomato fruits. Tomato powder made from high-technology factory has improved quality traits as compared to cooked and processed tomatoes.

The coloring substance of red ripe tomato, lycopene, alone is not responsible for the overall health benefits of tomato fruits. The vitamins, minerals and other compounds including the lycopene are all responsible for the health benefits of the tomato fruits.

Another thing is that one can store tomato powder for longer duration than either fresh tomato or canned tomato or tomato sauce or tomato puree or tomato paste. But one should be careful that

the tomato powder does not form cake or clump if the powder is kept in open air. The lid of the tomato powder must be kept air tight.

The price of fresh tomato may fluctuate in many countries. The field grown tomato and tomato products made from the field grown tomato are more beneficial than the greenhouse grown tomatoes. In large tomato processing industries, the tomato powder is generally made from field grown tomato fruits.

The tomato powder is very useful in the off-season. Tomato powder made from the field grown tomato fruits in the main season is better than the off season grown fresh tomato fruits.

So a new entrepreneur can well venture in this field by installing the tomato powders Industry to satisfy the present and future demand of our country as well as export demand of foreign countries.*(source: EIRI report)*

4.4 Export Potential of Tomato Powder

During 2006-07, 10,352 tons of tomatoes were exported. This is a substantial increase from 1019 tons in 2005-06. Main exports of tomatoes were to UAE i.e 10,176 tons, whereas exports to Kuwait, Saudi Arabia and Oman were only 84 tons, 43 tons and 40 tons respectively. These exports are negligible compared to imports of 2,10,199 tons by Saudi Arabia, 1, 25,821 tons by UAE, 82,475 tons by Kuwait, 2,53,00 tons by Qatar and 18,719 tons by Bahrain. There is 34.3% increase in demand of tomatoes in these countries over the year 2003.

This shows there is substantial export potential for tomatoes to GCC countries provided India maintains quality standards, by mandatory registration of farmers with GLOBALGAP and minimizing pesticide residues. Apart from this hygiene standards also need to be looked into. Keeping above observations in mind, India can easily target export of 30,000 to 40,000 tons of tomatoes to GCC. India needs to penetrate markets of Saudi Arabia, Kuwait, Qatar, and Bahrain by meeting their requirements. India's competing countries are Jordan and Syria. India is able to supply tomatoes at competitive prices compared to Jordan, but Syria supplies at much lower prices and thus, India will have to provide tomatoes at competitive rates by increasing productivity and reducing cost of production.

Asian Countries

For the first time India exported 406 tons to Singapore during 2006-07. There is huge potential for export of tomatoes to these countries. Even otherwise there are very nominal import duties in Indonesia, Philippines and there are no duties in Malaysia. The export potential can be gauged by imports of tomatoes by these countries. Total quantity of 41,725 tons were imported, which is a 44% increase in demand over the year 2003.Principal importers were Singapore (24,007 tons), Vietnam (12,910 tons) and Malaysia (3,589 tons). For India, the best opportunity is to export to Singapore. India can not only meet the requirements of Singapore market, but also nurture the market, which is very important for penetration. It should not be difficult to export tomatoes to ASEAN countries to a level of 4000- 5000 tons in next 4-5 years, provided India supplies at competitive prices by increasing productivity

Pacific Rim countries and China

There is no scope of exports of tomatoes to these countries for the time being.

EU countries

Export of tomatoes to EU is nil, however EU countries imported to a level of 2,478,794 tons during 2006. Export from India is not a possibility till we technology is improved and export by sea using MA cartons is feasible.

Measures for enhancing competitiveness for export
Following steps need to be taken on priority for enhancing competitiveness for exporting Tomatoes:

- India's yields of tomatoes are very low (17.5 tons/Ha) compared to many countries like U.S.A., Spain, Italy, Egypt, Brazil etc. In order to be competitive, India must enhance productivity of high quality production.

- Further, if India has to penetrate Middle East countries effectively, it must enhance quality of tomatoes and bring it to international standards not only in production but also in presentation, packing etc.

- Technology of CA and MA storage must be standardized and perfected so that at least to GCC countries, tomatoes can be sent by Sea.

4.5 Domestic Strengths for Export

- India stands at fourth position in production of tomatoes next to China, U.S.A. and Turkey.
- Maximum production of tomatoes takes place in Andhra Pradesh, Orissa, Karnataka, Maharashtra, West Bengal, Bihar, Gujarat etc.
- Tomatoes are available for export throughout the year.
- High yielding F1 hybrids are being cultivated by farmers on a good scale.
- There is excellent research support from all the SAUs and National Research Institutes like IIHR, Bangalore and IIVR (Indian Institute of Vegetable Research), Varanasi.
- Distribution of raised seedlings of F1 hybrids is quite prevalent and is getting popular among vegetable farmers.
- APEDA has established a number of Agri Export Zones for vegetables namely in Punjab, U.P., Gujarat, Bihar, Jharkhand and West Bengal for promoting exports of vegetables and infrastructure for the same is being/has been set up.

Exports
Export of tomatoes has increased from 12,886 tons in 2002-03 to 33,592 tons in 2006-07. A significant increase has been recorded of more than 250%.

It is observed that the use of tomato powder is gradually increasing in developed and rich countries. Since the cost of export of tomato powder will be about 80 to 90 % less than that of tomato, normally the scope of exporting tomato powder will increase. India can take this opportunity.

4.6 Packaging

The standard packaging system of tomato powder for bulk consumption is 50kg pack, initially in polythene bags and then in cartons.

The packaging cost of tomato powder ranges between 4-5% of total production cost.

5. Technical aspects of Tomato Powder Processing

5.1 Process flow for manufacturing of tomato powder

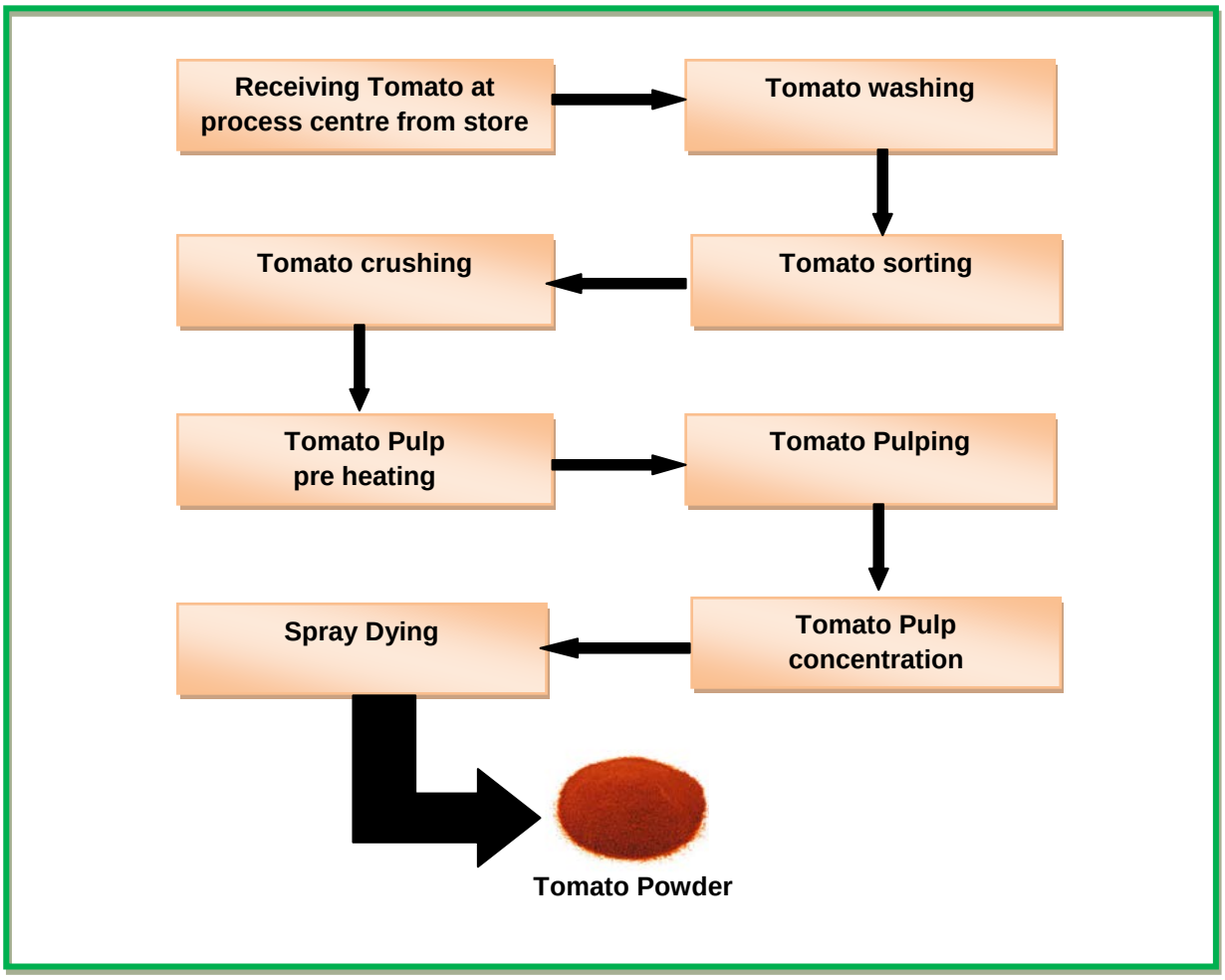
There are two processes for converting tomato to tomato powder. These are

i) Dehydration method and

ii) Spray drying method

For better yield and quality of product, for this project spray drying method is suggested. The process flow diagram of spray drying method is shown hereunder.

Process Flow Diagram of Tomato Powder



5.2 Spray drying technique

5.2.1 Introduction

Nowadays, the fast economic development has changed the trend of food consumption from calories assurance to diet nutrient enrichment. The consumers today are well aware of the importance of vitamins. This scenario has increased the global market demand towards fresh fruits. In order to handle the market demand throughout the year, the fresh fruits are preserved using different techniques. High moisture content in the fruit leads to having high water activity which leads the quality loss in fruits by increasing the enzyme activity and microbial growth. Therefore, the reducing moisture content and water activity in fruits is always desirable to maintain the quality. Drying is an ancient technique, which is used to preserve food by removing moisture content and water activity. There are many drying techniques invented such as spray drying, freeze drying and tray drying to increase the productivity and to achieve better control of a process to increase the product quality. Among the drying techniques, spray drying is usually applied to produce the fruit juice powder.

Dehydration by spray drying is used in a wide range of products in food industries to produce dry powders and agglomerates. Economic considerations of this method include hygienic conditions during processing, operational costs, and short contact time (Sagar *et al*., 2010; Yousefi *et al*., 2011). The quality of spray dried food depends on the different factors of spray dryer operating systems.

5.2.2 Principle of spray drying technique

The first spray dryers were manufactured in the USA in 1933. Spray drying is one of the best drying methods to convert the fluid materials directly into solid or semi-solid particles (Murugesan and Orsat, 2011). Spray drying is a unit operation by which a liquid product is atomized in a hot gas current to instantaneously obtain a powder. The gas generally used is air or more rarely an inert gas, particularly nitrogen gas. The initial liquid feeding can be a solution, an emulsion or a suspension (Gharasallaoui *et al*., 2007). It can be used to both heat-resistant and heat sensitive products.

Spray drying involves the complex interactions of process, apparatus and feed parameters which all have an influence on the final product quality (Chegini *et al*., 2008). The spray drying process can produce a good quality final product with low water activity and reduced weight, resulting in easy storage and transportation. The physiochemical property of the final product mainly depends on inlet temperature, air flow rate, feed flow rate, atomizer speed, types of carrier agent and their concentration. Spray drying is often selected as it can process material very rapidly while providing relative control of the particle size distribution. (Obon *et al*., 2009).

5.2.3 Spray dryer

The spray dryer is a device used to produce dried food. It takes a liquid stream and separates the solute or suspension as a solid and the solvent into a vapor. The solid is

usually collected in a drum or cyclone. The liquid input stream is sprayed through a nozzle into a hot vapor stream and vaporized. The form solidifies as moisture contents quickly leave the droplets. A nozzle is usually used to make the droplets as small as possible to maximize the heat transfer and rate of water vaporization. The spray dryers can dry a product very quickly compared to other methods of drying.

They also turn a solution or slurry into a dried powder in a single step, which can be the advantage for maximizing the profit and minimizing the process (Chegini and Ghobadian, 2007; Murugesan and Orsat, 2011).

5.2.4 Basic steps of spray drying

i) *Concentration of fruit juice*

Generally, the feedstock is concentrated before introducing into the spray dryer. The concentrated juice has increased solid content thereby reducing the amount of liquids that must be evaporated in the spray dryer. The feedstock in conventional large scale spray dryer normally concentrates to 50%-60% before being introduced to the spray dryer.

ii) *Atomization*

Atomization refers to the conversion of bulk liquid into a spray or mist, often by passing the liquid through a nozzle. The liquid which is sprayed through the nozzle increases the surface area of the liquid which later comes in contact with hot air and dries into a powder. The nozzle size may differ according to the size of spray dryer. Droplet size ranges from 20 μm to 180 μm and it depends on the nozzle. Smaller spray dryer occupies smaller nozzles and vice versa in the industrial scale spray dryer. The aim of this stage is to create a maximum heat transferring surface between the dry air and the liquid in order to optimize heat and mass transfers. The choice of the atomizer configuration depends on the nature and viscosity of feed and desired characteristics of the dried product (Master, 1986; Patel *et al*., 2009).

iii) *Droplet-air contact*

The important component of spray dryer is the chamber; here the sprayed droplet comes into contact with the hot air and the drying process begins. Air is heated by the heating element which is placed before entering the chamber at a predefined temperature depending upon the characteristics of the feed fluid. The hot air is brought in contact with the spray droplets in the following ways through the air distributor.

1. Co-current-Air and particles move in the same direction.
2. Counter-current-air and particles move in the opposite direction.
3. Mixed flow - particles are subjected to co-current and counter-current phase.

The thermal energy of the hot air is used for evaporation and the cooled air pneumatically conveys the dried particles in the system. The contact time of the hot air and the spray droplets is only a few seconds, once the drying is achieved and the air temperature of air drops instantaneously. The nozzle increases the contact area of droplet and hot air influences in the huge heat transfer between droplet and hot air. The hot air evaporates moisture content in the droplet and changes into powder form. In co-current process the liquid is sprayed in the same direction as the flow of hot air through the apparatus, hot air inlet temperature is typically 150-220oC, evaporation occurs instantaneously and then dry powders are exposed to moderate temperatures (typically 50-80oC) which limit the thermal degradations. In counter-current drying, the liquid is

sprayed in the opposite direction of hot air flow for high temperature process. Thermo-sensitive products are usually restricted to in this process. However, the main advantage of this process is considered as economic in term of energy consumption. (Master, 1986; Gharsallaoui *et al*., 2007; Patel *et al*., 2009; Murugesan and Orsat, 2011).

iv) *Droplet drying*

At this stage, contact between the liquid and gas phases balances the temperature and establishes vapor partial pressure. Heat transfer is carried out from the air towards the product and this induces the difference in temperature. Water transfer is carried out in the opposite direction due to the vapor pressure difference.
Based on the drying theory, three successive steps can be distinguished. :

- Just after the hot air - liquid contact, heat transfer majorly causes the increase of droplet temperature up to a constant value. This value is defined as the air drying humid thermometer temperature;
- After that, the evaporation of water droplet is carried out at a constant temperature and water vapor partial pressure. The rate of water diffusion from the droplet core to its surface is usually considered as constant and equal to the surface evaporation rate.
- Finally, when the droplet water content reaches a critical value, a dry crust is formed at the droplet surface and the drying rate rapidly decreases with the drying front progression and becomes dependent on the water diffusion rate through this crust.

Drying is finished when the particle temperature becomes equal to that of the air. Each product has a difference of particle-forming characteristics such as expand, contract, fracture or disintegrate. The resulting particles may be relatively uniform hollow spheres, or porous and irregularly shaped (Gharsallaoui *et al*., 2007; Master, 1986; Murugesan and Orsat, 2011; Patel *et al*., 2009).

v) *Separation of dried particles*

This separation is often done through a cyclone, placed outside the dryer which reduces product loss in the atmosphere. The dense particles are recovered at the base of the drying chamber while the finest ones pass through the cyclone to separate from the humid air. In addition to cyclones, spray dryers are commonly equipped with the filters, called ‘‘bag houses’’ that are used to remove the finest powder, and the chemical scrubbers remove the remaining powder or any volatile pollutants (e.g. Flavourings). The obtained powder is made up of particles which originate from spherical drops after shrinking. The drop of water and gas content depends on the composition. These particles can either be compact or hollow (Bimbenet *et al*., 2002; Gharsallaoui *et al*., 2007; Master, 1986).

vi) *Carrier agent*

The problem of powder stickiness is mainly due to the low glass transition temperature (Tg) of the low molecular weight sugars present in such products, essentially sucrose, glucose, and fructose.

The glass transition temperature (Tg), is the temperature at which the amorphous phase of the polymer is converted between rubbery and glassy states. Fruit juice powder obtained by spray drying might have some problems with their property, such as stickiness, hygroscopic and solubility, due to the presence of low molecular weight sugars and acids, which have a low glass transition temperature (Bhandari *et al*., Jittanit *et al*., 2010). Thus, they can stick on the dryer chamber wall during drying, leading to low product yield and operational problems. The low glass transition temperature (Tg), high hydroscopic, low melting point, and high water solubility of the dry solids produce the highly sticky products. Roos and Karel (1991) state that these solid materials are very hygroscopic in amorphous state and have loose free flowing character at high moisture content. These problems can be solved by the addition of some carrier agents, like polymers and gums, to the product before being atomized. Moreover, carrier agent is also used for microencapsulation. It can protect sensitive food components against unfavorable ambient conditions, mask or preserve flavours and aromas, reduce the volatility and reactivity and provide additional attractiveness for the merchandising of food products (Jittanit *et al*., 2010).

The common carrier agents used for fruit juices are maltodextrins and gum Arabic (Cano-Chuca *et al*., 2005; Gabas *et al*., 2007; Righetto & Netto, 2005). Maltodextrins are products of starch hydrolysis, consisting of D-glucose units linked mainly by $\alpha(1\rightarrow4)$ glycosidic bonds. They are described by their dextrose equivalence (DE), which is inversely related to their average molecular weight (Bemiller and Whistler, 1996). Maltodextrins are low cost and very useful for spray drying process on food materials. Gum Arabic is natural plant exudates of Acacia trees, which consists of a complex heteropolysaccharide with highly ramified structure. It is the only gum used in food products that shows high solubility and low viscosity in aqueous solution, making the spray drying process easier.(Rodriguez-Hernandez *et al*., 2005).

The use of different carrier agents and different drying conditions produces the different physicochemical properties of powders. Knowledge of food properties is essential and this will help optimize the processes and functionalities, reduce costs, mainly in the case of powders produced or used in pharmaceutical and food industries. Properties such as moisture content and water activity are essential for powder stability and storage. Bulk density is important for packaging and shipping considerations. Particle size distribution is having 1300 major roles in processing, handling and shelf life and the microstructure is related to powders functionality, stability and flowability (O'hagan *et al*., 2005).

vii) *Factors influencing the properties of fruit juice powder produced by spray dry technique*

Spray drying is a technique widely used in the food industry to produce food powder due to its effectiveness under the optimum condition (Cano-Chuca *et al*., 2005; Jittanit *et al*., 2010). The spray drying parameters such as inlet temperature, air flow rate, feed flow rate, atomizer speed, types of carrier agent and their concentration are influencing the particle size, bulk density, moisture content, yield and hygroscopicity in spray dried foods (Chegini and Ghobadian, 2005; Chegini and Ghobadian, 2007; Yousefi *et al*., 2011).

viii) *Concentration of carrier agent*

The concentration of the carrier agent also affects the powder properties. Low concentration of carrier agent may obtain the stickiness of powder. Quek *et al*. (2007)

investigated the effect of maltodextrin concentrations (0, 3 and 5%) on the properties of the watermelon juice powder. The result showed that there were hardly any powders accumulated in the collector if maltodextrin was not added to the feed. The particles produced were very sticky and mainly deposited onto the wall of drying chamber and cyclone and could not be recovered. The addition of 5% maltodextrin to the feed appeared to give better results than addition of 3% maltodextrin. These results showed that the maltodextrin was a useful drying aid in the spray drying process of watermelon juice and as a result it improved the yield of product. However, if the added maltodextrin was more than 10%, the resulted powders lost their attractive red-orange colour.

(Source: Spray drying technique of fruit juice powder: some factors influencing the properties of product, Phisut, N. International Food Research Journal 19(4): 1297-1306,2012)

Maltodextrin

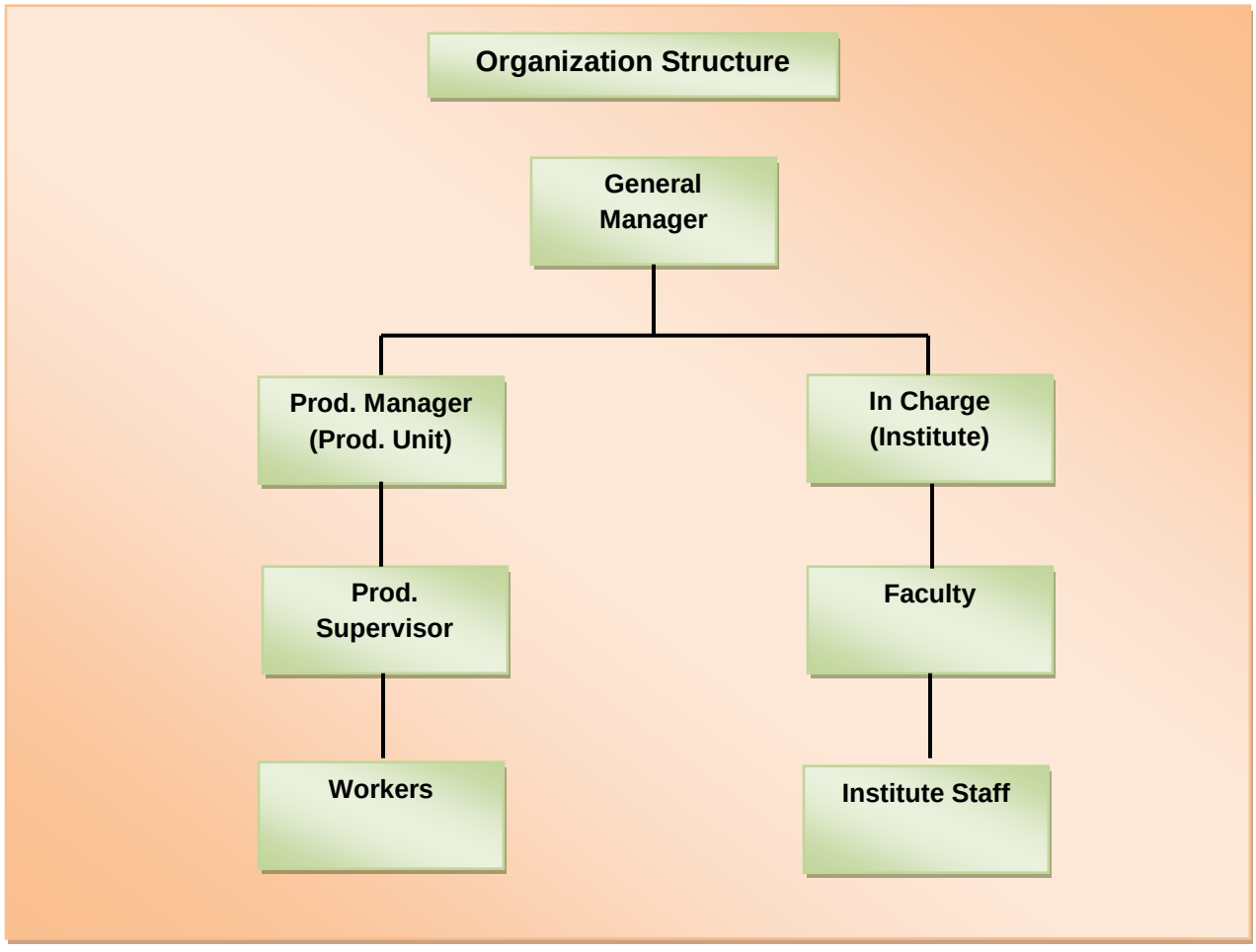
6. Infrastructure

The infrastructure of the unit is described under four chapters which are

1. Organization Structure
2. Tomato Powder Processing Unit
3. Universal Vegetable Processing Training Centre
4. Common facilities

6.1 Organization Structure

Both the Tomato Powder Processing Unit and the Universal Vegetable Processing Training centre will be under the control of the PPP partner. The organization chart of the unit is shown hereunder.



6.2 Tomato Powder Processing Unit

The infrastructure of the Tomato Powder Processing unit will be as detailed below

i) Land: 10.00 acres of land with boundary wall. *(Please refer drawing no 1)*
ii) Building: The building will consist of
   a) Tomato Powder and vegetable processing plant
   b) Vegetable Processing Training Centre and
   c) Common Facilities and Service Centres

Detail of infrastructure is given hereunder

a) Tomato Powder and vegetable processing plant

For the layout of the Tomato Processing unit and Vegetable Processing Centre please refer the drawing no 2

Sl	Facilities	Information for selecting the size of each facility centre
1	**Raw material store** (cold storage)	Fully ripe fruits are stored at 7 ^{o}C with 90% humidity for one week. A storage temperature of 13 ^{o} C with 90-95% relative humidity is recommended for slow ripening. Tomato will be stored in trays in 4 layers For 15 days the maximum stock could be 2000 MT of Tomatoes
2	**Other Raw materials store**	Other chemicals and ingredients
3	**Semi processed materials**	Tomato pulp in containers will be kept in the store. The maximum stock coul be 12000 MT (6 months)
4	**Finished Goods Store and Packing materials**	Finished products will be kept in packed condition at normal temperature. The Maximum stock could be 3000 MT (for 2 months)
5	**Processing floor**	In this factory there may be more than one type of products. The main processing line will be for tomato powder. But Tomato ketchup and tomato puree will also be processed
6	**Test Laboratory**	One laboratory can be divided in to 2 parts. One part for quality checking of each batch of tomato during processing and other part can be used as laboratory /

Sl	Facilities	Information for selecting the size of each facility centre
		simulator for the trainee of vegetable processing training centre
7	**General store**	For keeping the materials for housekeeping , repairs & maintenance, fire fighting etc
8	**Seeds and Fertilizer store**	The PPP partner should go for contract farming with the tomato producing farmers. The farmers should be provided with good quality of seeds and fertilizers.
9	**Locker room for workers**	

b. Vegetable Processing Training Centre

1	**Classrooms – 2 nos**	1. 50 per batch for Factory Manager 2. 50 per batch for Supervisor
2	**Library & Reading room**	
3	**Faculty room**	Maximum 4 faculties at a time

c. Common Facilities and Service Centres

Sl	Facilities	Information for selecting the size of each facility centre
1	**Administrative block**	Details of manpower requirement is given hereunder Rooms required for offices of 1. General Manager 2. Manager 3. Accounts & Administrative staff 4. Supervisors & Workers 5. Maintenance Staff 6. Conference room
2	**Toilets**	
3	**Canteen**	
4	**Security guard room**	
5	**Underground tank**	Water for firefighting (water, when available will be taken from the river)
6	**Tube well for drinking water**	
7	**Space for waste materials**	Solid Waste treatment plant. Wastage daily 1000 kg per day

Sl	Facilities	Information for selecting the size of each facility centre
8	**Space for Generator**	
9	**Space for Pump House**	
10	**Water treatment plant**	Rain water harvesting and waste water recycling treatment arrangement. This water could be used for toilets and cleaning the floors
11	**Solar lights**	Specially for garden area and street light
12	**Generator Room**	
13	**Surface drain**	
14	**Road inside the factory area**	

The entire premise will be protected by boundary wall

6.3 Water Requirement

In the project site one deep tube well with 3 HP submersible pump is required. The water quality in the surrounding area should be as per specification of 4251 – 1967. The safe potable water will be used for the processing zone, cold room and office. Total water requirement if approx. 20,000 Lit / Day. Provision of water storage reservoir, capacity of 45 KL is required. PVC reservoir at top of Administrative building and Toilet is essential. There is also a need of water treatment plant

6.4 Power & Fuel

- 11 KVA three phase HT electrical connections are required at site.
- 110 Amp. Circuit breaker switch is required to install.
- Main control panel with change over switch is required.
- 315 KVA Eco-friendly Transformer is required as standby power supply.
- For generator it is considered 40 lit / Hr fuel consumption.
- Running time assumed 2 hours per day. For Refer van it is considered consumption of fuel 6 Km / Lit and 30 lit / day for 300 days

7. Pollution Control and Quality Control

The Govt. accords utmost importance to control environmental pollution. The entrepreneur should have an environmental friendly attitude and adopt pollution control measures by process modification and technology substitution.

The following steps are suggested which may help to control pollution in vegetable processing industry wherever applicable.

In the vegetable processing industry wash water gives odiferous smell when left overnight or discharged to open field without any treatment.

7.1 Effluent & Disposal

After starting the Tomato Powder processing this unit can extend their product range and prepare Tomato Ketchup, Tomato Puree, Tomato Sauce etc and can also expand its production range and can produce other vegetable powder like Carrot Powder, Beet Powder and Chili Powder etc.

These products will generate solid waste. One effluent treatment plant is required in the project. Garbage effluent will be utilized in the organic fertilizer unit as Farm Yard Manure. The BOD of fruits / vegetables washed water is less. The smoke generated by the generator will be released as per rules of Pollution Control Board. The quantum of solid waste will be about 600 kg per day

7.2 Energy Conservation

With the growing energy needs and shortage coupled with rising energy cost, a greater thrust on energy efficiency in industrial sector has been given by the Govt. of India since 1980s. The Energy Conservation Act, 2001 has been enacted on 18th August 2001, which provides guidelines for efficient use of energy. Its conservation and capacity building of Bureau of Energy Efficiency created under the Act.

7.3 Quality Control

The processing unit should have ISO 2200 certificate. The unit should have proper documentation system to ensuring the quality of product and for this purpose the sample of every process should be tested and the quality of the product should be ensured

8. Production Capacity and Yield

Tomato Powder will be produced from fresh red tomatoes through spray drying method.

Production Capacity and Yield

Plant Capacity	Product: Tomato Powder
	Per hour: 250 kg
	Per day: 6 MT
	Per Month: 150 MT
	Per Year: 1800 MT
No of Working Days	25 days per month
	300 days per shift
No of Shifts	3 per day
One Shift	8 hours

Stages of Production

Production of Tomato Powder will be at 2 stages

The 1st stage	Production of Tomato Pulp from fresh Tomato
The 2nd stage	Production of Tomato Powder from Pulp

Yield

Yield of Tomato Pulp from Tomato	94%
Yield of Tomato Powder from Tomato Pulp	11%
% of Carrier Agent	<10%

From 100 kg Tomato 10 Kg of Tomato Powder will be produced

Capacity Utilization & Income (1st phase)							
Particular	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**	**9th**
Production Capacity (qty)	1800	1800	1800	1800	1800	1800	1800
Utilization (%)	60	70	80	80	90	90	90
Utilization (qty)	1080	1260	1440	1440	1620	1620	1620
Selling Price (L per MT)	2.00	2.00	2.00	2.20	2.20	2.50	2.60
Income (Rs. In lakhs)	**2160.00**	**2520.00**	**2880.00**	**3168.00**	**3564.00**	**4050.00**	**4252.50**

Capacity Utilization & Income (2nd phase)									
Particular	**10th**	**11th**	**12th**	**13th**	**14th**	**15th**	**16th**	**17th**	**18th**
Production Capacity (qty)	2700	2700	2700	2700	2700	2700	2700	2700	2700
Utilization (%)	65	75	80	80	85	85	90	90	90
Utilization (qty)	1755	2025	2160	2160	2295	2295	2430	2430	2430
Selling Price (L per MT)	2.70	2.81	2.92	3.04	3.16	3.39	3.42	3.56	3.70
Income (Rs. In lakhs)	**4837.25**	**5860.48**	**6563.73**	**6891.92**	**7688.80**	**8073.24**	**8975.54**	**9424.32**	**9895.53**

Particular	**19th**	**20th**	**21st**	**22nd**	**23rd**	**24th**	**25th**
Production Capacity (qty)	**2700**	3500	3500	3500	3500	3500	3500
Utilization (%)	**90**	65	75	80	80	85	85
Utilization (qty)	**2430**	2275	2625	2800	2800	2975	2975
Selling Price (L per MT)	**3.85**	4.00	4.16	4.32	4.50	4.68	4.87
Income (Rs. In lakhs)	**10390.31**	**10213.93**	**12374057**	**13859.52**	**14552.50**	**16235.13**	**17046.89**

9. Raw Materials and its procurement

9.1 Raw Materials (Tomato)

The main Raw Material of the processing unit will be Tomatoes

The **tomato** is the edible, often red fruit of the plant ***Solanum lycopersicum***, commonly known as a **tomato plant**. Both the species and its use as a food originated in Mexico, and spread throughout the world following the Spanish colonization of the Americas. Its many varieties are now widely grown, sometimes in greenhouses in cooler climates.

The tomato is consumed in diverse ways, including raw, as an ingredient in many dishes, sauces, salads, and drinks. While it is botanically a fruit, it is considered a vegetable for culinary purposes (as well as under U.S. customs regulations, see *Nix v. Hedden*), which has caused some confusion. The fruit is rich in lycopene, which may have beneficial health effects.

The tomato belongs to the nightshade family (*Solanaceae*). The plants typically grow to 1–3 meters (3–10 ft) in height and have a weak stem that often sprawls over the ground and vines over other plants. It is a perennial in its native habitat, although often grown outdoors in temperate climates as an annual. An average common tomato weighs approximately 100 grams (4 oz).

About 150 million tons of tomatoes were produced in the world in 2009. China, the largest producer, accounted for about one quarter of the global output, followed by United States and India. For one variety, plum or processing tomatoes, California accounts for 90% of U.S. production and 35% of world production.

According to FAOSTAT, the top producers of tomatoes (in tonnes) in 2011.

Rank	Country	Production (MT)
1	China	48,572,921
2	India	16,826,000
3	United States	12,526,070
4	Turkey	11,003,433

Rank	Country	Production (MT)
5	Egypt	8,105,263
6	Iran	6,824,298
7	Italy	5,950,215
8	Brazil	4,416,652
9	Spain	3,864,120
10	Uzbekistan	2,585,000

9.2 Varieties of Tomatoes

There are around 7500 tomato varieties grown for various purposes. Heirloom tomatoes are becoming increasingly popular, particularly among home gardeners and organic producers, since they tend to produce more interesting and flavorful crops at the cost of disease resistance and productivity. In 1973, Israeli scientists developed the world's first long shelf-life commercial tomato varieties.

Hybrid plants remain common, since they tend to be heavier producers, and sometimes combine unusual characteristics of heirloom tomatoes with the ruggedness of conventional commercial tomatoes.

Tomato varieties are roughly divided into several categories, based mostly on shape and size.

- "Slicing" or "globe" tomatoes are the usual tomatoes of commerce, used for a wide variety of processing and fresh eating.
- Beefsteak tomatoes are large tomatoes often used for sandwiches and similar applications. Their kidney-bean shape, thinner skin, and shorter shelf life make commercial use impractical.

- Ox heart tomatoes can range in size up to beefsteaks, and are shaped like large strawberries.
- Plum tomatoes, or paste tomatoes (including pear tomatoes), are bred with a higher solids content for use in tomato sauce and paste, and are usually oblong.
- Pear tomatoes are pear-shaped, and are based upon the San Marzano types for a richer gourmet paste.
- Cherry tomatoes are small and round, often sweet tomatoes generally eaten whole in salads.
- Grape tomatoes, a more recent introduction, are smaller and oblong, a variation on plum tomatoes, and used in salads.
- Campari tomatoes are also sweet and noted for their juiciness, low acidity, and lack of mealiness. They are bigger than cherry tomatoes, but are smaller than plum tomatoes.

Early tomatoes and cool-summer tomatoes bear fruit even where nights are cool, which usually discourages fruit set. There are also varieties high in beta carotenes and vitamin A, hollow tomatoes and tomatoes that are kept for months in storage.

Tomatoes are also commonly classified as determinate or indeterminate. Determinate, or bush types bear a full crop all at once and top off at a specific height; they are often good choices for container growing. Determinate types are preferred by commercial growers who wish to harvest a whole field at one time, or home growers interested in canning. Indeterminate varieties develop into vines that never top off and continue producing until killed by frost. They are preferred by home growers and local-market farmers who want ripe fruit throughout the season. As an intermediate form, there are plants sometimes known as vigorous determinate or semi determinate; these top off like determinates, but produce a second crop after the initial crop. The majority of heirloom tomatoes are indeterminate, although some determinate heirlooms exist.

9.3 Characteristics of Commercially Grown Tomato

An area of 2,11,640 hectares was brought under the cultivation of fruit crops during 2010-2011 which indicates 22.55% increase in area over 2005-2006.
On the other hand, area of about 943.32 thousand hectares was put under cultivation of vegetables in 2010-2011 which is 6.01% higher over 2005-2006.

Variety	Characteristic
ARTH-3	Plants determinate; fruits large, round, deep red, compact; uniform ripening, harvesting starts after 80-85 days and continues up to 160-180 days; gives an average yield of 88-95 tons/ha. Suitable for table purpose
Avinash-2	Heavy yielder, determinate, compact growing hybrid. Fruits semi oblong, medium sized, good colored, uniform ripening.
Pusa Hybrid-1	Plants are determinate; compact with good foliage cover and prolific bearing fruits are round, smooth and attractive. It has an

Variety	Characteristic
	added advantage of providing, tomato from June to mid July
Pusa Hybrid 4	Plants are determinate, compact with dark green foliage, good foliage cover; fruits are attractive, round smooth, average weight of 70-80grams and it shows uniform ripening, good for long transportation. Average yield 550 Qtl/Ha.
Vishal Arka	Plants are determinate; fruits are round, firm, deep red with green shoulder, average weight of 140 gram; tolerant to fruit cracking; matures in 160 days with an average yield of 75tons/Ha

In West Bengal the major tomato producing area is North Bengal in particular, Haldibari area of the District of Koochbehar and the adjoining area of the District of Jalpaiguri. The project site has been selected at the Moyanaguri in the the District of of Jalpaiguri. The other major sites of tomato producing areas are Haldibari, Dhupguri etc.

9.4 Season of Tomato Harvesting

In West Bengal the peak months for growing tomato are December and January and the lean months are November, February and March.

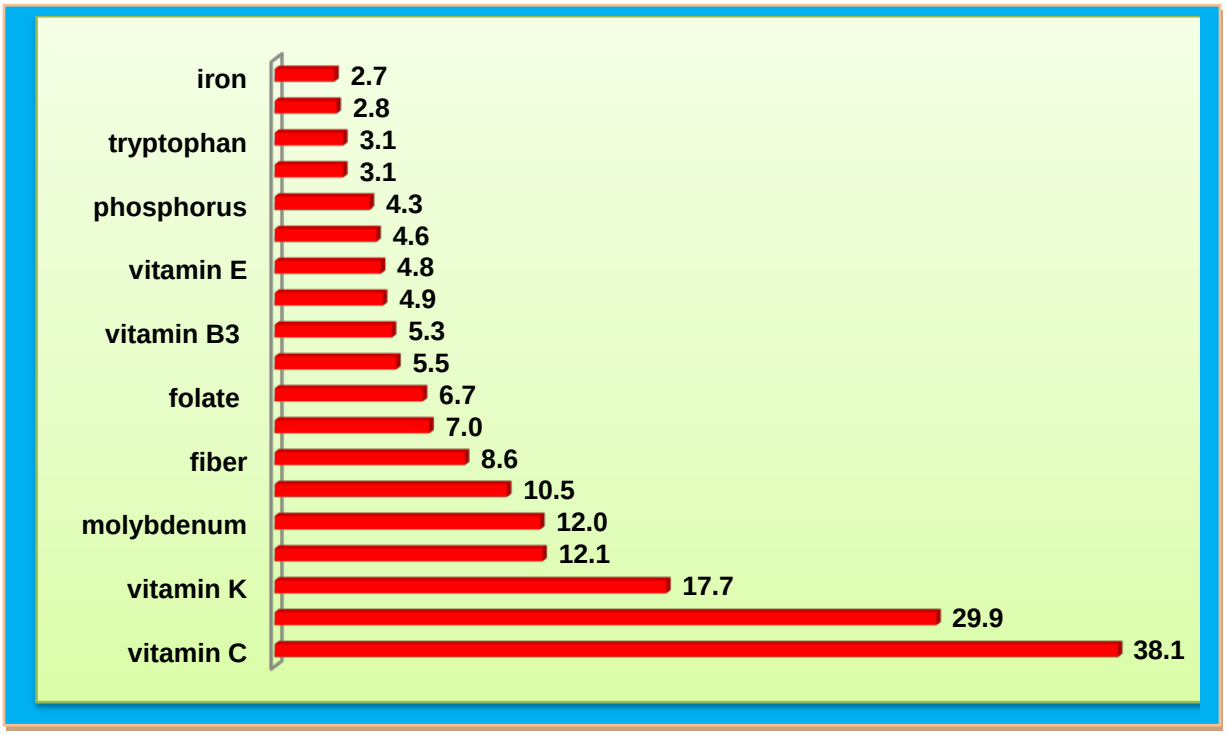
9.5 Nutrients in Tomato

The nutrients in tomato is shown hereunder

1.00 cup raw (180.00 grams)

Vitamin C	38.1	Vitamin B3	5.3
Vitamin A	29.9	Magnesium	4.9
Vitamin K	17.7	Vitamin E	4.8
Potassium	12.1	Vitamin B1	4.6
Molybdenum	12.0	Phosphorus	4.3
Manganese	10.5	Protein	3.1
Fiber	8.6	Pryptophan	3.1
Vitamin B	7.0	Chlorine	2.8
Folate	6.7	Iron	2.7
Copper	5.5		

Percentage of Nutrients in Tomato



9.6 Procurement of Tomato

The area where the tomato processing unit is proposed to operate is a rich tomato growing area. Tomato grows mostly in winter season. Sometimes the excess growth of tomato reduces the selling price of tomato and the farmers face problem even to recover the cost. Since Jalpaiguri area does not have any organized sector for controlling the selling price of tomato, efficiently procuring the tomatoes is a major way in which the partner can save its costs. As raw material prices may fluctuate and the PPP partner may face problems in procuring tomato at a steady rate, it is recommended that the PPP partner may go for contract farming or long term agreement with the tomato growers for procuring tomatoes at a steady rate every year.

Tomatoes of specific varieties which have more yield will be procured in winter and will be kept in refrigerated stores

The cost of tomato reduces to Rs. 5.00 per kg in winter. Though presently tomato can be produced throughout the year but the tomato grown in winter contains maximum lycopene which gives best quality tomato powder as far as taste, colour and yield is concerned. It is suggested that the PPP partner will arrange for contract farming

Procurement of tomatoes in each month and production of pulp is shown hereunder

Month	Unit	Op Bal	Purchase	Total	Production	Cl bal	Pulp
October	MT	0	2000	2000	2000	0	1880
November	MT	0	2000	2000	2000	0	1880
December	MT	0	4000	4000	4000	0	3760
January	MT	0	4000	4000	4000	0	3760
February	MT	0	4000	4000	4000	0	3760
March	MT	0	2000	2000	2000	0	1880
April	MT	0	0	0	0	0	0
May	MT	0	0	0	0	0	0
June	MT	0	0	0	0	0	0
July	MT	0	0	0	0	0	0
August	MT	0	0	0	0	0	0
September	MT	0	0	0	0	0	0
Total			**18000**				**16920**

Production of Tomato Powder from Pulp is shown hereunder

Month	Unit	Op Bal	Add	Total	Production	Cl bal	Powder
October	MT	0	1880	1880	1410	470	150
November	MT	470	1880	2350	1410	940	150
December	MT	940	3760	4700	1410	3290	150
January	MT	3290	3760	7050	1410	5640	150
February	MT	5640	3760	9400	1410	7990	150
March	MT	7990	1880	9870	1410	8460	150
April	MT	8460	0	8460	1410	7050	150
May	MT	7050	0	7050	1410	5640	150
June	MT	5640	0	5640	1410	4230	150
July	MT	4230	0	4230	1410	2820	150
August	MT	2820	0	2820	1410	1410	150
September	MT	1410	0	1410	1410	0	150
Total			**16920**		**16920**		**1800**

Procurement and Cost

Years	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**	**9th**
Production Capacity (qty)	18000	18000	18000	18000	18000	18000	18000
Utilization (%)	60	70	80	80	90	90	90
Utilization (qty)	10800	12600	14400	14400	16200	16200	16200
Purchase Rate (Rs, per MT)	15000	15000	15000	15000	15000	20000	20000
Cost of Tomato	**1620.00**	**1890.00**	**2160.00**	**2160.00**	**2430.00**	**3240.00**	**3240.00**

Year	**10th**	**11th**	**12th**	**13th**	**14th**	**15th**	**16th**	**17th**	**18th**
Production Capacity (qty)	27000	27000	27000	27000	27000	27000	27000	27000	27000
Utilization (%)	65	75	80	80	85	85	90	90	90
Utilization (qty)	17550	20250	21600	21600	22950	22950	24300	24300	24300
Purchase Rate (Rs, per MT)	20000	20000	20000	25000	25000	25000	25000	25000	30000
Cost of Tomato	**3510.0**	**4050.00**	**4320.00**	**5400.00**	**5737.50**	**5737.50**	**6075.00**	**6075.00**	**7290.00**

Year	**19th**	**20th**	**21ST**	**22ND**	**23rd**	**24th**	**25th**
Production Capacity (qty)	27000	35000	35000	35000	35000	35000	35000
Utilization (%)	90	65	75	80	80	85	85
Utilization (qty)	24300	22750	26250	28000	28000	29750	29750
Purchase Rate (Rs, per MT)	30000	30000	30000	30000	40000	40000	40000
Cost of Tomato	**7290.00**	**6825.00**	**7875.00**	**8400.00**	**11200.0**	**11900.00**	**11900.00**

10. Capital Cost

It is estimated that the Fixed Cost of the project will be Rs. 1592.6 lakhs as detailed below in the initial 2 years.

Assets (Fixed)	**Rs. (in lakhs)**
Initial Upfront Cost	105.00
Premise Development	430.91
Building	571.73
Plant & Machinery	258.80
Electrical Installation	207.63
Others Including Contingencies	126.69
Total	**1700.75**

A. Details of Fixed Cost

	Particulars	**Unit**	**Area**	**Rate (Rs.)**	**Amount Rs. (in lakhs)**	**Total Rs. (in lakhs)**
1.	**Initial Upfront Cost**					**105**
2.	**Premise Development**					
	Development of Land	C M	40150	260	104.19	
	Boundary Wall with gate	R Mt	1000		58.85	
	Approach Road with Box Culvert	R Mt	1200		129.70	
	Internal Road	R Mt	600		53.37	
	Surface Drain	R Mt	1000	3460	34.60	
	Truck & Car Parking area	LS			50.00	**430.91**
3.	**Buildings**					
	Tomato Powder Processing Area	Sq M	1030	12550	129.27	
	Raw Material Store	Sq M	1040	12550	130.52	
	Semi Finished Product Store	Sq M	250	12550	31.38	
	Finished Product Store	Sq M	515	12550	64.63	
	Packing Materials Stores	Sq M	250	12550	31.38	
	General Store	Sq M	300	12550	37.65	
	Laboratory	Sq M	42	12550	5.27	
	Administrative Building	Sq M	100	12550	12.55	
	Classrooms	Sq M	100	12550	12.55	
	Faculty Room	Sq M	25	12550	3.14	
	Library	Sq M	42	12550	5.27	
	Security room	Sq M	25	12550	3.14	

	Particulars	Unit	Area	Rate (Rs.)	Amount Rs. (in lakhs)	Total Rs. (in lakhs)
	Toilet Block	Sq M	255	12550	32.00	
	Security & Safety Arrangement	LS			5.00	
	Generator Room	Sq M	25	12550	3.14	
	Underground Reservoir with Fire Hydrant	No	150	30000	45.00	
	Deep Tube well	No	1	500000	5.00	
	Overhead Reservoir	KL	45	33000	14.85	**571.73**
4.	**Plant & Machinery**					
	Tomato processing & Tomato Powder making unit (complete)	Set			250.00	
	Weighing Machine	No	3	1	1.80	
	Equipment & Accessories	LS			7.00	**258.80**
5.	**Electrical Installation**					
	PUF Insulated Panel	Sq.M	2700	2100	56.70	
	PUF Block	Sq.M	540	1050	5.67	
	Compact ODU & IDU Unit	No	16	650000	104.00	
	Insulated Door	No	8	52000	4.16	
	Upper Sliding Door	No	2	230000	4.60	
	Electrical Air Curtain	No	10	4000	0.40	
	Installation of H T line	LS	1	1250000	12.50	
	Installation of L T line	LS	1	1000000	10.00	
	315 KVA Transformer	No	1	610000	6.10	
	Control Panel	LS	1	350000	3.50	**207.63**
6.	**Others**					
	200 KVA Generator	No	1	1095000	10.95	
	Solar Lighting	No	60	20000	12.00	
	Solid Waste Treatment Plant	No	1	20000	0.20	
	Furniture & Office Equipments	LS		400000	4.00	
	Government Fees & Consultancy	LS			50.00	
	Contingencies 3% (on Rs. 1660.00)				49.54	**126.69**
	Total Fixed Assets					**1700.75**

There has been a capacity increase that has been done in the 10th & 20th year. Two new tomato processing units have been procured in each of the two years.

The cost for each of these units has been calculated as follows:

a) For the tomato processing unit procured in the 10th year, the 1st year cost of 250 lakhs has been escalated by 5% for each of the 9 years to come up with the cost in the 10th year.
b) For the tomato processing unit procured in the 20th year, the 1st year cost of 250 lakhs has been escalated by 5% for each of the 19 years to come up with the cost in the 20th year.

11. Man Power Requirement & Cost

The unit will require 44 employees. There will be 12 unskilled labour and they can be engaged as casual labour. It is estimated that 6 skilled and 9 semiskilled workers will be required. The entire team will work under a General Manager who preferably will be a food technologist.

The perks of each employee is taken at 25%. It is suggested that to give support in developing the product range and to ensure the quality of the products SJDA will have an arrangement with the local agricultural university who will help the PPP partner in the area of research and development.

The chemist of the processing unit will check the sample of each batch to ensure the quality of the product.

A. For Tomato Powder manufacturing unit

Particulars	No.	Monthly	Yearly	Perks (25%)	Total
Food Technologist (GM)	1	35000	420000	105000	525000
Production Manager	1	25000	300000	75000	375000
Food Technologist/Chemist	1	20000	240000	60000	300000
Production Supervisor	3	15000	540000	135000	675000
Procurement Incharge	1	20000	240000	60000	300000
Export and Sales Incharge	1	20000	240000	60000	300000
Skilled Labour	6	10000	720000	180000	900000
Semiskilled Labour	9	8000	864000	216000	1080000
Office Staff	3	7000	252000	63000	315000
Storekeeper	1	7000	84000	21000	105000
Total (A)	**27**		**3900000**	**975000**	**4875000**

B. For Universal Vegetable Processing Training Centre

Particulars	No.	Monthly	Yearly	Perks (25%)	Total
Lecturer	2	25000	600000	150000	750000
Peon/Bearer	1	5000	60000	15000	75000
Laboratory Assistant	1	7000	84000	21000	105000
Librarian	1	7000	84000	21000	105000
Total (B)	**5**		**828000**	**207000**	**1035000**
Unskilled Workers (C)	**12**	6000	72000	0.00	**864000**
Total (A+B+C)= D	**44**				**5982000**
Say					**6774000**

12. Project Economics & Financial Analysis

12.1 Income from Sale of Tomato Powder

Export price of Tomato Powder may be as high as Rs. 800 per kg depending on the quality of Tomato Powder. But in this project a very conservative selling price of Rs. 200 per kg is taken.

Income from sale of Tomato Powder is taken in the following way:

a) Base price of tomato powder

Years	Price (in Rs/kg)
3-5	200
6-7	220
8	250
9	260

b) The increase in selling price of tomato powder is taken as 4% per annum after year 9 .

12.1 Income from Training Institute

Course: 1	**Production Manager**
Course Duration:	6 months
Batch:	Two
No of Participants:	40 x 2 = 80 in a year
Course Fee:	Rs. 30000 per participants per year

Course: 2	**Production Supervisor**
Course Duration:	3 months
Batch;	Four
No of Participants:	40 x 4 = 160 in a year
Course Fee:	Rs. 25000 per participants per year

Income from Training Institute

Production Manager	80 x Rs.30000 = Rs. 24 lakhs
Production Supervisor	160 x Rs.25000 = Rs. 40 lakhs
Total Income	**Rs. 64 lakhs per year**

12.2 Depreciation

Depreciation for each of the capital assets has been calculated by a straight line depreciation method. The depreciation % for each of the capital asset categories has been taken as the following:

Capital Asset	Depreciation %
Building	3.33
Plant & Machinery	4.76
Electrical Installations	3.33
Others	3.33

12.3 Working Capital

Particulars	**Month**	1st Yr	2nd Yr	3rd yr	4th yr	5th yr
Raw Materials (Tomato)	1/2	135.00	157.50	180.00	180.00	202.50
Semi Processed Materials (Pulp)	1	126.90	148.05	169.20	169.20	190.35
Finished Products (Powder)	2	180.00	210.00	240.00	240.00	270.00
Carrier Agent & Other Chemicals	1	58.50	68.25	78.00	78.00	87.75
Packing Materials	LS	15.00	15.00	15.00	15.00	20.00
Receivables	1/2	135.00	157.50	180.00	189.00	212.63
Total		650.40	756.30	862.20	871.20	983.23
Less Creditors		60.00	70.00	75.00	75.00	100.00
Working Capital		**590.40**	**686.30**	**787.20**	**796.20**	**883.23**

Particulars	**Margin**	**1st Yr**	**2nd Yr**	**3rd yr**	**4th yr**	**5th yr**
PPP partners contribution 25%	25%	147.60	171.58	196.80	199.05	220.81
Loan From Bank 75%	75%	442.80	514.73	590.40	597.15	662.42
Total		**590.40**	**686.30**	**787.20**	**796.20**	**883.23**

12.4 Repayment of Interest on Working Capital Loan

Year	**Opening Balance**	**Disbursement**	**Total**	**Interest (15%)**
1st Year	0.00	442.80	442.80	66.42
2nd Year	442.80	71.93	514.73	77.21
3rd Year	514.73	75.68	590.40	88.56
4th Year	590.40	6.75	597.15	89.57
5th Year	597.15	65.27	662.42	99.36
6th Year	662.42	0.00	662.42	99.36
7th Year	662.42	0.00	662.42	99.36

It is observed that in the 11th year, the net cash accrual for the project is Rs. 742 lakhs. So enough cash is there at this time to pay back the working capital principal. So the working capital principal has been repayed back in the 11th year.

12.9 Considerations for Calculation of Profitability Statement

Sale Price	Taken at Rs. 200.00 per kg in the 1st 3 years
Production of Tomato Powder	Capacity: 150 MT per month Yearly Production taken as 1st Year: 60% 2nd Year:70% 3rd Year: 80% 4th Year 80% 5th Year: 90%
Cost of Raw Materials	Standard Cost at Rs 15.00 per kg in initial 5 years Rs. 20/kg (Years 8-12) Rs. 25/kg (Years 13-17) Rs. 30/kg (Years 18-22) Rs. 40/kg (Years 23-25)
Interest on Working Capital	15% per annum

12.10 Expenses in the P & L Statement

The expenses have been categorized into the following heads: The price in the base year and increase % per year has been listed down below:

Expense	**Price in base year (in lakhs)**	**Increase % per year**
Electricity Charges	50	10
Salaries & Wages	67.74	5
Fuel Charges	30	10
Repairs & Renewals	5	10
Office & Admin Charges	6	10
Marketing Expense	50	10

Land can be obtained on lease basis for use from SJDA by the PPP Partner. The land will be provided to the PPP Partner on a zero lease basis.

12.11 P & L Projections

		Years	**3**	**4**	**5**	**10**	**15**	**20**	**25**
REVENUE (INR Lakhs)			2198.40	2569.28	2941.95	4857.77	7730.93	9397.01	14956.39
TOTAL			2198.40	2569.28	2941.95	4857.77	7730.93	9397.01	14956.39

Years	3	4	5	10	15	20	25
Cost of Raw Materials (B)	1620.00	1890.00	2160.00	3510.00	5737.50	6825.00	11900.00
Operating Expenses(C)	350.92	382.50	416.54	594.60	727.24	1121.28	1695.04
EBITDA (A-B-C)	227.48	296.78	365.41	753.17	1266.19	1450.73	1361.35
Depreciation	39.21	39.21	39.21	57.68	57.68	87.76	87.76
EBIT	188.27	257.57	326.20	695.49	1208.51	1362.97	1273.59
Interest	215.11	211.03	207.51	143.97	0.00	0.00	0.00
EBT	-26.83	46.54	118.69	551.52	1208.51	1362.97	1273.59
Income Tax	0.00	15.82	40.34	187.46	410.77	463.27	432.89
PAT	-26.83	30.72	78.35	364.06	797.74	899.70	840.70
Depreciation	39.21	39.21	39.21	57.68	57.68	87.76	87.76
Cash Accrual	12.37	69.93	117.56	421.74	855.42	987.46	928.46

13 Various Options of Project Structuring

The various options of project structures that have been analyzed in the model are as follows:

a) The entire capital cost funded by the PPP Partner: (**Option 1)**
b) 40% viability grant funding (**Option 2**)
c) Rs. 13 crore contribution by SJDA (**Option 3**)

The entire capital cost has been phased to be invested in the initial 2 years on a 40:60 basis. The various financing options analyzed are as follows:

a) Debt Equity Ratio =2:1
b) Loan Term = 10 years
c) Moratorium period for payment of principal = 3 years
d) Interest Rate for Long Term Loan = 11%

13.1. Analysis of various options

a) **Option 1 (Entire investment by PPP Partner)**:

In this scenario, the entire project cost of Rs. 1700.75 lacs is to be borne by the PPP Partner. The investment will be done in two years.

Years	Capital Cost Invested
Year 1 (40%)	Rs. 680.30 lakhs
Year 2 (60%)	Rs. 1020.45 lakhs

So, the equity and debt contributions for the PPP Partner, for the two years, are listed down as follow:

Years	Mode of Capital Invested	
	Equity	**Debt**
Year 1	Rs. 226.77 lakhs	Rs. 453.53 lakhs
Year 2	Rs. 357.16 lakhs	Rs. 714.32 lakhs

The cash flow of such type of investment has been analyzed for a debt equity ratio of 2:1 to come out with the project IRR and equity IRR of the project. The project IRR and equity IRR calculated for this type of investment is listed down as under:

Project IRR	23%
Equity IRR	39%

The returns are on the higher side considering a high beta stock also gives a return in the range of 15%. And considering equity IRR of 39%, this looks like a very profitable business to enter into.

b) Option 2 (Viability Grant funding)

In this scenario, the project cost of Rs. 1700.75 lacs is to be invested by two parties. 60% investment is to be done by the Concessionaire and 40% investment is to be borne by SJDA.. The investment is to be done in two years as follows.

Years	Capital Cost Invested (by PPP Partner)
Year 1	Rs. 408.18 lakhs
Year 2	Rs. 612.27 lakhs

So, the equity and debt contributions for the PPP Partner, for the two years, are listed down as follows:

Years	PPP Partner Share	
	Equity	Debt
Year 1	Rs. 136.06 lakhs	Rs. 214.29 lakhs
Year 2	Rs. 272.12 lakhs	Rs. 428.59 lakhs

The cash flow of such type of investment has been analyzed for a debt equity ratio of 2:1 to come out with the project IRR and equity IRR of the project.

The project IRR and equity IRR calculated for this type of investment is listed down as under.

Project IRR	32%
Equity IRR	52%

The returns are very high for this type on investment. But as the first option is feasible, this option is not required to be pursued.

c) Option 3 (Rs. 13 crore contribution by SJDA)

In this scenario, the project cost of Rs. 1700.75 lacs is to be invested by two parties. Rs 1300 lacs is to be invested by SJDA and Rs. 400.75 lacs is to be invested by the private partner. The investment is to be done in two years as follows.

Years	Capital Cost Invested (by PPP Partner)
Year 1	Rs. 160.3 lakhs
Year 2	Rs. 240.45 lakhs

So, the equity and debt contributions for the PPP Partner, for the two years, are listed down as follows:

Years	PPP Partner Share	
	Equity	**Debt**
Year 1	Rs. 53.43 lakhs	Rs. 106.87 lakhs
Year 2	Rs. 84.16 lakhs	Rs. 168.32 lakhs

The cash flow of such type of investment has been analyzed for a debt equity ratio of 2:1 to come out with the project IRR and equity IRR of the project.
The project IRR and equity IRR calculated for this type of investment is listed down as under.

Project IRR	58%
Equity IRR	91%

The returns are very high for this type on investment. But as the first option is feasible, there is not a great need for this type of option.

13.2 Summary of various options

The Project IRR and Equity IRR for each of the options is listed down as follows:

Option	Project IRR	Equity IRR
Capital Cost funded by PPP Partner	23%	39%
Viability grant funding(40%)	32%	52%
Contribution by SJDA (13 crore)	58%	91%

The high IRR values for project and equity indicate that the project is viable and any contribution by any Government Agency is not required. The PPP Partner can develop, operate and maintain the centre on its own.

14 Sensitivity Analysis

14.1 Revenue and Total Raw Material and Operating Cost

The Project IRR calculations for the sensitivity analysis done on revenue and total raw material and operating cost for the various options listed above are described below:

a) **Option 1 (Entire investment by PPP Partner)**:

		Revenue			
		0%	**-2%**	**-3%**	**-5%**
Cost (Raw Material & Operating Costs	**0%**	22.66%	20.53%	19.36%	16.80%
	2%	20.86%	18.50%	17.19%	14.24%
	3%	19.87%	17.39%	15.98%	12.82%
	5%	17.77%	14.91%	13.31%	9.34%

b) **Option 2 (Viability Grant funding)**:

		Revenue			
		0%	**-2%**	**-3%**	**-5%**
Cost (Raw Material & Operating Costs	**0%**	31.72%	28.96%	27.45%	24.19%
	2%	29.38%	26.34%	24.68%	20.93%
	3%	28.10%	24.92%	23.16%	19.16%
	5%	25.40%	21.77%	19.76%	15.11%

c) **Option 3 (Rs. 13 crore contribution by SJDA)**:

		Revenue			
		0%	**-2%**	**-3%**	**-5%**
Cost (Raw Material & Operating Costs	**0%**	58.12%	52.99%	50.36%	44.59%
	2%	53.69%	48.41%	45.41%	38.82%
	3%	51.43%	45.82%	42.74%	35.65%
	5%	46.63%	40.23%	36.66%	28.90%

14.2 Revenue and Total Capex

The Project IRR calculations for the sensitivity analysis done on revenue and total capex for the various options listed above are described below:

a) Option 1 (Entire investment by PPP Partner):

		Revenue Sensitivity			
		0%	**-3%**	**-5%**	**-8%**
Capital Cost Sensitivity	**0%**	22.66%	19.36%	16.80%	12.05%
	5%	21.90%	18.65%	16.11%	11.42%
	10%	21.18%	17.98%	15.47%	10.81%

		Revenue Sensitivity			
	15%	20.50%	17.35%	14.86%	10.24%

b) Option 2 (Viability Grant funding):

		Revenue Sensitivity			
		0%	**-3%**	**-5%**	**-8%**
Capital Cost	**0%**	31.72%	27.45%	24.19%	18.24%
	5%	30.72%	26.52%	23.32%	17.46%
	10%	29.78%	25.66%	22.51%	16.73%
	15%	28.91%	24.85%	21.73%	16.04%

c) Option 3 (Rs. 13 crore contribution by SJDA):

		Revenue Sensitivity			
		0%	**-3%**	**-5%**	**-8%**
Capital Cost	**0%**	58.12%	50.36%	44.59%	34.10%
	5%	51.52%	44.68%	39.48%	30.13%
	10%	46.52%	40.36%	35.60%	27.05%
	15%	42.57%	36.85%	32.46%	24.56%

From the sensitivity analysis, it can be concluded that the Project IRR is very sensitive to the total raw materials and operating expense.

15 Conclusion

It can be concluded from the financial analysis that the project is viable even when the selling price of Tomato Powder is taken at Rs. 200 per kg. But in reality the selling price of Tomato Powder is higher and it may be Rs. 800 per kg. This depends on the quality of tomatoes and its mass contents as well as lycopene contents of the tomatoes.

It is expected that the PPP partner will have contract with the local farmers for procurement of tomatoes so that he can procure tomatoes at an agreed rate for a long time and can maintain his production cost.

From the financial analysis, it is clear that the option of the entire capital cost financing by the PPP Partner has very good financial viability. Therefore the PPP Partner can profitably develop, operate and maintain the proposed vegetable processing and training centre.

An initial upfront cost of Rs. 105 lakhs is to be paid by the selected bidder to SJDA. SJDA can then enter into a Development cum Operation Agreement by which the PPP Partner pays SJDA an annuity per year which escalates at a rate of 5% per annum. This annuity amount can be taken as the price bid criteria during bidding by the PPP Partner at the RFP Stage. The land of the site will be transferred on lease basis to the preferred bidder with an annual lease fee of zero.