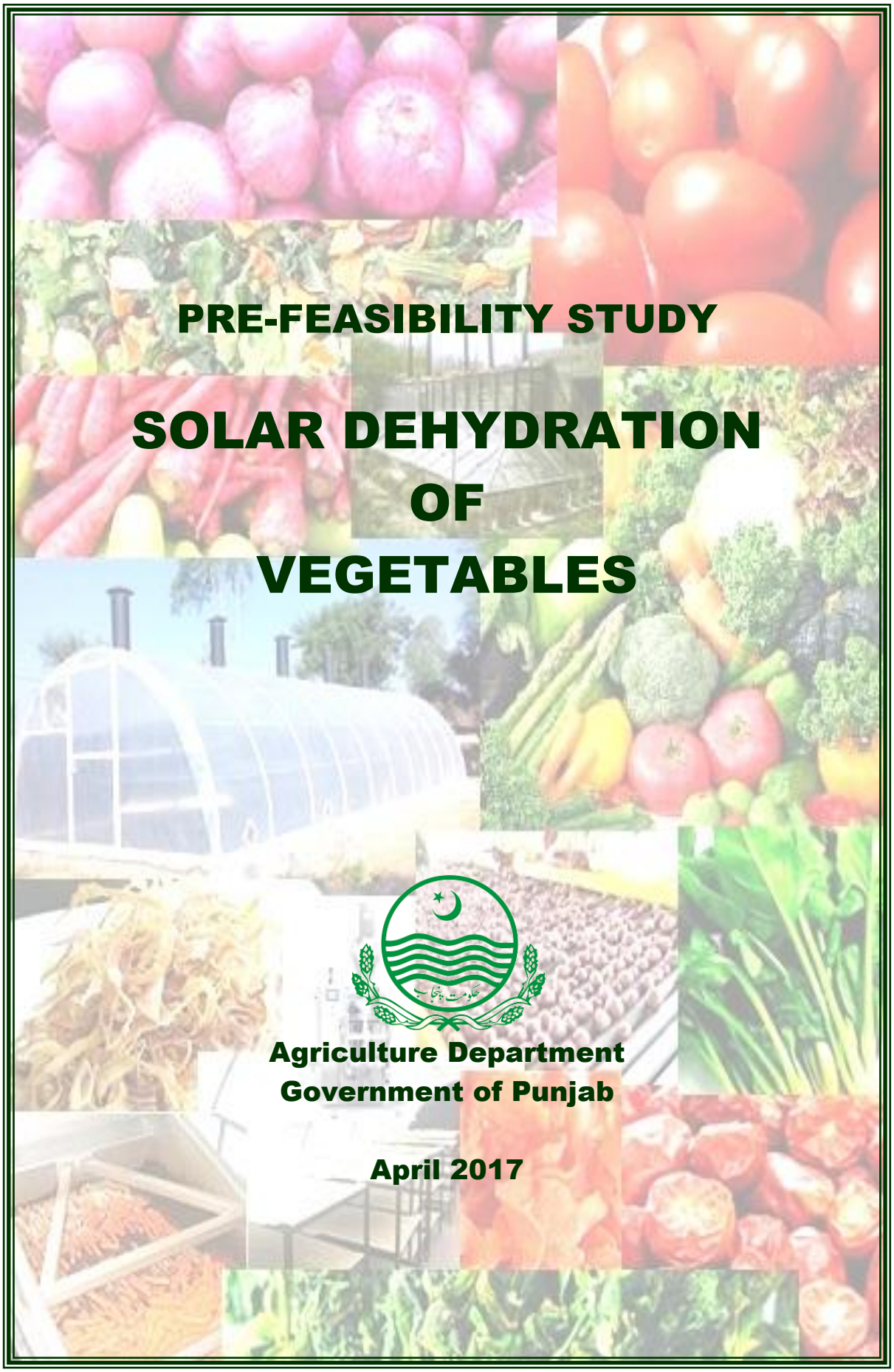

PRE-FEASIBILITY STUDY

SOLAR DEHYDRATION OF VEGETABLES

Agriculture Department
Government of Punjab

April 2017

Acronyms

Acronym	Description
ASF	Agribusiness Support Fund
CPEC	China Pakistan Economic Corridor
GI	Galvanized Iron
GST	General Sales Tax
HS	Harmonised System
IMF	International Monetary Fund
IRR	Internal Rate of Return
NPV	Net Present Value
SMEDA	Small and Medium Enterprise Development Authority
UK	United Kingdom
USA	United States of America
USAID	United States Agency for International Development

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Disclaimer

This document has been prepared with the objective to provide basic information about the subject business proposition. The content of the document has been developed on the basis of data and information collected from various reliable secondary and primary sources and is based on certain assumptions. While reasonable due diligence has been carried out during information collection and working out the presented calculations, the reader is strongly encouraged to carry out any further scrutiny and diligence to collect any other information that may be deemed necessary to take an informed decision. Professional advice from qualified technical expert/consultant should preferably be sought before taking any decision to act upon the information presented in the document. Department of Agriculture, Government of Punjab does not assume any liability for any financial or other loss in consequence of undertaking any activity on the basis of the information provided in the document.

1.0 EXECUTIVE SUMMARY

Processing of fresh vegetables and fruits is carried out to produce high value added products that have a prolonged shelf life and offer convenience of transport, storage and sourcing to the final consumers. Dehydrationadds value to fresh fruits and vegetables by removing water by exposing them to high temperatures to reduce their weight and increase shelf life.

Dehydrated vegetables and fruits are produced and traded in large quantities around the world. International trade of dehydrated horticultural products has been increasing over the years. In 2015, the total export market of dehydrated vegetables was USD 15.4 billion. This included USD 4.3 billion of exports of dried vegetables in whole, cut, sliced, powdered form and USD 11.1 billion exports of dried leguminous vegetables. Expanding international market of dried vegetable offers an attractive opportunity for private investors. It also opens a window for the vegetables farmers of Punjab to sell their surplus produce that is available in large quantities during peak production seasons and usually gets wasted. The subject document presents the findings of the pre-feasibility of establishing a solar dehydration unit for drying vegetables; destined for export market.

The products selected for the purpose of this study include dehydrated onion, carrot, tomato, spinach and chillies. The unit will have a capacity of handling 10 tons of fresh vegetables by having ten solar dehydrators; each having a capacity of one ton. A batch of one ton will take two days to dry. The dehydration process will be carried out using solar power that will remove large share of moisture in the fresh produce. The process will be supported by fuel-powered cabinet dehydrators that will be used only for removing any residual moisture during the days when adequate sunlight may not be available due to unfavorable weather conditions. Different products will be processed during different months corresponding to their peak production seasons to get maximum benefit of low prices during those periods.

The project has been proposed to be established in Khanewal to be close to the production clusters of the target products. The project has a total cost of PKR 62.3 million; financed by 100% investor's equity. Working capital constitutes 23.9% of the total project cost. The project is assumed to operate at 75% capacity utilization during the first year of operations and is expected to generate revenues of PKR 49.56 million and gross profit of PKR 23.78 million in the first year. Net profit after tax is PKR 9.5 million.

The project is found to be financially feasible with an IRR of 27.91% and a positive NPV of PKR 18.57 million. The viability is sensitive to fluctuation in fresh vegetables prices and the selling prices of the driedvegetables in international markets. Project's Summary Sheet provides information on key highlights of the project.

1.1 Project's Summary Sheet

Project's Concept	
Objective	The project aims to produce dehydrated vegetables using solar dehydrators
Product Line	Dehydrated onion, carrot, tomato, spinach, chillies
Operative Capacity	10Tons of fresh produce (in two days)
Location	Khanewal
Target Market	Export market
Technology Employed	Solar drying

Project Cost (PKR Million)	
Total Project Cost	62.30
Capital Cost	47.38
Working Capital	14.92

Financing Plan (PKR Million)		% Share
Equity	62.30	100%

First Year's Summary Income Statement (PKR Million)		% of Revenues
Revenues	49.56	100%
Cost of Sales	25.78	52.0%
Gross Profit	23.78	48%
Operating Costs	9.16	18.5%
Earnings Before Interest and Tax	14.62	29.5%
Tax	5.12	10.3%
Net Income	**9.50**	19.2%

Financial Feasibility	
Internal Rate of Return (IRR)	27.91%
Net Present Value (NPV) @ 15%	PKR 18.57 million
Payback Period (years)	3.95

Conclusion
The project is financially viable keeping in view all the bases and assumptions used for marketing, technical and financial assessments/calculations.

2.0 INTRODUCTION

2.1 Context

With a population of over 190 million people, Pakistan is the sixth most populous country and the 43rd largest economy in the world. In the current global economic scene, Pakistan is being seen as the top emerging market economy in South Asia that is progressing towards a more advanced stage through rapid growth and industrialization. Pakistan is being classified as one of the Next Eleven (N-11) countries that have the potential to become one of the world's large economies in the 21stcentury. Economic growth of the country has been on a rise during recent years; being 4.0% in 2014 and 4.2% in 2015. The IMF projects that the growth trend will continue and reach 5.2% by the year 2020.The World Bank projects that by 2018, Pakistan's economic growth will increase to 5.4% due to greater inflow of foreign investment from China-Pakistan Economic Corridor (CPEC). Government is determined to capitalize on the emerging growth trend and is working hard to ensure implementation of all the necessary steps in the right direction to increase the flow of private sector investment to expedite economic growth process. Strengthened macroeconomic outlook, improved law and order situation and facilitative government policies are contributing to improve the investment climate for foreign and local investment.

For private sector investment to flow, identifying and providing information about the feasible business opportunities is an important starting point. Investment promotion materials are developed to introduce the investors to potential business opportunities, provide basic information about the projects' capital and operational costs and work out the basic financial feasibility of the presented propositions. Agriculture, being the mainstay of Pakistan's economy, offers host of attractive investment opportunities for local and foreign investors. The current document discusses the pre-feasibility of one such option.

2.2 Agriculture Sector Overview

Pakistan is an agricultural economy. Agriculture accounts for 20.9% of the GDP and provides livelihood to 43.5% of the rural population. Agriculture GDP is derived from four major subsectors. Livestock is the biggest contributor to GDP that accounted for 56.3% of the total value in 2014-15. Crops was the second largest subsector accounting for 39.6% share; followed by the two smaller subsectors, Fisheries and Forestry, respectively accounting for 2.1% and 2.0% of the total value.Subsector-wise distribution is shown in Figure 1.

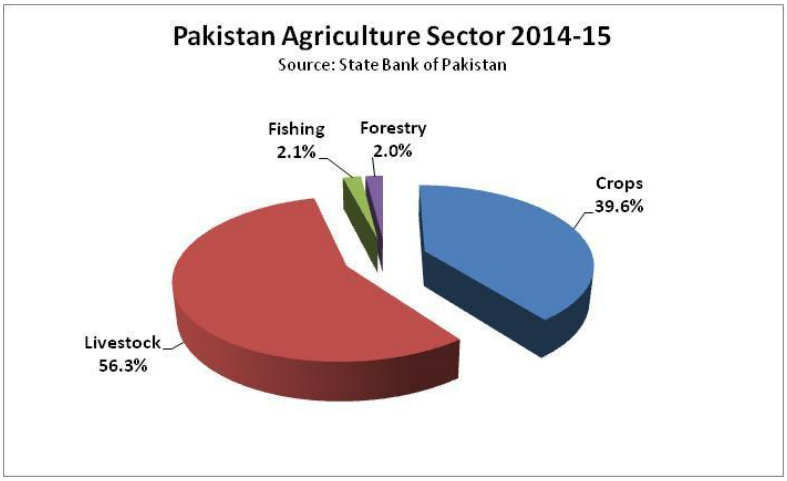


Figure 1 - Pakistan Agriculture Subsectors Distribution

The crops subsector is further divided into three categories. 'Important Crops' accounted for 64.5%, 'Other Crops' 28.1% and 'Cotton Ginning' 7.4% of the total value of crops in 2014-15. Horticultural crops, including fruits, vegetables and condiments are included in the 'Other Crops' category.

Punjab is the most populated province and the largest agriculture producer in the country. Figure and Figure 3shows Punjab's sharesin total agricultural production of different commodity groups; in comparison with the production shares of other provinces in 2014-15.

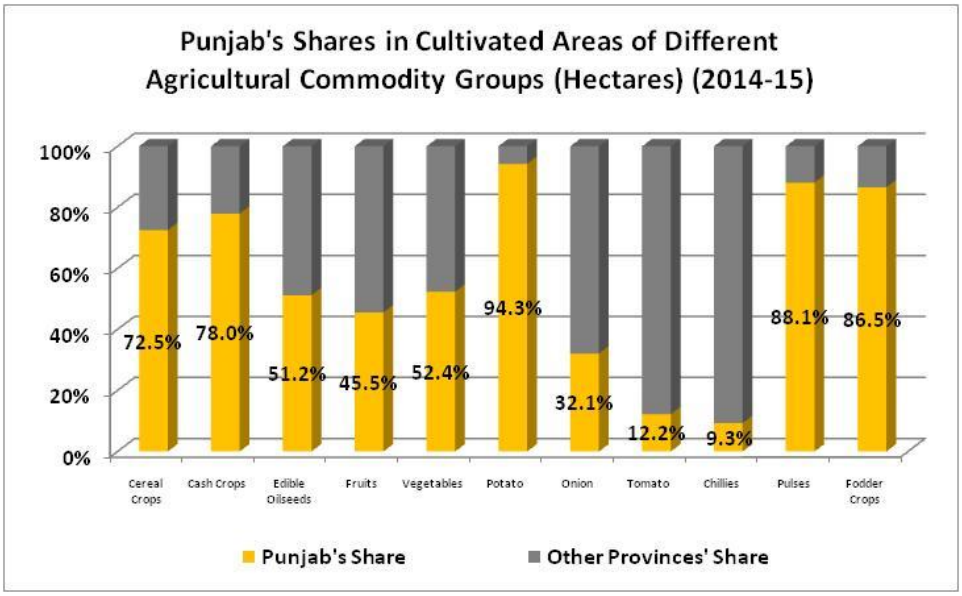


Figure 2 - Punjab's Share in Cultivated Areas of Different Commodity Groups

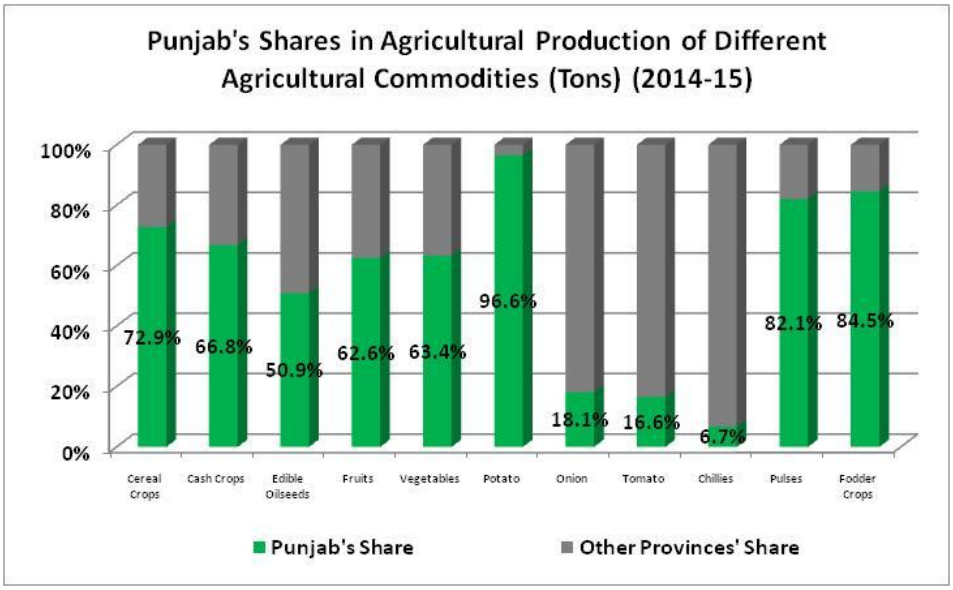


Figure 3 - Punjab's Share in Production of Different Commodity Groups

Punjab holds the biggest shares in cultivated areas and productions of majority of the agricultural commodities. In 2014-15, the cereal crops[1] were cultivated over an area of 10.13 million hectares to obtain a produce of 27.32 million tons. That translated into 72.5% share in cultivated area and 72.9% share ofthe overall national production of cereal crops. Similarly, the province has a leading position in cash crops[2] where it produced 51.5 million tons that accounted for 66.8% of the national production. During the same year, Pakistan's total production of edible oilseeds[3] was 581 thousand tons of which 51% was contributed by Punjab. In horticultural production as well, Punjab maintains a leading position. Fruits cultivation in Pakistan was spread over an area of 775 thousand acres to produce6.79 million tons. Punjab held a share of 45.5% in total cultivated area and 62.6% in total production. Vegetable production in Punjab was1.96 million tons that accounted for 63.4% share of the total national production.In case of potato, Punjab heldthe lion's shares of 93.4% and 96.6% in the total national cultivated area andtotal production. A similar situation also existed for pulses and fodder crops where the Punjab's shares in total national productionrespectively were 82% and 84.5%.

In some of the horticultural commodities, Punjab exists as a smaller player. These includes onion, tomato and chillies where the province respectively holds 18.1%, 16.6% and 6.7% shares in the total national production.

2.2.1 Horticulture Sector of Punjab

The horticulture basket of Punjab is diverse containing large variety of fruits, vegetables and condiments.[4]In 2014-15, Pakistan's total horticultural production was

[1]Includes Wheat, Rice, Maize, Jowar, Bajra and Barley

[2] Includes Cotton, Sugarcane, Tobacco, Jute, Sugar beet, Guar and Sunhemp

[3] Includes Rapeseed, Mustard, Canola, Sesame, Groundnut, Soybean, Sunflower and Safflower

[4] Include onion, garlic, coriander, chillies and turmeric

15.84 million tons which was grown on a total cultivated area of 1.46 million hectares. Fruits accounted for 44.4% and vegetables 44.9% of the total national horticultural production. The vegetables included potato as the major product accounting for 56% of the total vegetables production. Condiments accounted for 10.7% of the total national horticultural production. Figure 4shows the split.

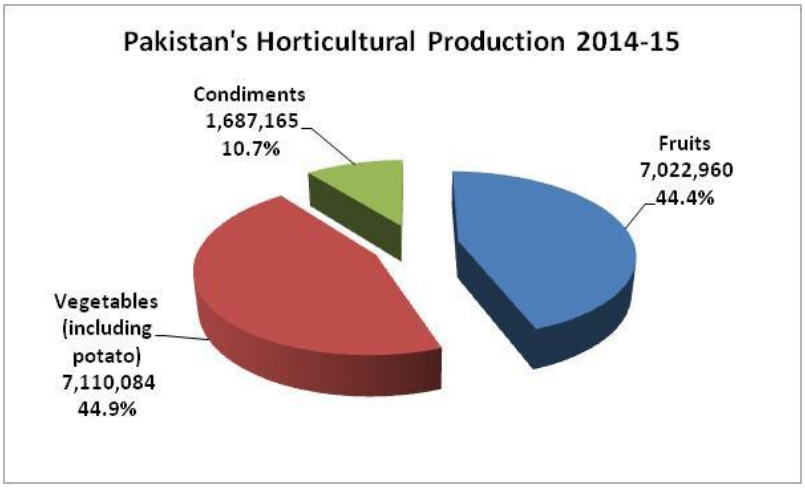


Figure 4 - Pakistan's Horticultural Production Distribution

Punjab is the major contributor in most of the horticulture product categories. In 2014-15, Punjab's total horticultural production was 10.67 million tons which accounted for 67.4% of the total national production. During the same year, 63.7% of the national fruit production was contributed by Punjab. Citrus and mango are the two main contributors in Punjab's total fruit production. Punjab's share in national vegetable production (excluding potatoes) is 62.8%. Figure 5 to Figure 8show the shares of Punjab in total national production of different horticultural products grown in the country.

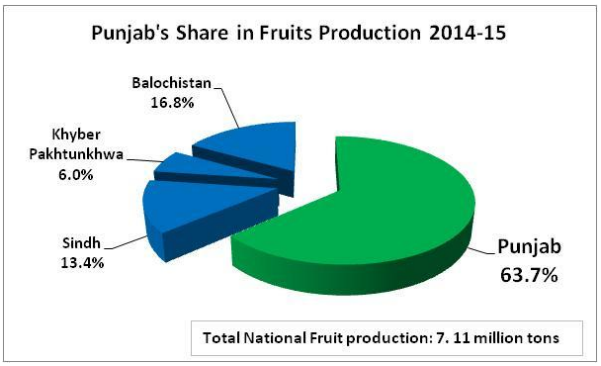


Figure 5 - Punjab's Share in Fruit Production

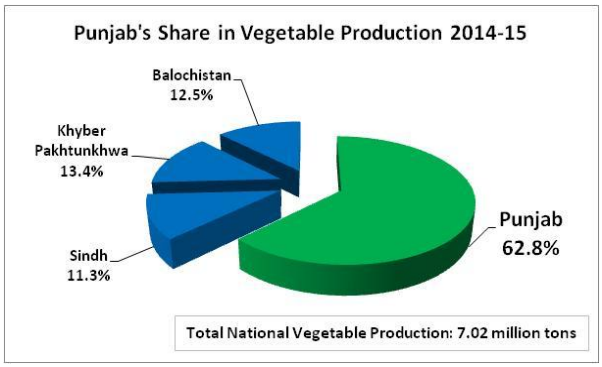


Figure 6 - Punjab's Share in Vegetable Production

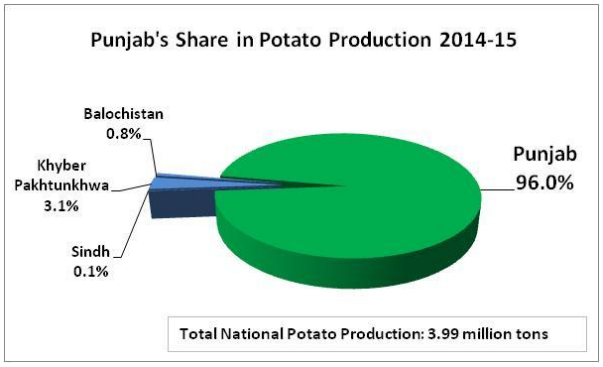


Figure 7 - Punjab's Share in Potato Production

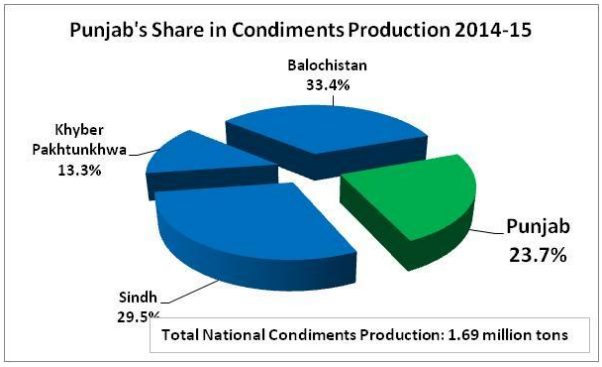


Figure 8-Punjab's Share in Condiments Production

Punjab enjoys a monopolistic position in potato production by producing 3.83 million tons and claiming 96% share in the total national production in 2014-15. Condiments constitute the only horticultural product category where Punjab is not the largest producer. In 2014-15, the province produced 0.4 million tons of condiments to contribute 23.7% to the national condiments basket.

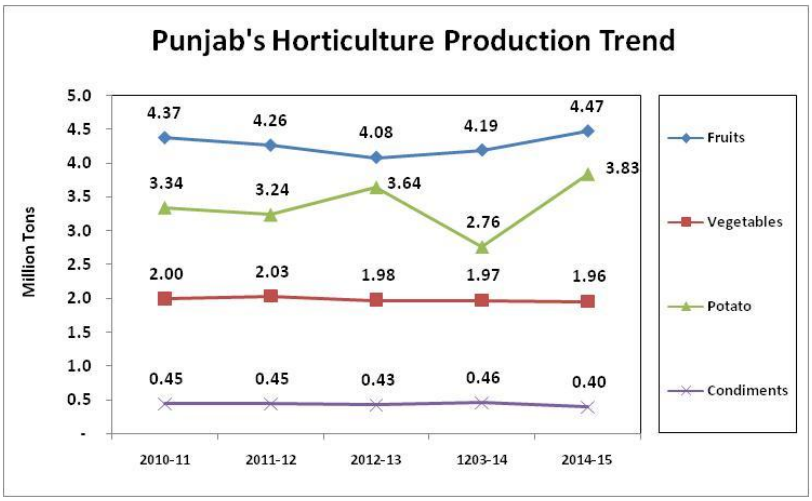


Figure 9 - Punjab's Horticultural Production Trend 2011-15

During the five years from 2011 to 2015, the horticultural production of Punjab has been almost stable. Fruit production increased by 2.3%; whereas potato production increased by 14.8%. There was a drop of 2.3% in vegetables production and decrease of 10.3% in condiments production during the five year period. Punjab's horticulture production trend is shown in Figure 9.

3.0 DEHYDRATION OF VEGETABLES[5]

Major portion of vegetables and fruits production is consumed in fresh form. Because of its perishable nature, the surplus produce, which is a significant share of the total production, is wasted. This postharvest loss can not only be secured but further value can also be added by employing different preservation methods.

Dehydration is one of the oldest,economical and simple mean of extending the shelf life of vegetables and fruits.The basic concept of dehydration is to reduce moisture content of the produce to hamper the activity of all the decaying elements which cause deteriorative changes in the produce during storage. The produce to be dried is subjected to hot air which removes the moisture content of the produce; making it stable against microbiological and chemical changes; which otherwise can spoil it. Exposing agricultural produce to sun is a preservation method that has been in practice over centuries. Solar radiation in Pakistan is very high during major part of the year which offers a promising energy resource. This is an affordable and sustainable resource that can be employed for processing and preservation of surplus fruits and vegetables to reduce the large postharvest losses. Surplus horticultural produce, available at cheaper rates during peak production in the season, can be preserved to be used during off season.

Dehydration processes differ by type of the drying method used which is driven by the type of food and the characteristics of the final product. Exposure of the substance to sunlight, called Sun Drying, is the simplest and most economical mode of drying the produce. However, by being completely weather-dependent, this preservation method is not considered very reliable. As sun drying is carried out in the open area, due to the presence of many contaminants, quality of the final product cannot be ensured. Sudden changes in weather conditions, like wind or rain, can lead to unacceptable results. To cope with this concern, solar- drying of agricultural products in enclosed structures by forced convection is considered a betterdrying method. A solar dryer intensifies the solar energy and supplies the product with more heat than is available under ambient conditions. Moreover, the food dried in the enclosed structure is safe from dust, dirt, flies and other contaminants. As the product is not directly exposed to the sun rays, its color and nutritive value is better than the sun dried product.

The dehydrated products are source of concentrated minerals, salts and sugars of fruits and vegetables,are economical to produce/pack, and can be stored in much lesser space than that required for the fresh, canned or frozen products. Moreover, it is stable at ordinary storage conditions. The reduced weight and volume of dehydrated horticultural products also reduce the transportation costs. However, some loss of heat sensitive vitamins occurs when sliced/diced cut vegetables/fruitsare

[5] The terms 'dehydration' and 'drying' and used interchangeably in the available literature.

exposed to hot air during dehydration process. With high quality dehydrated foods being produced and an increased preference for instant and convenience foods, the potential of dehydrated vegetables and fruits is increasing with time.

3.1 Vegetables Dehydration ProcessFlow

3.1.1 Process Flow

The process of dehydration of vegetables and fruits is carried out in different steps. The process can be divided into three main sections; Preparation for drying, drying and post-drying operations. Simplified process flow to prepare dehydrated vegetables/fruits is shown in Figure 10.

3.1.2 Preparation for Drying

Pre-drying stage involves preparation of the fresh horticulture produce. This is done to increase the effectiveness and efficiency of drying process, maintain the quality of the final product in terms of its color and physical appearance and also to prepare the final product in a form demanded by the market. The fresh produce to be dried is inspected, sorted, washed, peeled/trimmed, cut into small pieces or slices, blanched and pretreated with antioxidants as and when required. For better quality finished product, these steps in handling are done before the harvested vegetables start wilting.

Inspection/Sorting:The fresh vegetables are selected and sorted according to their size, ripeness and soundness. Blemished/damaged pieces are removed carefully.

Washing/Peeling:The sorted fruit/vegetables are passed through washer and peeler. Odd shape fruits like mango may be hand peeled or specialized peeling machines may be used. The peeled raw material is trimmed, washed and sliced or diced mechanically. If required, coring[6] is also carried out. Thin, uniform, peeled slices dry at the fastest rate. If the whole fruit is desired to be dried, skin of the fruit is cracked to enhance the drying process.

Slicing/Dicing:Mostly the vegetables and fruits are cut into small pieces to speed up the drying process. Cutting/slicing offers larger surface areas in contact with the heating medium (air) and more surfaces from which moisture can escape. Smaller particles or thinner layers reduce the distance heat must travel to the center of the stuff to be dried and also reduce the distance through which moisture from the center of the food has to travel to reach the surface and evaporate. As a general rule, plums, grapes, figs, dates are dried as whole fruits without cutting/slicing.

Blanching:After peeling, trimming, cutting and slicing, the vegetables are blanched by exposing them to hot water or steam for a brief period of time to deactivate

[6] Removal of seeds present in the center of fruits (apple, pear, etc.)

enzymes. These enzymes, if not inactivated, can cause loss in quality, flavor, color, texture, and nutrients. The enzymes which are needed to be inactivated are peroxidase, catalase, and lipoxygenase. The enzyme Peroxidase which is the most heat stable and can easily be detected is considered as indicator of effectiveness of the blanching treatment (Arthey, 1993). Blanching cleans the surface of the product by removing any dirt and reduces the amount of microorganisms present on the surface (Desrosier and Tressler, 1977).

Blanching is usually carried out between 75 and 100C for 1 to 10 minutes, depending on the size of individual vegetable pieces (Holdsworth, 1983). This is done by immersing the vegetables/fruits in boiling water or passed through a blancher (steaming chamber) for the time recommended for different products. Blanched vegetables should be promptly cooled down to control and minimize the degradation of soluble and heat-labile nutrients. (Deitrich et al., 1977). Steaming is preferable to scalding because some of the nutrients that are water-soluble can be lost in the blanching water. Steaming retains these nutrients to a greater degree.Green beans, carrots, okra, turnip and cabbage should always be blanched. Blanching is not needed for onions, tomatoes, chillies and sweet peppers. Tomatoes are dipped into hot water for 1-2 minutes when they need to be peeled but this is not blanching. As a rule, fruit is not blanched.

Pretreatment: Some vegetables and fruits like potatoes, bananas and apples turn brown very quickly after peeling or slicing. This undesirable color change occurs due to activity of an enzyme called phenol oxidase. Preservatives are used to improve the color and preservation qualities of the dried vegetables and fruits. Preservatives include items such as Sulphur dioxide, ascorbic acid, citric acid, salt and sugar. Exposure to sulfur environment retards the browning of fruits. After washing, peeling and slicing, the prepared fruits are subjected to Sulfuring or Sulfiting. For uniform application of Sulfur Dioxide gas to the cut surface of the produce, sulfuration is accomplished in closed (hermetic) chambers. For sulfating, the vegetables/fruits are dipped into 1-2% Sodium Bisulfite solution for 1-3 minutes. Sulfuring process must be closely controlled so that enough Sulfur is present to maintain the physical and nutritional properties of the product throughout its shelf life but not large enough that it adversely affects flavor, aroma, etc. Pre-treatment of the vegetables/fruits is done after blanching. The materials which are not to be blanched are treated after cutting/slicing and before start of drying/dehydration operation.

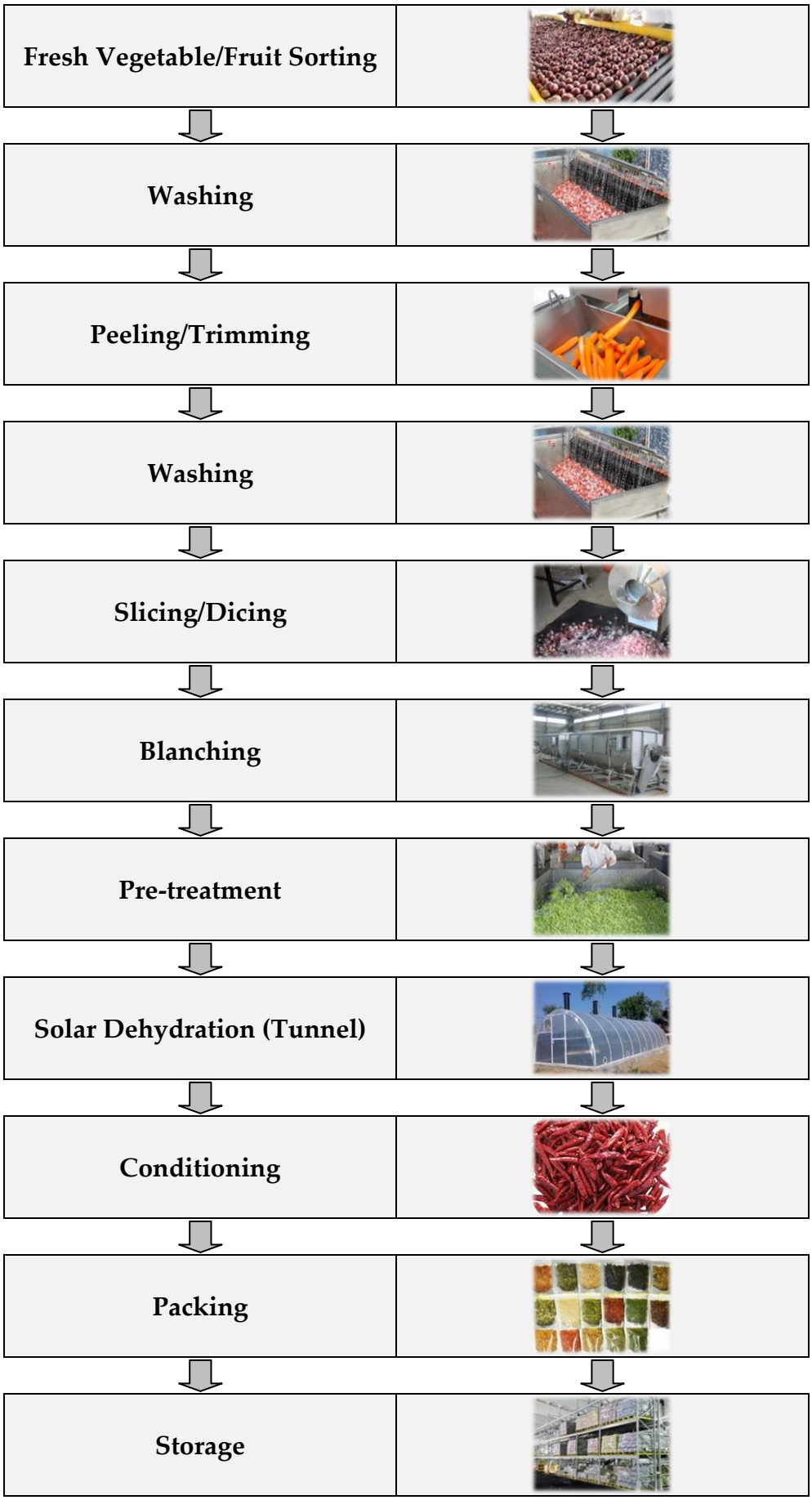


Figure 10 - Process Flow Chart to Prepare DriedVegetables/Fruits in Solar Dryer

3.1.3 Drying Process

Drying/Dehydration is the heart of the whole process and involves the application of heat to vaporize water from the vegetable/fruit tissue, and some means of removing water vapors after its separation from the product being dried. Air is the most common medium for transferring heat to a drying tissue and convection is the mainly-involved mode of heat transfer. Energy has to be supplied for raising temperature and blowing air in a fuel based dehydrator, whereas sun radiant energy is used in case of sun drying and solar dehydration. Time, temperature, moisture content of the air (humidity) and amount of air blown to remove the evaporated water are important factors which determine the efficacy of the drying/dehydration process.Vegetables and fruits are mostly dehydrated between 60 and 70C. Drying is generally started with higher temperatures in the first hour or so, and is turned down after the first hour.

The three different processes for drying/dehydration have their own merits and demerits and are narrated below:

Solar Drying:Solar drying is a common and cost-effective method in which the heat energy of sun is used to remove the moisture from the product. Sun drying is limited to climates where hot sun and dry atmosphere is available. The climatic conditions of Pakistan allow effective use of this method of drying. The process involves spreading the prepared fruit or vegetable on racks, trays, roofs or even ground in the sun till they are dried. Sun drying process offers the advantages of simplicity and low capital and operational cost. Solar dryers may be direct, indirect or hybrid.

Direct Solar Dryer:In this type of dryer, the product in the dryer is covered with transparent glass or polythene sheet. The sun passing through the transparent sheet directly falls on the product. As the product absorbs energy direct from the source, temperature cannot be controlled in this type of dryer. Exposure of the fruit/vegetable direct to the sun may lead to color deterioration of the product and loss of nutrients.

Figure 11 – Solar Tunnel Dryer

Indirect Solar Dryer:This method does not expose the product directly to the sun. A collector (generally a black surface) absorbs the sun radiation and converts it into

heat energy. Air that is to be used for dehydration of the product is heated by passing over the collector. Temperature of this indirect mode of drying can be controlled. The incoming hot air exits along with the moisture removed from the product usually through a chimney. The produce in these indirect solar dryers are placed in trays or shelves inside an opaque drying cabinet. As the produce dried is not exposed directly to the sun, product of better color is produced in this dryer.

Figure 12 – Indirect Glass Type Solar Dryer for Vegetables/Fruits Drying

Hybrid Solar Drying:This type of dryer possesses features of direct and indirect type solar dryers. The product is dried by using energy received directly from the sun passing through transparent glass/polythene sheet as well as by the pre-heated air coming from the collector.

Atmospheric dehydration:This type of dehydration may be carried out in batch or continuous processes. Batch process uses kiln, tower or cabinet dryers while the continuous process uses drying tunnel, continuous belt,etc., to move the product from one end to the other. The prepared and treated material is spread on trays and stacked on trolleys. These trolleys, loaded with prepared/pre-treated material, are placed in the tunnel, consisting of a long chamber constructed by special bricks. Heated air with controlled conditions of temperature and humidity is passed over the food in batch dryers while in continuous processes food is passed through the tunnel and hot air is passed using counter-current or co-current flow to eliminate moisture from the product. Temperature, humidity, air velocity, direction of air flow, type of dryer and type and size of the food are the major factors in defining the effectiveness and efficiency of the dehydration process. Atmospheric dehydration is the most widely used commercial method of fruit and vegetable dehydration. This drying process easily allows reducing the moisture to the levels required for ensuring the required shelf life.

Sub-atmospheric dehydration: This type of dehydration occurs at low external pressure by creating vacuumto remove moisture at less than the boiling point under ambient conditions. It includes vacuum shelf, vacuum drum, vacuum belt and freeze dryers. This process requires higher capital and operational costs and is thus used only for material which may deteriorate due to oxidation by exposure to air.

3.1.4 Post-DryingFinishing Processes

Treatment of the dehydrated product varies according to the type of vegetable or fruit and the intended use of the product. The treatments may include conditioning, screening, inspection and packaging.

Conditioning is required since sometimes, due to different sizes/shapes of the pieces and their location in the dryer, during dehydration, the moisture content of the different portions within the same batch differs. The conditioning process is carried out to ensure uniform distribution of this residual moisture. The product is kept under conditioning for two to five days. The excess moisture contained in a part of the product is absorbed by the drier part leading to the equilibrium and product consistency.

Screening is carried out to remove any unwanted size of the dehydrated product (known as 'fines'). Inspection is done to remove any foreign material, discolored pieces or pieces with some other defects.

After drying and cooling, the dehydrated material is packed in poly bags and sealed. Packaging is mostly common to all dehydrated products and important to protect the shelf life of the product. Packaging must be done in a food grade material and must protect the product against moisture, light, air, dust, foreign odor, insects and rodents. Moreover, itmust be strong enough to maintain the product's size, share and appearance throughout storage, handling and marketing.

4.0 MARKET ANALYSIS

Dehydrated products have sale potential in both local and export markets.

4.1 Local Market

Locally, the spices manufacturers are the largest consumers of dehydrated vegetables and condiments. The dried products are sold in the same formas well as used as raw material for developing different recipes of spice mixes. With increasing disposable incomes in the middle and upper middle segments of the society, the consumption of spices and the related products is on a rise. This increasing demand is in turn creating an increased demand for dehydrated products.

In addition to spice manufacturers, the dehydrated products have a market where they are used as substitute of fresh products. For example, the use of onion and garlic powders, dried fenugreek leaves, dried coriander leaves, etc. are in common use by the local consumers. The dehydrated products offer an added convenience to housewives in storage, preparation and serving of food. However, the demand for these products in the local market is small because fresh produce is available during most of the months during the year and people prefer to use fresh products due to their higher quality perception and lower prices.

There are many institutional buyers of dehydrated products in the country. Pakistan Army is the most important institution in this regard which generates a high demand of dehydrated vegetables and condiments. During exercises or war situations, the army personnel have limited access to routine supply of fresh vegetables and fruits. In such situations, dehydrated products are used to meet the nutritional needs of the army personnel.Pakistan International Airlines (PIA) is another important consumer of dehydrated vegetables and condiments which uses these as raw material for their food operations. Hotels and restaurants represent another important group of consumers of dehydrated vegetable and fruit products.

4.2 Export Market

Dried fruits and vegetables is a major category in the world export market of horticultural products.

International trade of edible vegetables, roots and tubers is reported under the 2-digit HS code 07. Total world export market of edible vegetables in 2015 was USD 65.6 billion. Overall export growth of this category during the 9-year period from 2007 to 2015 has been 47.4%. There are fourteen subcategories (at 4-digit HS code level); two of which, HS 0712 and HS0713, represent the trade of dried vegetables. World exportsof these two categories during the last five years are shown in Figure 13 and Figure 14.

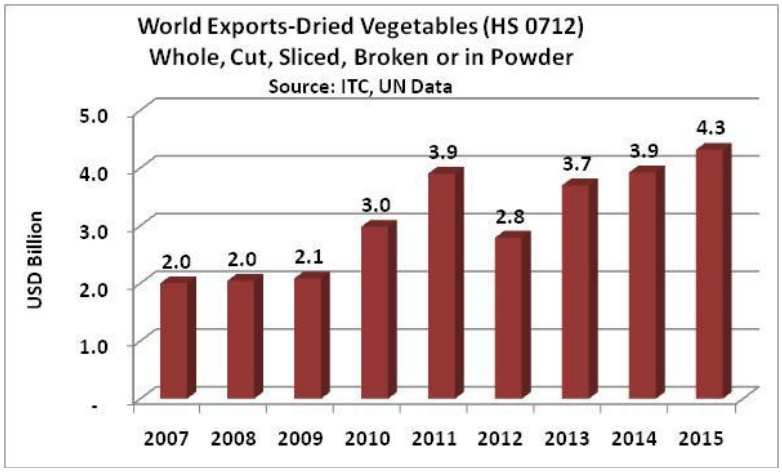


Figure 13 - World Exports of Dried Vegetables

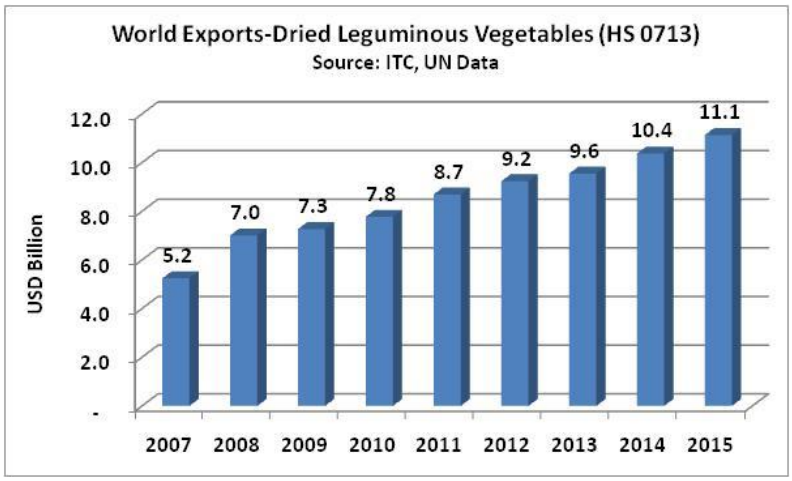


Figure 14 - World Exports of Dried Leguminous Vegetable

The world market of dried vegetables as whole, cut, sliced, broken or powdered form (HS 0712) was USD 4.3 billion in 2015; increasing from USD 2.0 billion in 2007 andrepresenting into an overall growth of 116% and an average growth rate of 14% per annum. The dried leguminous vegetables market, reported under HS 0713,was much bigger. In 2015, total exports in this category were USD 11.12 billion. During the nine year period from 2007 to 2015, overall growth rate in this category 112%; this translates into average growth rate of 14% per annum.

International trade under the HS 0712 is reported under six subcategories (at 6-digit HS code level). The categories and the exported quantities and values are shown in Table 1.

Product code	Product label	Export Value - 2015 (000 USD)	Growth % (2007-15)
'071239	Dried mushrooms and truffles, whole, cut, sliced, broken or in powder	1,586,938	373%
'071290	Dried vegetables and mixtures of vegetables,	1,416,041	16%

	whole, cut, sliced, broken or in powder		
'071232	Dried wood ears "Auricularia spp.", whole, cut, sliced, broken or in powder	672,757	1031%
'071220	Dried onions, whole, cut, sliced, broken or in powder	492,748	60%
'071233	Dried jelly fungi "Tremella spp.", whole, cut, sliced, broken or in powder	85,008	420%
'071231	Dried mushrooms of the genus "Agaricus", whole, cut, sliced, broken or in powder	63,858	8%
Total		**4,317,350**	**116%**

Table 1 - Dried Vegetables World Exports in Different Subcategories

Dried mushrooms and truffles is the largest category accounting for 36.8% of the total export value under this category. It is followed by dried vegetables and their mixtures which account for 32.8% share. Dried onion is a relatively smaller category accounting for 11.4% share of the total products listed under HS 0712. Figure 15shows the shares of different products exported under this category.

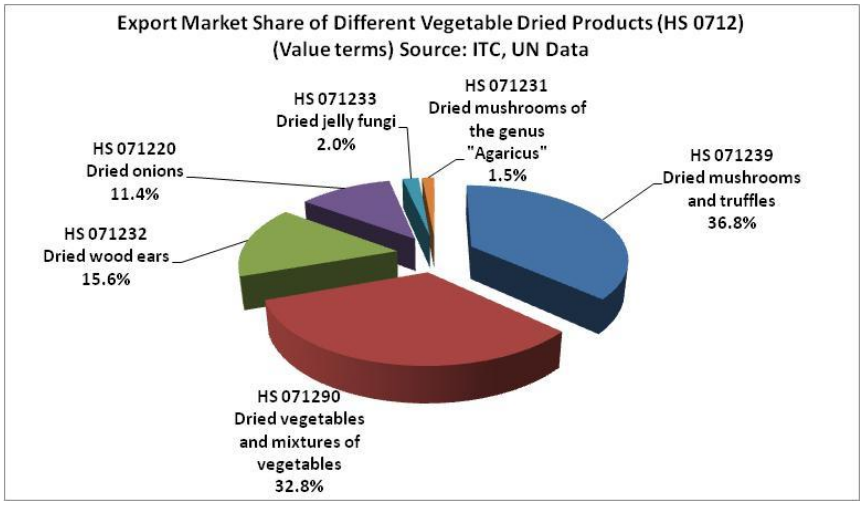


Figure 15 - Export Market Segments of Dried Vegetable Products - 2015

Though mushrooms are produced in Pakistan, the country is not a large producer of these products. Similarly, products like wood ears and jelly fungi are not produced in the country. In this context, the two categories more relevant for Pakistani producers of dried vegetables are dried onions (HS 071220) and Other dried vegetables[7] reported under HS 071290; for which abundant supply of raw material is available in the country.From 2007 to 2015, the export market of dried onion grew by 60% and that of other dried vegetables grew by 16%. Compared to these, the largest category of mushrooms and truffles grew by 373% during the same period.

[7] Under HS 071290, different types of dried vegetables are reported by different trading countries. Some common products include dried garlic, tomatoes, carrot, spinach, capsicum, broccoli, celery stalks, bamboo shoots, parsley, olives, and dried vegetables nes. (not elsewhere specified)

4.2.1 Dried Onions and Other Dried Vegetables/Mixture

Dried onion (HS 071220) export was a USD 493 million market in 2015. The export market showed a continuous growth trend during the period from 2009 to 2015, and grew by 55%; representing a yearly average growth of around 9%. Compared to that, the export market of Other Dried Vegetables/Mixture of Vegetables (HS 071290)[8] was a three times larger market with a total size of USD 1.41 billion in 2015. The market however showed a relatively modest growth rate of 24% during the period from 2009 to 2015. Unlike the exports of dried onion, the exports of 'Other' dried vegetables did not follow a continuously increasing trend. The exports increased from 2009 to 2011 and later, decreased till 2014; with an increase in the following year. The 7-year export trends of the two categories are shown in Figure 16.

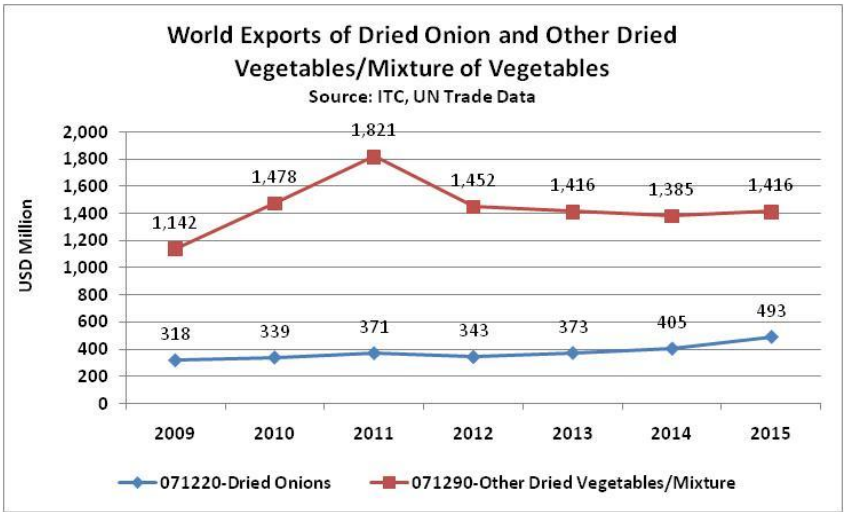


Figure 16 - World Exports of Dried Onions and Other Dried Vegetables/Mixture

Dried onion is exported by large number of countries. In 2015, India was the largest exporter with exports of USD 129 million to claim 26% share of international market. It was followed by USA with exports of USD 90 million with 18% share. Tanzania, Egypt, China and Germany were the next large players with 18%, 8%, 7% and 5% shares respectively. Figure 17 shows the shares of major exporters of Dried onions.

Leading exporting country in the market of 'Other' dried vegetables was China with exports of USD 603 million claiming a large share of 42%. Other exporters were all the developed countries; including USA, Germany and Netherlands, respectively being the second, third and fourth largest exporters with 9%, 8% and 7% market shares. Figure 18 the shares of the major exporters of Dried Other Vegetables/Mixture.

[8]The three products considered for the purpose of this pre-feasibility include dried tomatoes, dried spinach and dried carrot. International trade data on these three products is not available in a segregated form and is reported in a cumulative form under HS 071290, Other' Dried Vegetables.

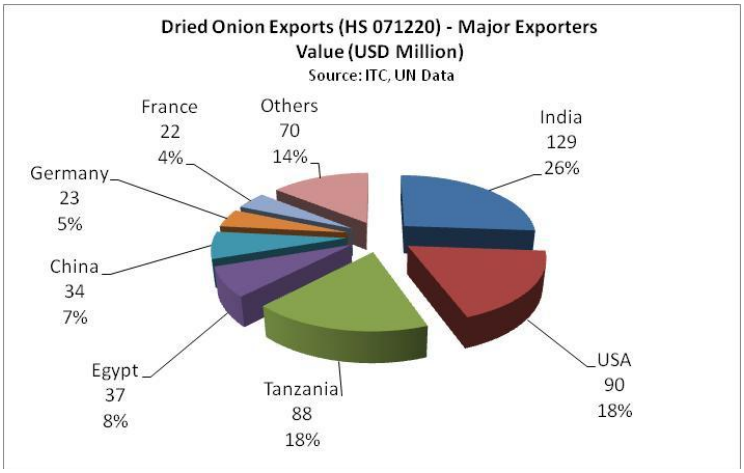


Figure 17 - Dried Onion Major Exporting Countries

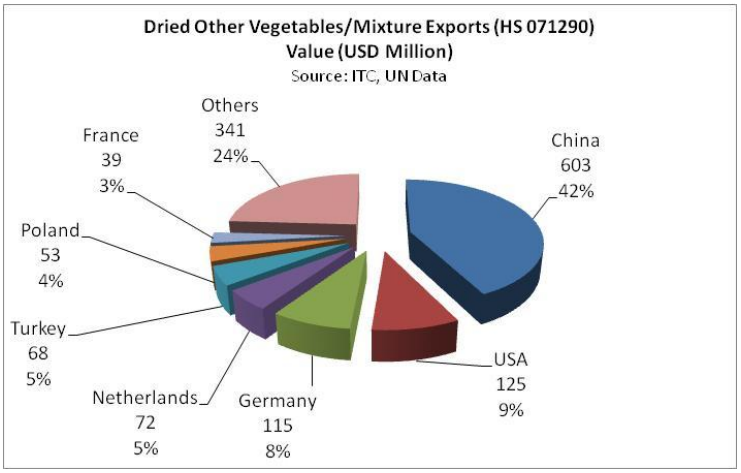


Figure 18 - Other Dried Vegetables Major Exporting Countries

4.2.2 Dried Chillies

Chillies are reported under the 4-digit HS code 0904 in two sub categories. Whole dried chillies are reported under HS 090421 and dried powdered chillies are reported under HS 090422. Global exports of the two categories are shown in Figure 19.

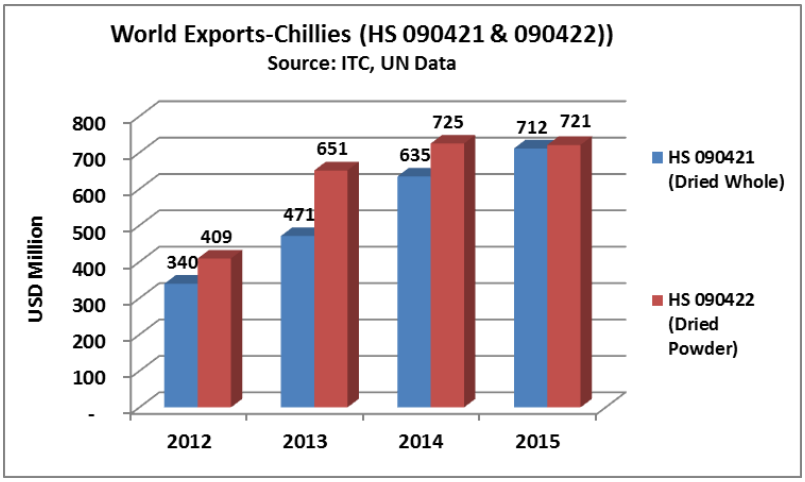


Figure 19 - Global Exports of Red Chillies

Total global exports of red chillies in 2015 were USD 1,433 million which grew from USD 749 million in 2012; a very high overall growth of 91%; and an average growth rate of 30% per annum. Whole chillies exports accounted for 50.4% share and chillies powder accounted for 49.6% share of the total global exports of red chillies.

India is the biggest exporter of dried whole chillies with 55% market share in 2015. India exports grew from USD 159 million in 2012 to USD 392 million in 2015 which represents a growth of 146%. China and Peru were the second and the third largest exporting countries with 15.6% and 9% shares respectively. During the period from 2012 to 2015, the exports of China and Peru dropped by 20% and 18% respectively. It appears that India is eating up the shares of these two countries in the international export market of whole dried chillies.

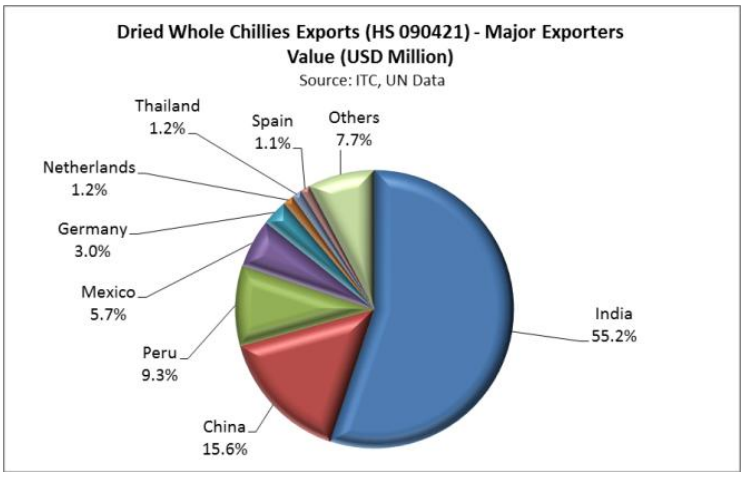


Figure 20 – Dried Whole Chillies Exports – Major Exporting Countries

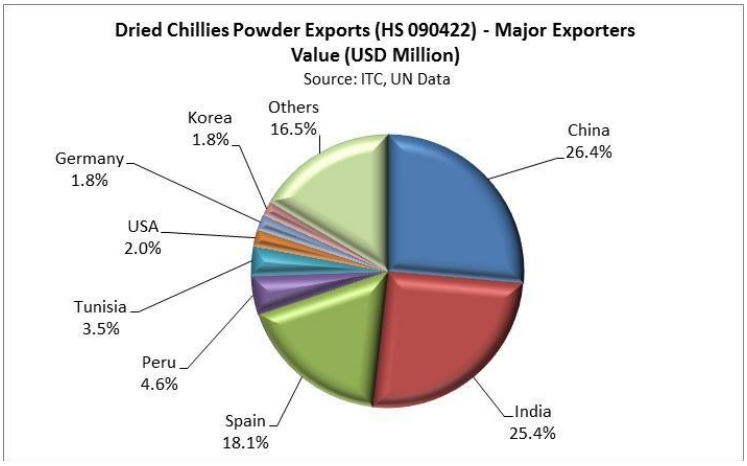


Figure 21 – Dried Chillies Powder Exports – Major Exporting Countries

The export market of dried chillies powder was also dominated by India and China. China was the market leader with exports of USD 190 million; accounting for 26% market share. Overall growth in exports of China from 2012 to 2015 was 50%; an average yearly growth of 17%. India was the second largest exporter with exports of USD 183 million and its exports declined by 4% during this period.

4.3 Pakistan's Trade of Dried Vegetables

Though not very pronounced, but Pakistan does have a presence in the international market of dried vegetables. In 2015, the country exported 76,397 tons of dried vegetable products earning PKR 1.84 billion (USD 18 million). Exports in different product categories are summarized in Table 2.

HS Code	Description	Quantity (kg)	Value (000 PKR)	Share in Value
07122000	Onion. Whole Dried Cut	75,883,842	1,564,985	82.7%
07123100	Mushroom Genus Agaricus Dried	24,785	211,944	11.2%
07123200	Woodear Dried Whole Cut	2,100	4,879	0.3%
07123300	Jelly Fungi Dry Cut Whole	20	6	0.0%
07123900	Other Truffle Dry Cut	378,414	103,476	5.5%
07129000	Other Vegetables Mixture Dried	54,270	5,127	0.3%
07131000	Peas Dried Shelled	51,000	2,642	0.1%
07139010	Black Metpe Dry Whole	2,230	241	0.0%
Total		**76,396,661**	**1,893,300**	**100.0%**
Source: Pakistan Bureau of Statistics				

Table 2 - Pakistan's International Trade of Dried Vegetables-2015

Major share of these exports were constituted by dried onion which in value terms accounted for 82.7% of the total. In quantity terms, the share of dried onion in the total exports of dried vegetables was more than 99%. Other important category of Pakistani exports was Dried Mushrooms of Genus Agaricus. In 2015, 24.7 tons of mushrooms were exported to earn PKR 212 million (USD 2 million) and account for 11.2% share of the total exports.

4.3.1 Pakistan's Dried Onion Exports

Looking at the five-year exports of dried onions, a continuously rising trend is observed. Exports from Pakistan witnessed phenomenal increase from PKR 6 million in 2012 to PKR 1.56 billion in 2015; an increase of 260 times. In quantity terms, this increase was even higher, increasing from 23 tons in 2012 to around 76,000 tons in 2015.[9] Export growth from 2014 to 2015 mainly originated from increased exports to

[9] Although these are the official export figures, these should be used with the following consideration. Apparently, the export figures of dried onion appear to be very high. For having 75,000 tons of dried onion, at 10-11% yield, it requires more than 700,000 tons of fresh onion. It is unlikely that such a high share of the local onion production is converted into dried onion and exported. One way of explaining these figures can be the possibility that fresh onion exports are mistakenly reported under this category of dried onions. The possibility is also supported by looking at the unit export price which comes out to be PKR 20 per kg which is an unrealistically low price for dried onion. However, this can be the price of fresh onion.

UAE and Malaysia. Figure 22and Figure 23 show five-year trends of dried onion exports value and quantity from Pakistan.

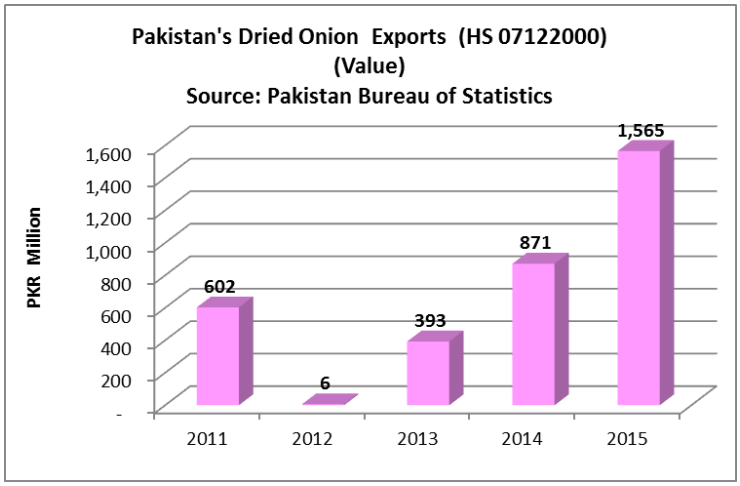


Figure 22 – Pakistan's Dried Onion Exports Value Trend

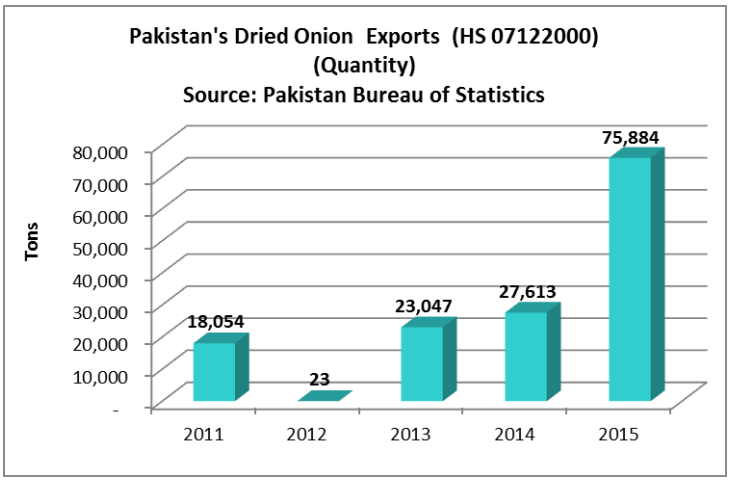


Figure 23 – Pakistan's Dried Onion Exports Quantity Trend

78% of the total dried onion exports of Pakistan were sent to UAE and Malaysia; with respective shares of 44% and 33%. Other importing countries were Sri Lanka, Oman, Bangladesh and Bahrain. Figure 24shows the shares of different importers. It can be observed that almost all the counties importing dried onion from Pakistan were from Asia or from Far East regions. No developed country from European or American continents was importing this product from Pakistan.

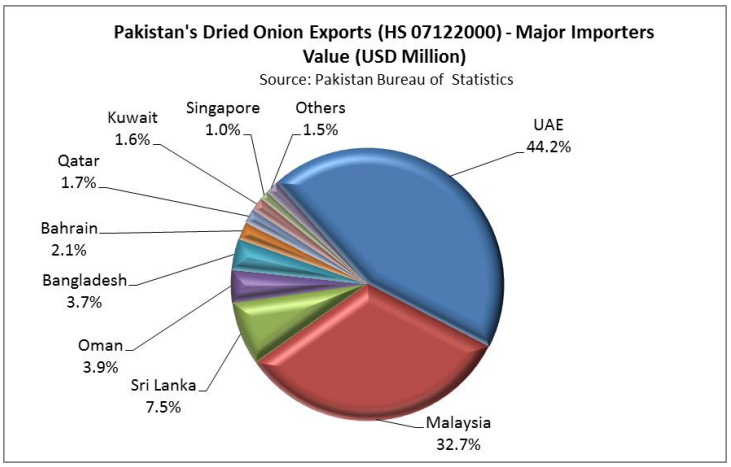


Figure 24 – Pakistan's Dried Onion Exports- Major Importers

Compared to that, the major countries importing dried onion from India and China are the developed countries. In 2015, top importers of dried onion from India were Germany, UK, USA, Poland and Belgium, accounting for 16%, 10%, 9%, 7% and 6% shares of India's total exports. Similarly, China's biggest trading partners of dried onion were USA, Germany and Australia, accounting for 22%, 11% and 10% shares respectively. Pakistan's current focus has been the markets which are less quality conscious. That leaves the room to improve the quality perception of the local product and start targeting high end markets to fetch higher prices and harvest more profits.

4.3.2 Pakistan's Other Dried Vegetables Exports

Looking at Pakistan's exports in other dried vegetables, a declining trend is observed in all the product categories. Figure 25shows the trends. This decline is in spite of the fact that the global market of all of these products has been increasing during these years.

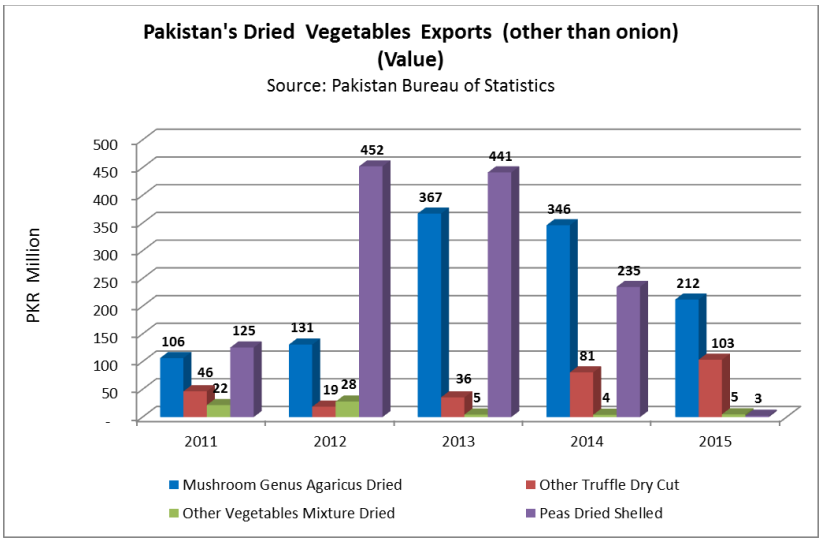


Figure 25 – Pakistan's Dried Vegetables (other than onion) Exports

Pakistan has small exports under HS 071290, Other Vegetables Mixture Dried. In 2015, country's total exports were 54.3 tons worth PKR 5.1 million. Germany was the main buyer accounting for 97% of the total export quantity. Other buying country was USA. In 2014, total exports were PKR 4.3 million. Germany was the largest buyer with 53% share of export quantity. Other countries importing this product from Pakistan were China, Saudi Arabia and USA.

4.3.3 Pakistan's Red Chillies Exports

Pakistan has a presence in the international export market of red chillies. In 2015, the country exported products in four different categories. Table 3shows the export quantities and values of red chillies exported by Pakistan.

HS Code	Description	Quantity (kg)	Value (000 PKR)	Share in Value
09042110	Red Chillies Whole	2,076,475	487,816	84.8%
09042190	Other Fruit Genus Capsicum	4,620	2,199	0.4%
09042210	Red Chillies Powder	204,865	80,935	14.1%
09042290	Other Pepper Dried, Crushed	9,574	3,990	0.7%
Total		2,295,534	574,940	100.0%

Source: Pakistan Bureau of Statistics

Table 3 – Pakistan's Red Chillies Exports - 2015

Pakistan exported 2,076 tons of whole dried red chillies worth PKR 488 million.85% of the total red chillies exports were constituted by whole dried product. The exports of the higher value added product, red chillies powder were 205 tons with a value of PKR 81 million and a share of 14% in the total exports of red chillies. This distribution does not match with the distribution of international market where the two products have equal shares of the total red chillies market. The current export mix indicate towards the potential of increasing market penetration into high value added dried red chilli products. Higher value addition potential is also validated by looking at unit export prices; with whole dried chilli being exported at PKR 234 per kg and the powdered chilli being sold at PKR 417 per kg.

Five year export trends show that the exports peaked in 2013 and dropped in the later years. The key reason for that peak was the unusual high exports to Mexico during that year. On an overall basis, the export value of whole dried chillies increased by 134% during the five year period whereas the export value of chillies powder decreased by 62%. It can be seen that the export mix of red chillies was in line with that of global export market in 2011 when the exports of the two products were almost the same. However, in the later years, the focus of Pakistani exporter shifted to lesser value added product. The export trends are shown in Fig --- and Fig ----.

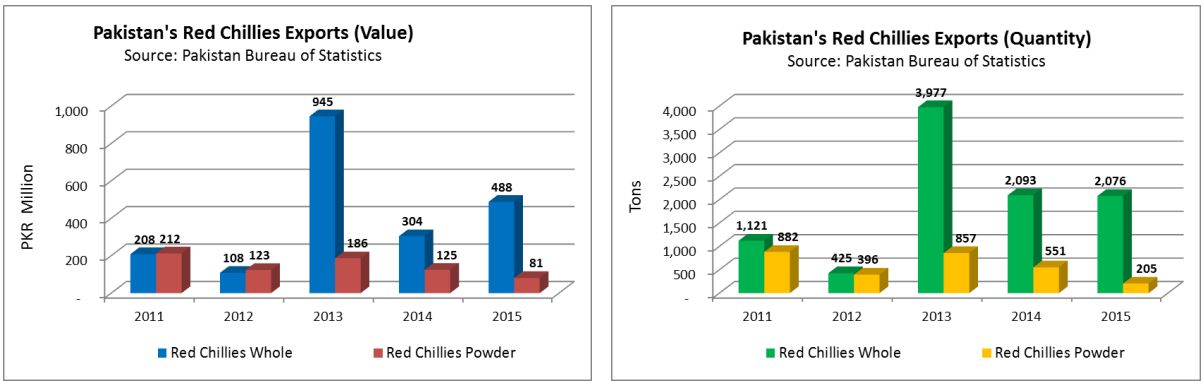


Figure 26 – Pakistan's Red Chillies Exports (Value and Quantity)

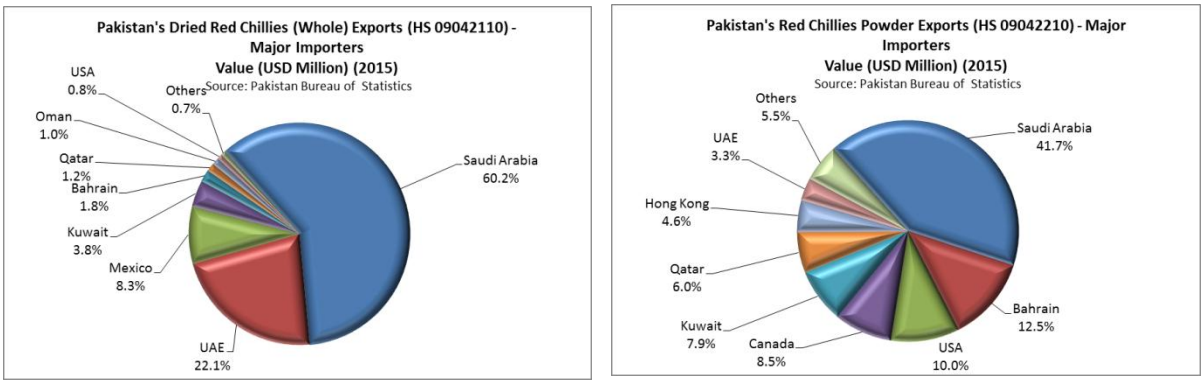


Figure 27 – Pakistan's Red Chillies Exports-Major Importers (Whole and Powder)

Saudi Arabia is the largest importer of Pakistani red chillies with shares of 60% and 42% in exports of whole red chillies and chillies powder respectively. Other trading partners are mostly from the Middle East. Mexico is an important importer from North American continent which accounted for 8% share of whole dried chillies in 2015. Mexico was not a major importer in red chillies powder. USA and Canada respectively were the third and fourth largest importers of Pakistani red chillies powder with 10% and 8.5% shares. This is accounted by the chillies powder being imported in packed form under different Pakistani spice manufacturers and is being consumed by the Pakistani and Indian people living there.

5.0 RAW MATERIAL AVAILABILITY FOR DRIEDVEGETABLES

The products considered for drying include onion, tomato, carrot, spinach and chillies. There is abundant availability of thesevegetables for producing the value added dehydrated products. Major share of the produce is consumed in the local market. Some products are also sold in export market. A significant share of fruits and vegetables in Pakistan is lost due to lack of proper post-harvest practices. Use of inappropriate harvesting techniques, inadequate storage, lack of proper transportation and marketing inefficiencies are the key reasons for high post-harvest losses of the horticultural produce of Pakistan. As per the estimates these losses may go as high as 20-25%. Even using an optimistic figure of 10%, the total loss of fruits and vegetables in Pakistan come out to be 1.58 million tons. Even if we use a low average price of PKR 2000 per ton, the total monetary loss due to post harvest losses is more than PKR 3 billion per annum. With the same calculation, estimate of the fruits and vegetables lost in Punjab will be about 1.0 million tons that will translate into about PKR 2 billion per annum.

Establishment of value addition facilities like dehydration plants will help reduce these post-harvest losses. A portion of this potentially lost horticultural production will be saved by being processed in such facilities.Punjab has a major share in production of most of the targeted fruits and vegetables.The following paragraphs discuss the availability of vegetables for the proposed solar dehydration unit.

5.1 Vegetables Availability

5.1.1 Onion

Onion is the largest condiment produced in Pakistan. Total national production in 2014-15 was 1.67 million tons of which 0.3 million tons was supplied by Punjab; accounting for 18% share of national production. Onion production has been on a decline during the past years. During the period 2011-2015, national onion production decreased by 2.9% and Punjab's production decreased by 3.8%.

District	Production 2013-14 (tons)	Production Share
Khanewal	33,923	9.5%
Bhakkar	25,629	7.1%
Bahawalpur	24,707	6.9%
Rahimyar Khan	20,129	5.6%
Okara	19,089	5.3%
Rajanpur	19,036	5.3%
Lodhran	18,074	5.0%
Bahawalnagar	17,092	4.8%

Other Districts	181,121	50.5%

Table 4 - Onion Producing Districts in Punjab

Onion is produced in all districts of Punjab. However, its major production clusters are in southern districts. District Khanewal is the largest producer of onion; followed by Bhakkar, Bahawalpur, Rahimyar Khan and Okara. Table 4 shows the production shares of the major onion producing districts of Punjab.

5.1.2 Tomato

Tomato's total national production in 2014-15 was 566,043 tons. 94,549 tons of this was contributed by Punjab which accounted for 17% production share. During the five year period from 2011 to 2015, tomato production increased by 6.9% at national level and increased by 7.7% in Punjab.

District	Production 2013-14 (tons)	Production Share
Sheikhupura	16,199	16.2%
Muzaffargarh	15,120	15.1%
Khushab	14,370	14.4%
Gujranwala	7,764	7.8%
Rahimyar Khan	5,200	5.2%
Sargodha	4,143	4.1%
Bahawalpur	4,091	4.1%
Bahawalnagar	3,770	3.8%
Other Districts	29,421	29.4%

Table 5 - Tomato Producing Districts in Punjab

Major tomato producing districts of Punjab are shown in Table 5. Tomato's main production centers in Punjab are located in central and southern Punjab. Sheikhupura is the largest district growing 16.2% of the total tomatoes of Punjab. Muzaffargarh, Khushab, Gujaranwala and Rahimyar Khan are the other larger tomato producing districts.

5.1.3 Chillies

Chilli is an important condiment produced in the country. Punjab is relatively a smaller producer compared to Sindh. However, there is sufficient production to provide raw material for the proposed solar dehydration facility. In 2014-15, the total chillies production in Punjab was 9,400 tons which was 6.7% of the national production. During the five year period from 2011 to 2015, chillies production in Punjab increased by 18%.

The production centers of chillies in Punjab are located in Southern Punjab. Pakpattan is the largest district accounting for 14% share. It is followed by Multan, Lodhran and Vehari with 13%, 6.9% and 6.1% shares respectively. Table 6 shows the shares of major chillies producing districts of Punjab.

District	Production (2013-14) (Tons)	Share in Production
Pakpattan	1,263	14.0%
Multan	1174	13.0%
Lodhran	618	6.9%
Vehari	552	6.1%
Kasur	532	5.9%
Bahawalpur	499	5.5%
Bahawalnagar	496	5.5%
Khanewal	476	5.3%
Other Districts	3,410	37.8%

Table 6 - Chillies Producing Districts in Punjab

5.1.4 Carrot, & Spinach

Carrot and spinach are produced in all districts of Punjab. Larger production centers of these vegetables exist mostly in and around central and southern Punjab with Sheikhupura, Gujranwala, Faisalabad, Multan and Lahore being the key districts.

5.2 Proposed Dehydration Calendar

The viability of vegetable and fruitprocessing business greatly depends on the price of the raw material since it constitutes the major cost of the final product. It is therefore very important that the vegetables and fruits are procured during the months when there is maximum supply available with the lowest prices of the year. For that, the monthly wholesale price data of the last three years was analyzed. The processing months for each of the target products were decided on the basis of that data. A solar dehydration calendar of the whole year was developed on that basis.The wholesale price analysis for the target raw materials for solar drying is discussed in the following paragraphs:

5.3 Raw Material Prices

5.3.1 Onion

Onion is harvested in Punjab in December and January. The price trend of onion is seen to be inconsistent during different years. However, November December and Januaryare seen as three months in which price is lower compared to other months.

Therefore, these three months are selected for processing onion. The processing days of onion will be 81. Three year wholesale price trend of onion is shown in Figure 28.

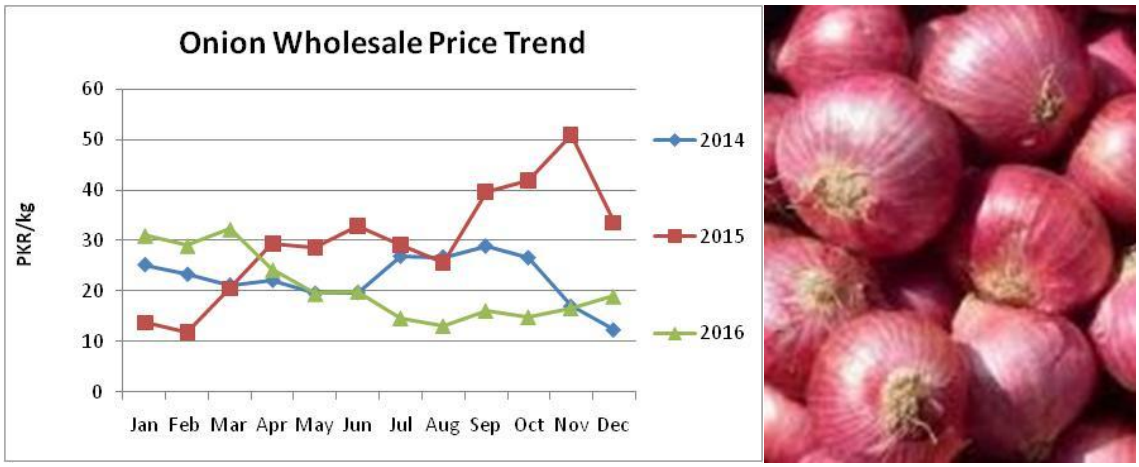


Figure 28 - Onion Wholesale Price Trend

5.3.2 Tomato Prices

Tomato is an important vegetable of Punjab. It is produced in both Rabi and Kharif seasons in KP and Balochistan. In Punjab and Sindh, it is produced only in Rabi season. Its harvesting is started in March and continues till June. Looking at the wholesale price trend of three years, it is seen that tomato is sold at lowest prices during the month of May. In that context, tomato drying for the purpose of this pre-feasibility has been proposed in the months of April and May. Total processing days will be 54.Figure 29 shows the three year price trend of tomatoes.

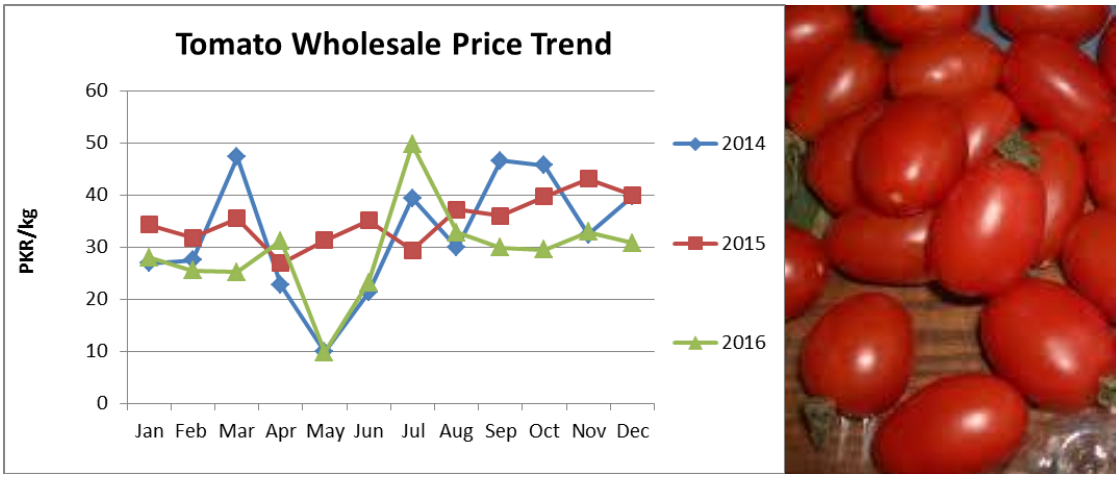


Figure 29 – Tomato Wholesale Price Trend

5.3.3 Carrot Prices

Monthly wholesale price trend of carrot are seen to be very consistent during three years from 2014 to 2016. Prices have been lower during winter and higher during summer months. Figure 30 shows the price trends.

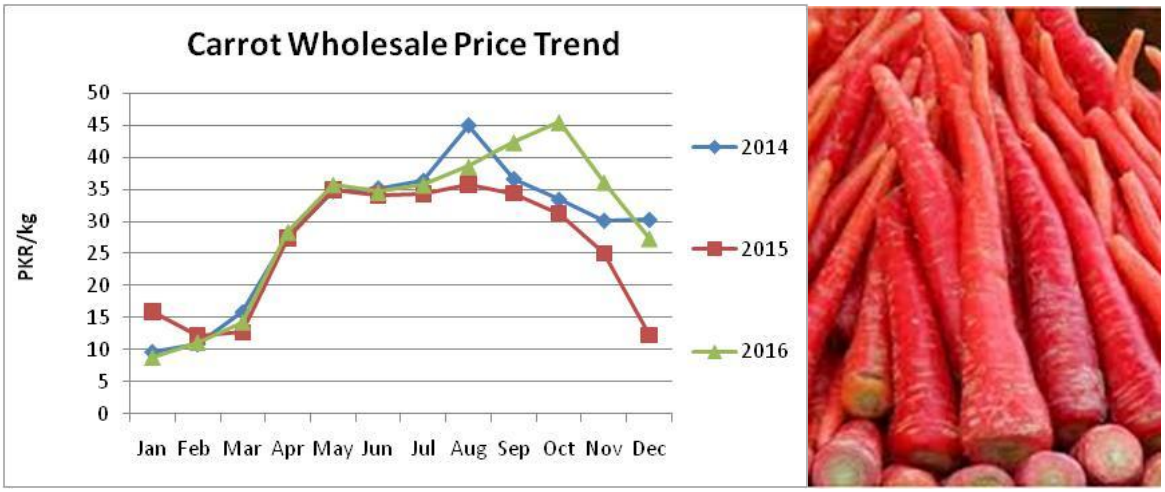


Figure 30 - Carrot Monthly Wholesale Price Trend of Three Years

December, January, February and March are the months during which carrot is available at lower prices. Consequently, February and March have been selected for processing carrot. Total processing days for carrot will be 54.

5.3.4 Spinach Prices

Looking at the monthly wholesale price trend spinach during three years, the month of October has been selected for processing spinach.Figure 31shows the three year price trend of spinach. Total processing days for spinach will be 27.

Figure 31 - Spinach Monthly Wholesale Price Trend of Three Years

5.3.5 Chillies Prices

Monthly wholesale prices of fresh chillies have been shown in Figure 32. The prices are at their lowest during the months of May, June, July and August. In that regard, the drying months for chillies have been fixed as June, July and August. Total processing days for chillies will be 84.

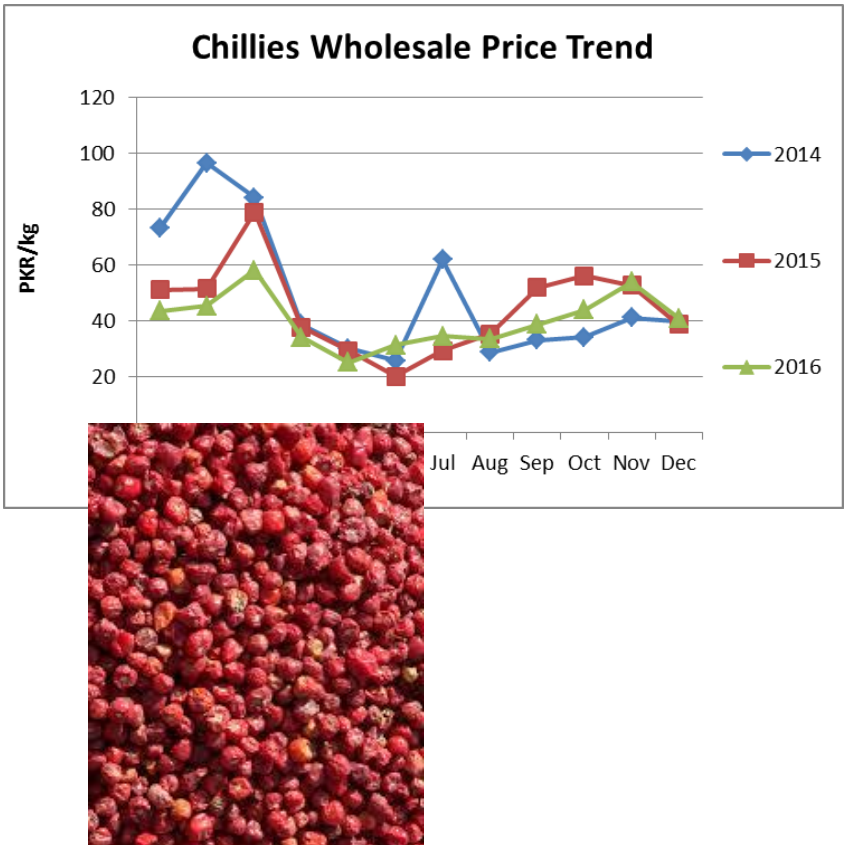


Figure 32 – Chillies Wholesale Price Trend

Based on the above discussion, the dehydration calendar for the proposed facility is shown in Figure 33.

Vegetables Dehydration Calendar (Solar)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Onion	Carrot		Tomato		Chillies				Spinach	Onion	
30 days	58 days		61 days		91 days				30 days	60 days	

Figure 33–Solar Dehydration Calendar

There will be no drying activity during the month of September and annual maintenance of the plant will be carried out. Solar dehydration unit will be operational for 330 days during the year.

5.3.6 Raw Material Prices

The raw material prices used in this pre-feasibility study have been based on the following approach:

For each commodity, an average of the prices of the processing months was calculated.The price was discounted by a factor since the available wholesale price data is based on auction prices in fruit and vegetable markets. Procurement of fruit and vegetables for processing can also be done directly from the farmer to avoid middleman's commission and other associated marketing costs and fees. In fact it is a regular practice of the processing units to procure directly from the farmers. Thus the raw material price was obtained by discounting the wholesale prices by a factor of 30% for all the products.

With the above approach, the raw material prices calculated for different commodities are listed in the following table:

Commodity	Months	Average Wholesale Price (Rs/kg)	Discounted price (80%)
Onion	January, November, December	22.2	17.8
Tomato	April, May	20.6	16.4
Carrot	February, March	12.7	10.2
Spinach	October	23.9	19.1
Chillies	June, July, August	33.0	26.4

Table 7 - Vegetables (Raw Material) Prices

5.4 Dried Products' Selling Prices

The study has been conducted with the assumption that the final dehydrated products will be sold in export markets. Consequently, export market prices have been used as the selling prices of the final products. Information for that has been obtained mainly from Trade Map data of ITC (International Trade Center).[10] For some products where specific information was not available from that source, some primary sources from the local market have been consulted and information from known international trading websites has been used. Average values of the selling prices have been considered.

5.4.1 Dried Onion Prices

Export price of dried onions by major exporters is listed in Table 8.

[10]http://www.trademap.org/Country_SelProduct_TS.aspx

Exporting Country	Export Value (USD million)	Quantity (Tons)	USD/ton	PKR/ton
India	129,333	48,650	2,658	279
USA	90,090	33,639	2,678	281
Tanzania	88,088	9,665	9,114	957
Egypt	36,881	13,116	2,812	295
China	33,773	12,257	2,755	289
Germany	22,738	6,821	3,334	350
France	21,734	8,631	2,518	264
Belgium	9,291	3,314	2,804	294
Source; ITC Trade Map				

Table 8 - Dried Onions Export Prices of Major Exporting Countries

While the price of some countries like Tanzania is reported as high as Rs 957 per kg, there are others like France whichhave an export price of Rs 264 per kg. The price appears to be clustering around Rs 280 per kg. This is also the average export price of India. In this context, the export price of dried onion for the purpose of this pre-feasibility has been assumed to beRs 280 per kg.

5.4.2 Dried Tomato Prices

In the absence of any export or local data availability, online prices of sundried tomato were used as basis to determine the selling prices of the dried tomato for this pre-feasibility study. Prices of the products available for sale on alibaba.com were observed. The prices started from around USD 1 per kg and went as high as USD 6-7 per kg. Majority of the posted prices were in the range of USD 2.5-3.5. In this context, the average price for the dried tomato that will be produced by the proposed facility has been assumed as PKR 250 per kg. Annex I-A shows the selling prices of dried tomato products by different sellers on alibaba.com.

5.4.3 Dried Carrot Prices

For dried carrot also, online selling prices were used as the basis. Majority of the prices of dried carrot fell in the range USD 1-2. In view of this, for the purpose of this pre-feasibility study, the selling price of dried carrot has been assumed to be PKR 150 per kg. Annex I-B shows the selling prices of dried carrot products by different sellers on alibaba.com.

5.4.4 Dried Spinach Prices

Price data of dried spinach products available online was used to determine the sale price of this product. Majority of the products were found to be selling in the price range of USD 1.5-3.0 per kg. Consequently, a price of PKR 150 was used for the purpose of calculations of this pre-feasibility study. Annex I-C shows the selling prices of dried spinach products by different sellers on alibaba.com.

5.4.5 Dried Chillies Prices

Dried red chillies will be sold in whole form in local as well as export market. Yearly average wholesale prices of dried red chillies in Lahore market in 2016, 2015 and 2014 respectively were PKR 221.7, PKR 223 and PKR 210 per kilogram. Pakistan's average export selling price of whole dried red chillies in 2015 was PKR 234 per kilogram. Keeping these prices in view, the average selling price of whole dried chillies has been assumed to be PKR 225 per kilogram.

The selling prices used for calculating revenues are summarized in Table 9.

Dried Product	Selling Price (PKR/kg)
Dried Onion	280
Dried Tomato	250
Dried Carrot	150
Dried Spinach	150
Dried Chillies	250

Table 9 – Final Dried Products' Prices

6.0 THE PROPOSED BUSINESS

6.1 Purpose of the Business

The proposed business focuses on processing locally produced vegetables to produce dehydrated products using solar technology. Five vegetables, onion, tomato, carrot,spinach and chillieshave been included in this study. The final dehydrated products will be sold in export markets. The project will directly contribute towards adding value to the agriculture sector of Punjab by reducing post-harvest losses and converting the farm produce into high value added products. Local farmers will also benefit by finding the opportunity to sell part of their surplus production which otherwise is lost due to low demand in peak production seasons.

6.2 Product Line

The product line of dehydrated fruits, vegetables and condiments includes five products that will be processed in the proposed facility:

1. Dried Onion
2. Dried Tomato
3. Dried Carrot
4. Dried Spinach
5. Dried Chillies

Selection of this product line is based on the following rationale:

- Horticultural products are seasonal and not available around the year. Therefore, it is not feasible to run the plant on single product and multiple products have to be selected. Selection of vegetables was made with the approach to keep the plant running for the whole year. The peak season of the selected vegetables do not have much overlap with each other.

- Export market demand in terms of its overall size and growth rate has been considered as a key factor. Dried onion and dried chillies have defined, large international markets. However, Pakistan's performance in those markets is way below its potential. Similarly, other dried products are also sold in international markets as value added products. All the included products have online selling markets indicating the demand for these products in different markets.

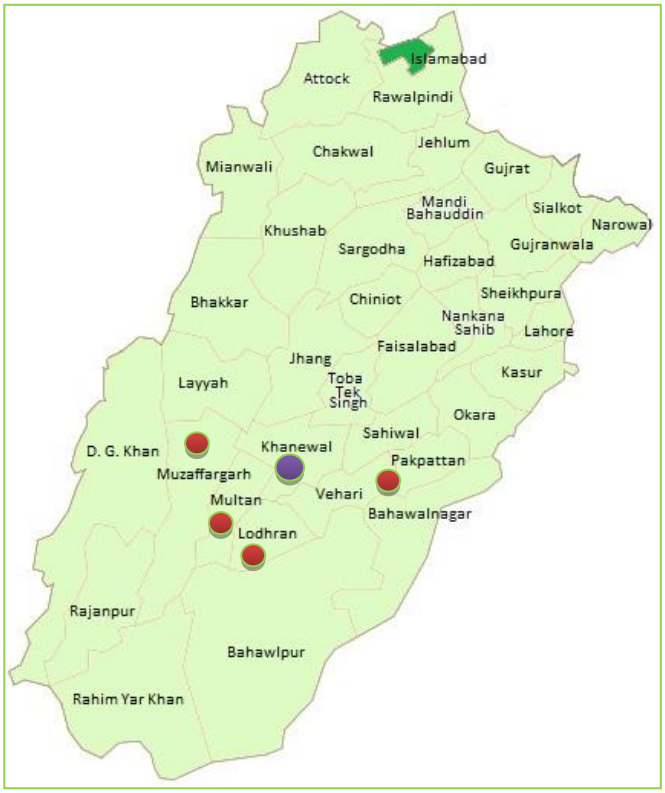
- Most of the included products were the ones with lower selling prices. This was done since the solar drying technology is a relatively cheaper process compared to the fuel-based drying process. That allows selling these lower value added products at lower prices to remain aligned with the market trends.

- Abundant availability of local raw material is the other important factor for selection of the above-mentioned products. All those products are produced in large quantities in Punjab. For some products like chillies, for which the current production volumes are not very large, it has been assumed that the establishment of this facility will make the local farmers increase the production of the commodity to meet the growing demand.

- It was also considered that the selected product line should include most of those horticultural products which are produced in Punjab so that the farmers of Punjab and the local agriculture receive the main benefit. In the selected product line, all the five products are produced in Punjab and the intention of the proposed project is to use the local production as raw material.

6.3 Proposed Location

The proposed solar dehydration project should ideally be located at a place closer to production centers of the target vegetables. The prime target product in this study is onion that will be processed during 27% of the available production days. In that context, Khanewal is the most suitable district since this is the largest onion producing district of Punjab. The project will be able to easily source onions for dehydration from this production hub. Bhakkar is the second largest onion producing district which is not very far off from Khanewal and can also act as a supplier of onion for the project. Other selected products are tomato, carrot, spinach and chillies. Muzaffargarh is the second largest tomato producing district of Punjab accounting for 15% of the provincial production. It borders with Khanewal and thus can provide the required supplies of tomato for dehydration in the proposed project. Khanewal is also a suitable location for sourcing chillies since Multan and Lodhran are respectively the second and third largest producers of chillies in Punjab. Both of these districts border with Khanewal and thus can supply chillies for the project. Pakpattan is the largest chillies producing district of Punjab which is not very far off from Khanewal. Khanewal and Multan are also important producers of carrot and spinach making the sourcing of these two vegetables easy for the proposed solar dehydration project located in Khanewal.



The other factor that has been kept under consideration for selecting location is being close to the main highways; major share of the production has been assumed to be destined for export markets. Similarly, proximity to CPEC route is also important to open the possibility of establishing this project in the Special Economic Zones (SEZ) that have been planned to be established on the route.

6.4 Plant Capacity

Solar Drying units can be available in range of capacities. The investor can select a drying unit on the basis of market demand and the technical considerations of the target products fordrying. Capacities generally quoted by the machinery suppliers are usually designed for a batch of one to two tonsof fresh produce.The drying time varies with the moisture content in different fresh products; however, with a normal sunny day, an average drying time of two days is considered sufficient to produce the desired specifications of the dried vegetable product. Increasing capacity of such units is not complicated since solar unitscan be added asstandalone units to increase the capacity. The capacities of machines in the pre-drying sectioncan be managed by having differing processing speeds to accommodate such capacity enhancements.

For the purpose of this pre-feasibility study, the plant capacity has been based onten units; each having acapacity of a batch of one ton of fresh produce. Since the drying time for one batch will be two days, the effective capacity of one solar dryer will be 0.5 tons of fresh produce per day. Total effective capacity of the proposed five solar dryers will be 5 tons per day of fresh produce. The production of final dried product will vary with the moisture content and yield for different products.

The pre-feasibility study has been developed in the context of attracting foreign investors to invest in projects that will be developed along the CPEC route. Higher capacity using ten drying units has been assumed since larger units are usually more profitable than the smaller ones. This will make the project more attractive for the foreign investors.

The dehydrated products processed in the proposed unit will be sold in the export market which shows healthy growth rates. Pakistan's current performance in those markets is below its true potential. A large project will be able to tap that opportunity more successfully.

Some smaller drying units are already functional in Punjab and other provinces. The study will provide information and help evaluate and demonstrate the commercial viability of solar drying units of higher capacity. The information will be useful for the existing units for a possible up-gradation of their existing capacities.

6.5 Project Cost

The project has a total cost of PKR 62.3 million.Details of different cost components are shown in Table 10and discussed in the following pages.

Cost Item	Cost (PKR)
Land	10,000,000
Preparation Machinery	1,125,000
Solar Dryers	13,000,000
Cabinet Dryer	4,000,000
Finishing Machinery	2,600,000
Allied Machinery & Equipment	4,100,000
Building & Civil Works	10,392,250
Office Equipment & Furniture	755,000
Pre-operating expenses	1,409,613
Capital Investment	**47,381,863**
Working Capital	**14,923,943**
Total Project Cost	**62,305,806**

Table 10 - Project Cost Details

6.5.1 Land and Building

Total land requirement for the project has been estimated to be 17,500 square feet which is equal to 4kanals.[11] Land cost has been assumed to be PKR 2.5 million per kanal. A lower-than-market cost has been considered has been done on the assumption that the project will be established in a special economic zone. A land cost of approximately half of the market price has been assumed.

Space requirement for all the sections of the solar drying unit and the associated civil construction costs are presented in Table 11.

Space	Space Requirement (sq. ft.)	Construction cost (Rs/sq.ft.)	Building & Civil Works Cost (PKR)
Processing hall	2,000	1,500	3,000,000
Solar Dryers	7,438		
Vegetable Storage	2,000	1,200	2,400,000
Finished product storage		1,200	3,000,000

[11]Kanal is the commonly used unit for land measurement in Punjab. One Kanal is equal to 4,500 square feet. Eight Kanals (36,000 square feet) constitute one acre of land.

Generator room	100	1,200	120,000
Office space	500	2,000	1,000,000
Open spaces	2,908	300	872,250
Total Land	17,445		10,392,250

Table 11 - Land and Building Cost Details

6.5.2 Machinery and Equipment

The costing of the project has been done on the basis of local machinery and equipment. The proposed fruits and vegetables dehydration unit is based on locally manufactured machinery and equipment. Some components of the plant, such as instrumentation systems, are imported. List of machinery along with the cost is provided in Table 12.

Plant Section	Cost (Rs)
Vegetables Preparation Machinery	1,125,000
Solar Dryers	13,000,000
Cabinet Dryer	4,000,000
Post Drying Finishing Machinery	2,600,000
Allied Machinery & Equipment	4,100,000
Total Machinery (PKR)	**24,825,000**

Table 12 - Machinery & Equipment Cost

Details of machinery and equipment are provided in Table 13 to Table 16.

Machine	Origin	No.	Cost (PKR)	Total Cost
Sorting conveyor	Local	1	200,000	200,000
Washer	Local	1	200,000	200,000
Onion Peeler[12]	Local	1	160,000	160,000
Carrot Peeler	Local	1	125000	125,000
Slicer	Local	1	120,000	120,000
Cutter	Local	1	20,000	20,000
Stainless Steel (SS) tubs set	Local	1	20,000	20,000
Blancher	Local	1	200,000	200,000
Working tables (SS) 4 ft X 10 ft	Local	2	40,000	80,000
Total				**1,125,000**

Table 13 – Vegetables Preparation Machinery Costs

Machine	Origin	No.	Cost (PKR)	Total Cost
Solar Tunnel Dryer (Polythene)	Local	10	1,300,000	13,000,000

[12] Onion peeler of Chinese origin was available at a price of USD 7,300 FOB Chinese port

(including trays)				
Cabinet Dryer	Local	2	2,000,000	4,000,000
Total				**17,000,000**

Table 14 – Solar Dryers Cost

Detailed specifications of solar tunnel dryer are provided in Annex II.

Machine	Origin	No.	Cost (PKR)	Total Cost
Grinder	Local	1	100,000	100,000
Weighing and Packing Machine (for dried pieces)	Local	1	1,500,000	1,500,000
Weighing and Packing Machine (for powdered products)	Local	1	1,000,000	1,000,000
Total				**2,600,000**

Table 15 – Post-Drying Finishing Machinery Costs

Machine	Origin	No.	Cost (PKR)	Total Cost
Laboratory Equipment[13]	Local	1	300,000	300,000
Steam generator	Local	1	500,000	500,000
Electrification /installation	Local	1	100,000	100,000
Tube well	Local	1	600,000	600,000
Transformer (50 KVA)	Local	1	2,000,000	2,000,000
Generator (20 KVA)	Chinese	1	600,000	600,000
Total				**4,100,000**

Table 16 – Allied Machinery & Equipment Costs

6.5.3 Office Equipment and Furniture

Office equipment and furniture is required for administrative and production staff. It includes furniture, interior decoration and IT equipment. Details are presented in Table 17.

Item	No.	Cost	Total Cost (Rs)
Office Furniture	1	400,000	400,000
Office Interior	1	200,000	200,000
Laptop Computers	1	60,000	60,000
Desktop Computers	2	35,000	70,000
Printers	1	20,000	20,000
Telephone sets	5	1,000	5,000
Total	**6**		**755,000**

[13] Includes moisture meter, digital weigh scale, air oven, desiccator and standard lab equipment

Table 17 - Office Equipment and Furniture Cost

6.5.4 Pre-Operating Expenses

Pre-operating expenses include the cost of utility connections, registration and licenses, salaries of the personnel that will be hired before the start of plant operations and the operational expenses, such as travelling, office expenses, etc. Summary of pre-operating expenses is provided in Table 18.

Pre-Operating Costs	Cost (Rs)
Registration, licenses, etc.	500,000
Consultancies for civil works, etc.	519,613
Salaries	285,000
Admin. Expenses	105,000
Total (Rs)	**1,409,613**

Table 18 - Pre-Operating Costs

6.5.5 Working Capital

Initial working capital requirement has been worked out with the approach that marketing efforts will be required to penetrate the export markets following which sales will start flowing. Thus, the funds requirement for vegetables (which constitute the biggest cost component) has been calculated for six months. Similar approach has been taken for packing material. For utility costs and salaries as well, a safer time period of six months has been followed. An allocation of 2% of the machinery cost has been made for spare parts. Initial working capital requirements have been calculated for 75% capacity utilization as per the assumed capacity utilization schedule. Table 19shows the working capital requirement.

Cost Item (PKR)	Cost (Rs)	Basis
Vegetables	10,121,322	6 months
Packing Material	871,350	6 months
Electricity bills	420,352	6 months
Gas charges	106,920	6 months
Salaries	2,407,500	6 months
Spares	496,500	2% of Machinery Cost
Starting Cash Balance	500,000	
Total Working Capital	**14,923,943**	

Table 19 - Working Capital Details

6.6 Operating Assumptions

6.6.1 Revenue Assumptions

The project's revenue is obtained by selling five dried vegetable products (dried onion, dried tomato, dried carrot, dried spinach and dried chillies) inexport markets. Processing of these products will be carried out in months as per the dehydration calendar. At 100% capacity, operating 330 days a year, the plant will produce 290,450 tons of dehydrated products. Detail is provided in Table 20.

Product	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Production
Dried Onion	16,500	-	-	-	-	-	-	-	-	-	16,500	16,500	49,500
Dried Tomato	-	-	-	18,000	18,600	-	-	-	-	-	-	-	36,600
Dried Carrot	-	18,200	19,500	-	-	-	-	-	-	-	-	-	37,700
Dried Spinach	-	-	-	-	-	-	-	-	-	16,500	-	-	16,500
Dried Chillies	-	-	-	-	-	49,500	51,150	49,500	-	-	-	-	150,150
Total	**16,500**	**18,200**	**19,500**	**18,000**	**18,600**	**49,500**	**51,150**	**49,500**	**-**	**16,500**	**16,500**	**16,500**	**290,450**

Table 20–Annual Production of Dried Vegetables at 100% Capacity

It was assumed that the proposed solar dehydration unit will operate at 75% capacity during the first year and 85% during the second year. It will run start production at 100% capacity in third year.

6.6.1.1 Export Prices of Dehydrated Products

	Export Price (Rs/kg)
Dried Onion	280
Dried Tomato	250
Dried Carrot	150
Dried Spinach	175
Dried Chillies	230

Table 21 - Export Sale Price of Dehydrated Products

Based on the above assumptions, revenues during the first year of the project were calculated to be Rs49.56 million. Detailed revenue calculations are presented in Annex III. Annual growth in export market selling prices was assumed to be 10%.

6.6.2 Costs Assumptions

6.6.2.1 VegetablesCost

The cost of vegetables is calculated on the basis of yields of dehydrated products from fresh vegetables. Yields are presented in Table 22.

Product	Yield	Fruit Required (kg/kg dried product)
Dried Onion	11%	9.1
Dried Tomato	12%	8.3

Dried Carrot	13%	7.7
Dried Spinach	11%	9.1
Dried Chillies	32%	3.0

Table 22 - Dried Products Yields from Fresh Vegetables

6.6.2.2 Raw Materials Prices

The vegetables costs were calculated on the basis of wholesale prices of the five commodities. Averages of the prices of the commodity during the processing months were used. Table 23shows the prices used for calculating fruits/vegetables cost:

Product	Cost (Rs/kg)
Dried Onion	15.6
Dried Tomato	14.4
Dried Carrot	8.9
Dried Spinach	16.8
Dried Chillies	23.1

Table 23 – Fresh Vegetables (Raw Material) Prices

Annual growth in raw material prices was assumed to be 10%.Based on the above-mentioned data, the total vegetables cost during the first year of operations was PKR20.24 million. Detailed calculations are shown in Annex III-B.

6.6.2.3 Packaging Cost

The dried products will be packed in polythene bags. Packaging cost has been assumed to be PKR 8 per kg of dried product. On that basis, total packaging cost during first year of production (75% capacity utilization) comes out to be Rs1.74 million. Packaging cost has been assumed to grow at 10% per year.

6.6.2.4 Electricity Cost

Electricity cost has been calculated on the basis of overall plant load of 50 KVA as per the load requirement for different products and the capacity utilization assumptions during each year. B2 Industrial supply tariff has been applied to calculate the monthly bill. An annual increase of 10% in electricity cost has been assumed. Latest electricity tariff is attached as Annex III-C.

6.6.2.5 Depreciation/Amortization

Straight line depreciation method has been applied to calculate the yearly depreciation cost. Different rates applied to different types of assets are shown in Table 24. Detailed depreciation and amortization schedules are presented in Annex III-D.

Asset	Depreciation Rates
Land	0%
Solar Dryers	20%
Building & Civil Works	5%
Preparation/Allied Machinery	10%
Office Equipment	20%
Vehicles	20%

Table 24 - Depreciation Rates

6.6.3 Debt Assumptions

The project is assumed to be financed 100% with equity. Project's capacity to absorb loan cost has been discussed in the sensitivity analysis presented in a later sectionin this report.

6.6.4 Human Resource Plan

The project will require human resource in all important functions. Overall management will be carried out by Plant Manager who will be assisted by people for procurement, production, marketing, accounts and maintenance personnel. Plant operators will be hired to manage dehydration operations whereas semiskilled labor will be engaged in vegetables preparation and packaging activities. Total manpower requirement has been worked out to be 21 of which 13 will be engaged in production-related activities and 8 in administrative activities. Human resource requirements and the associated cost is presented in Table 25.

Designation	No.	Salary (Rs/month)	Total (Rs/month)	No. of Months	Salary per annum
Plant Manager	1	40,000	40,000	12	480,000
Admin/Accounts Officer	1	30,000	30,000	12	360,000
Marketing Officers	1	35,000	35,000	12	420,000
Security Guards	4	15,000	60,000	12	720,000
Gardner	1	15,000	15,000	12	
Total Administration Staff	**8**		**180,000**		**2,160,000**
Production Staff					
Designation	**No.**	**Salary (Rs/month)**	**Total (Rs/month)**		**Salary per annum**
Procurement Officers	1	30,000	30,000	12	360,000
Operators	2	20,000	40,000	12	480,000

Plant Helpers	2	15,000	30,000	12	360,000
Maintenance Technicians	1	25,000	25,000	12	300,000
Loading/Unloading Labor	3	15,000	45,000	11	495,000
Product preparation labor	3	15,000	45,000	11	495,000
Packing labor	1	15,000	15,000	11	165,000
Total Production Staff	**13**		**230,000**		**2,655,000**
Total Staff	**21**		**410,000**		**4,815,000**

Table 25 - Human Resource Cost Details

6.6.5 Financial Assumptions

No. of Projection Years 10
Discount Rate used for calculating NPV 20%

6.7 Project's Feasibility Results

6.7.1 Financial Viability

The project of Dehydration of Fruits and Vegetables is found to be financially feasible. Financial feasibility results are summarized in Table 26.

IRR	27.91%
NPV (PKR)	18,569,700
Payback Period (years)	3.95

Table 26 - Financial Feasibility Results

Positive NPV indicates that the financial viability of the project.

6.7.2 Profitability Ratios

	Amount (PKR)	Percent
Sales	49,565,250	100.0%
Cost of Sales	25,778,552	52.0%
Gross Profit	23,786,698	48.0%
Operating Costs	9,516,535	20.9%
Earnings Before Interest and Taxes	**11,445,694**	**25.1%**
Net profit	**7,439,701**	**16.3%**

Table 27 – Profitability Ratios

6.7.3 Projected Income Statement

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Operating Revenues	49,565,250	61,791,345	79,965,270	87,961,797	96,757,977	106,433,774	117,077,152	128,784,867	141,663,354	155,829,689
Direct Costs										
Vegetables	20,242,644	25,235,829	32,658,132	35,923,945	39,516,340	43,467,974	47,814,771	52,596,248	57,855,873	63,641,460
Packing material	1,742,700	2,172,566	2,811,556	3,092,712	3,401,983	3,742,181	4,116,399	4,528,039	4,980,843	5,478,927
Direct Electricity	600,703	748,877	969,134	1,066,048	1,172,653	1,289,918	1,418,910	1,560,801	1,716,881	1,888,569
LPG cost	213,840	266,587	344,995	379,495	417,444	459,189	505,107	555,618	611,180	672,298
Generator Cost	217,728	239,501	263,451	289,796	318,776	350,653	385,718	424,290	466,719	513,391
Payroll Production	2,655,000	2,920,500	3,212,550	3,533,805	3,887,186	4,275,904	4,703,494	5,173,844	5,691,228	6,260,351
Maintenance cost	105,938	132,069	169,500	183,625	197,750	211,875	226,000	240,125	254,250	268,375
Total Direct Cost	**25,778,552**	**31,715,929**	**40,429,318**	**44,469,425**	**48,912,130**	**53,797,693**	**59,170,400**	**65,078,965**	**71,576,974**	**78,723,372**
Gross Profit	**23,786,698**	**30,075,416**	**39,535,952**	**43,492,372**	**47,845,846**	**52,636,081**	**57,906,752**	**63,705,902**	**70,086,380**	**77,106,318**
Operating Costs										
Payroll Admin	2,160,000	2,376,000	2,613,600	2,874,960	3,162,456	3,478,702	3,826,572	4,209,229	4,630,152	5,093,167
Fixed Electricity	240,000	259,200	279,936	302,331	326,517	352,639	380,850	411,318	444,223	479,761
Depreciation	4,453,113	4,453,113	4,453,113	4,453,113	4,453,113	1,702,113	1,702,113	1,702,113	1,702,113	1,702,113
Amortization	281,923	281,923	281,923	281,923	281,923	-	-	-	-	-
Marketing Cost	396,000	405,600	414,000	63,200	39,448	42,299	45,380	48,712	52,317	56,219
Office maintenance Cost	781,500	826,650	880,965	939,294	1,001,968	1,069,346	1,141,821	1,219,820	1,303,810	1,394,300
Licensing/Regulatory Fee	250,000	262,500	275,625	289,406	303,877	319,070	335,024	351,775	369,364	387,832
Legal/Professional Fee	300,000	315,000	330,750	347,288	364,652	382,884	402,029	422,130	443,237	465,398
Vehicle fuel & maintenance	300,000	330,000	363,000	399,300	439,230	483,153	531,468	584,615	643,077	707,384
Total Operating Costs	**9,162,535**	**9,509,985**	**9,892,911**	**9,950,814**	**10,373,183**	**7,830,205**	**8,365,256**	**8,949,712**	**9,588,292**	**10,286,175**
Earnings before interest and taxes	**14,624,163**	**20,565,431**	**29,643,041**	**33,541,558**	**37,472,664**	**44,805,876**	**49,541,496**	**54,756,190**	**60,498,087**	**66,820,143**
Interest	-	-	-	-	-	-	-	-	-	-
Earnings before taxes	**14,624,163**	**20,565,431**	**29,643,041**	**33,541,558**	**37,472,664**	**44,805,876**	**49,541,496**	**54,756,190**	**60,498,087**	**66,820,143**
Tax	5,118,457	7,197,901	10,375,064	11,739,545	13,115,432	15,682,056	17,339,523	19,164,666	21,174,331	23,387,050
Net Operating Income	**9,505,706**	**13,367,530**	**19,267,976**	**21,802,013**	**24,357,231**	**29,123,819**	**32,201,972**	**35,591,523**	**39,323,757**	**43,433,093**
Other Income (interest on investments)										
Net Income	**9,505,706**	**13,367,530**	**19,267,976**	**21,802,013**	**24,357,231**	**29,123,819**	**32,201,972**	**35,591,523**	**39,323,757**	**43,433,093**
Balance brought forward	-	9,505,706	20,585,913	31,883,111	42,948,099	53,844,265	66,374,467	78,861,151	91,562,140	104,708,717
Total profit available for appropriation	9,505,706	22,873,236	39,853,889	53,685,124	67,305,331	82,968,084	98,576,439	114,452,675	130,885,897	148,141,810
Dividend	-	2,287,324	7,970,778	10,737,025	13,461,066	16,593,617	19,715,288	22,890,535	26,177,179	29,628,362
Balance carried forward	**9,505,706**	**20,585,913**	**31,883,111**	**42,948,099**	**53,844,265**	**66,374,467**	**78,861,151**	**91,562,140**	**104,708,717**	**118,513,448**

6.7.4 Projected Balance Sheet

ASSETS											
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Current Assets											
Cash	996,500	11,280,695	23,011,580	30,849,584	43,633,349	55,946,666	66,529,309	76,703,467	86,690,466	96,681,442	87,708,284
Raw material	10,992,672										
Advance Processing Charges	2,934,772										
Short term securities		-	-	-	-	-	-	-	-	-	-
Accounts Receivables		24,782,625	30,895,673	39,982,635	43,980,899	48,378,988	53,216,887	58,538,576	64,392,433	70,831,677	77,914,845
Total Current Assets	**14,923,943**	**36,063,320**	**53,907,252**	**70,832,219**	**87,614,248**	**104,325,655**	**119,746,197**	**135,242,043**	**151,082,899**	**167,513,119**	**165,623,129**
Fixed Assets											
Land	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000
Solar Dryers	13,000,000	10,642,500	9,460,000	8,277,500	7,095,000	5,912,500	4,730,000	3,547,500	2,365,000	1,182,500	-
Other Machinery and Equipment	11,825,000	10,400,000	7,800,000	5,200,000	2,600,000	-	-	-	-	-	-
Building & Civil Works	10,392,250	9,872,638	9,353,025	8,833,413	8,313,800	7,794,188	7,274,575	6,754,963	6,235,350	5,715,738	5,196,125
Office Equipment & Furniture	755,000	604,000	453,000	302,000	151,000	-	-	-	-	-	-
Vehicles	-	-	-	-	-	-	-	-	-	-	-
Net Fixed Assets	**45,972,250**	**41,519,138**	**37,066,025**	**32,612,913**	**28,159,800**	**23,706,688**	**22,004,575**	**20,302,463**	**18,600,350**	**16,898,238**	**15,196,125**
Other Assets											
Pre-operating Expenses	1,409,613	1,127,690	845,768	563,845	281,923	-	-	-	-	-	-
Total Other Assets	**1,409,613**	**1,127,690**	**845,768**	**563,845**	**281,923**	**-**	**-**	**-**	**-**	**-**	**-**
TOTAL ASSETS	**62,305,806**	**78,710,148**	**91,819,045**	**104,008,976**	**116,055,970**	**128,032,342**	**141,750,772**	**155,544,506**	**169,683,249**	**184,411,357**	**180,819,254**

LIABILITIES											
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Current Liabilities											
Accounts Payables		6,898,636	8,927,326	9,820,059	10,802,065	11,882,271	13,070,499	14,377,548	15,815,303	17,396,834	-
Short term loan											
Total Current Liabilities	**-**	**6,898,636**	**8,927,326**	**9,820,059**	**10,802,065**	**11,882,271**	**13,070,499**	**14,377,548**	**15,815,303**	**17,396,834**	**-**
Long Term Liabilities											
Long term debt	-	-	-	-	-	-	-	-	-	-	-
Long term debt	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Equity											
Paid up Capital	62,305,806	62,305,806	62,305,806	62,305,806	62,305,806	62,305,806	62,305,806	62,305,806	62,305,806	62,305,806	62,305,806
Retained Earnings		9,505,706	20,585,913	31,883,111	42,948,099	53,844,265	66,374,467	78,861,151	91,562,140	104,708,717	118,513,448
Total Equity	**62,305,806**	**71,811,512**	**82,891,718**	**94,188,917**	**105,253,905**	**116,150,071**	**128,680,273**	**141,166,957**	**153,867,946**	**167,014,523**	**180,819,254**
TOTAL LIABILITIES	**62,305,806**	**78,710,148**	**91,819,045**	**104,008,976**	**116,055,970**	**128,032,342**	**141,750,772**	**155,544,506**	**169,683,249**	**184,411,357**	**180,819,254**

6.7.5 Projected Cash Flow Statement

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Operating Activities											
Net Income		**9,505,706**	**13,367,530**	**19,267,976**	**21,802,013**	**24,357,231**	**29,123,819**	**32,201,972**	**35,591,523**	**39,323,757**	**43,433,093**
Depreciation		4,453,113	4,453,113	4,453,113	4,453,113	4,453,113	1,702,113	1,702,113	1,702,113	1,702,113	1,702,113
Amortization		281,923	281,923	281,923	281,923	281,923	-	-	-	-	-
Change in raw material inventories	(10,992,672)	10,992,672	-	-	-	-	-	-	-	-	-
Change in advance processing charges	(2,934,772)	2,934,772									
Change in spares inventory	-	-	-	-	-	-	-	-	-	-	-
Change in Accounts Receivables		(24,782,625)	(6,113,048)	(9,086,963)	(3,998,264)	(4,398,090)	(4,837,899)	(5,321,689)	(5,853,858)	(6,439,243)	(7,083,168)
Change in Accounts Payables		6,898,636	2,028,690	892,733	982,006	1,080,206	1,188,227	1,307,050	1,437,755	1,581,530	(17,396,834)
Cash from operations	**(13,927,443)**	**10,284,195**	**14,018,208**	**15,808,782**	**23,520,790**	**25,774,383**	**27,176,260**	**29,889,446**	**32,877,533**	**36,168,156**	**20,655,204**
Financing Activities											
Short term debt principle repayment											
Long term debt principle repayment		-	-	-	-	-	-	-	-	-	-
Addition to short term debt											
Additions to long term debt	-										
Issuance of shares	62,305,806										
Net cash from financing activities	**62,305,806**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Investing Activities											
Capital Expenditure	(47,381,863)										
Cash from investing activities	**(47,381,863)**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Net Cash	996,500	10,284,195	14,018,208	15,808,782	23,520,790	25,774,383	27,176,260	29,889,446	32,877,533	36,168,156	20,655,204
Cash balance brought forward	-	996,500	11,280,695	23,011,580	30,849,584	43,633,349	55,946,666	66,529,309	76,703,467	86,690,466	96,681,442
Cash investment in securities		-	-	-	-	-	-	-	-	-	-
Cash available for appropriation	996,500	11,280,695	25,298,904	38,820,361	54,370,374	69,407,732	83,122,926	96,418,755	109,581,001	122,858,622	117,336,646
Dividend	-	-	2,287,324	7,970,778	10,737,025	13,461,066	16,593,617	19,715,288	22,890,535	26,177,179	29,628,362
Cash carried forward	**996,500**	**11,280,695**	**23,011,580**	**30,849,584**	**43,633,349**	**55,946,666**	**66,529,309**	**76,703,467**	**86,690,466**	**96,681,442**	**87,708,284**

6.7.6 NPV and IRR Calculations

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Net Cash Flow (Rs)	996,500	10,284,195	14,018,208	15,808,782	23,520,790	25,774,383	27,176,260	29,889,446	32,877,533	36,168,156	20,655,204
Total Investor Cash outflow (Rs)	(62,305,806)										
Net Cash flows (Rs)	(62,305,806)	10,284,195	14,018,208	15,808,782	23,520,790	25,774,383	27,176,260	29,889,446	32,877,533	36,168,156	20,655,204
Accumulated Cash flows (Rs)		(52,021,611)	(38,003,402)	(22,194,621)	1,326,169	27,100,553	54,276,813	84,166,258	117,043,792	153,211,948	173,867,152
Payback period (years)		1.00	1.00	1.00	0.95	-	-	-	-	-	-
IRR	**27.91%**										
NPV (Rs)	**18,569,700**										
Payback (years)	**3.95**										

6.8 Sensitivity Analysis

Sensitivity of project's viability in terms of NPV was analyzed with respect to changes in different revenue and cost components. In addition, project's capacity to absorb debt cost was also analyzed. While studying the effect of one variable, all other variables have been assumed to be constant.

6.8.1 Project's Sensitivity to Sales Price Growth Rate

Sales prices of the final products have been assumed to grow at 10% per annum. The export market sale prices are driven by global demand-supply dynamics and the project does not have any control on those. Therefore a sensitivity analysis was carried out to know the fluctuations beyond which the project becomes infeasible. Drop in NPV with a drop in sales price growth rate are is shown in Figure 34.

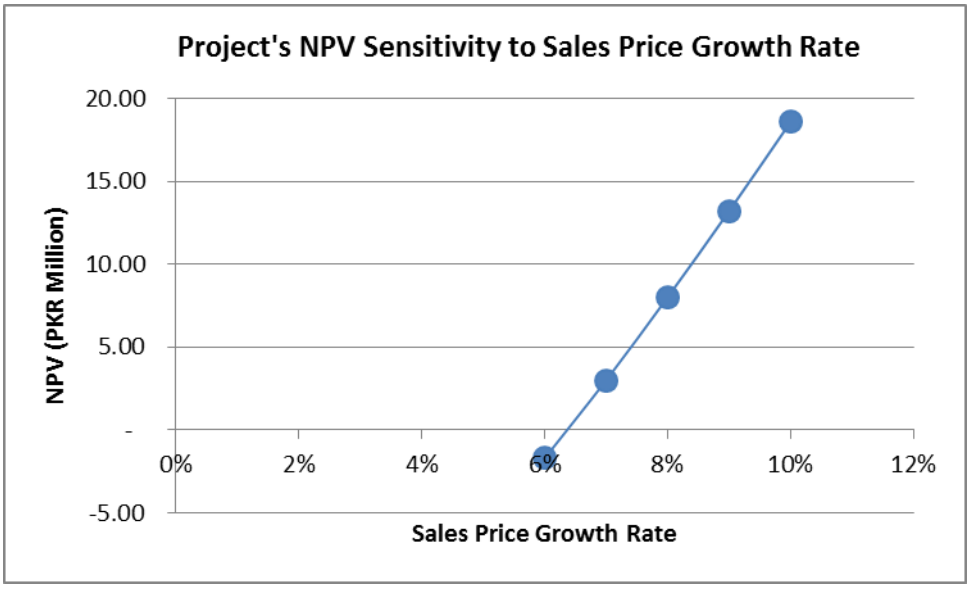


Figure 34 – Project's Sensitivity to Sales Price Growth Rate

The project remains in the feasible range as long as the sales prices of the final products grow above 6.5% per annum. Below this value, the project becomes financially unviable.

6.8.2 Project's Sensitivity to Raw Material Growth Rate

Raw material prices have been assumed to grow at 10% per annum. Just like market sale prices, the raw material (fresh vegetables) prices are also driven by demand-supply dynamics and the project does not have any control on those. Therefore a sensitivity analysis was carried out to know the fluctuations beyond which the project becomes infeasible. Project's profitability direct decreases with increase in raw material prices Drop in NPV with increase in annual growth rate of fresh vegetables prices is shown in Figure 35.

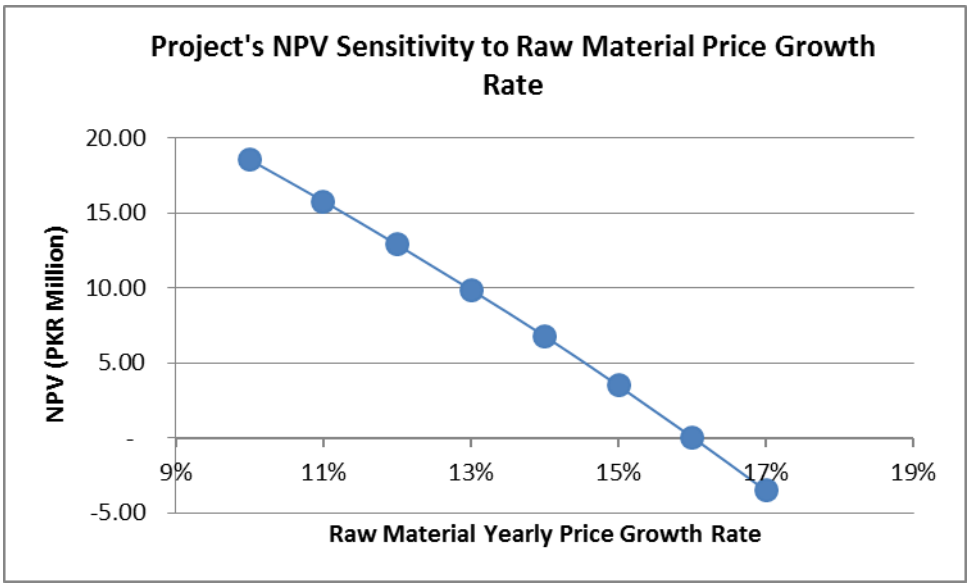


Figure 35 – Project's Sensitivity to Raw Material Price Growth Rate

Project was found to be financially viable up to annual increase of about 16% in the prices of fresh vegetable. The threshold is quite above the average inflation rate and thus the risk to project's viability due to increase in raw material prices should not be considered high.

6.8.3 Project's Sensitivity to Land Price

The project assumes that land will be available in special economic zones at rates lower than the market rates. Impact on project's viability was analyzed in case the assumption could not materialize and the project has to be established on land available on market rates. Figure 36 shows the results.

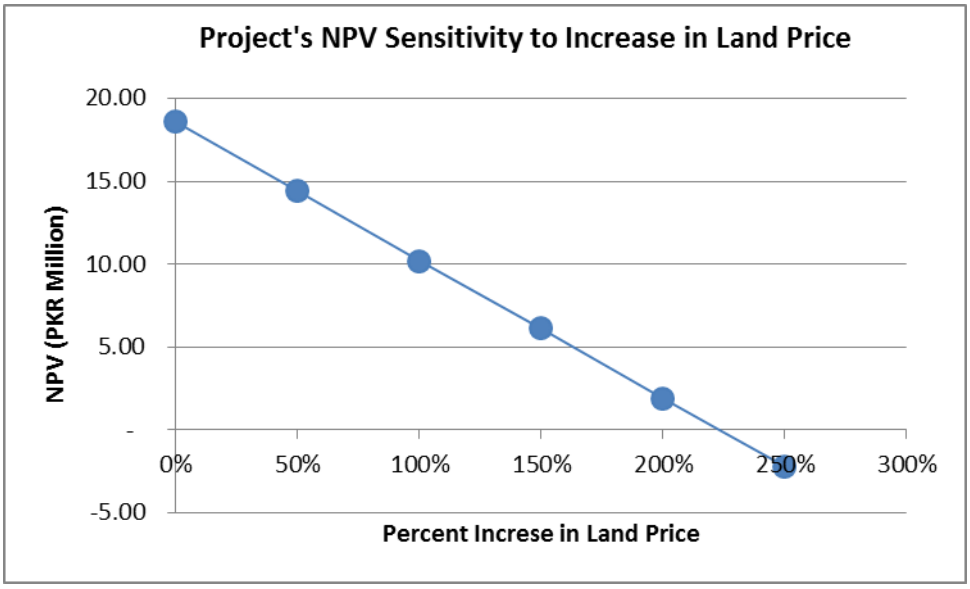


Figure 36 – Project's Sensitivity to Increase in Land Price

The project is seen to be fairly safe with increase in land prices. NPV remains positive even if land is acquired at three time of the cost that has been used in project's calculations.

6.8.4 Project's Capacity to Absorb Debt

The project has been assumed to be financed solely with equity. Addition of debt in the project's capital structure directly affects the NPV due to added cost of interest payments and additional cash outflows for principle repayments. Figure 38shows that the project has a significant capacity to absorb debt. NPV remains positive even for a 50% share of debt (15% p.a. for 10 years). The project becomes unviable when the share of debt in total investment increases beyond 54%.

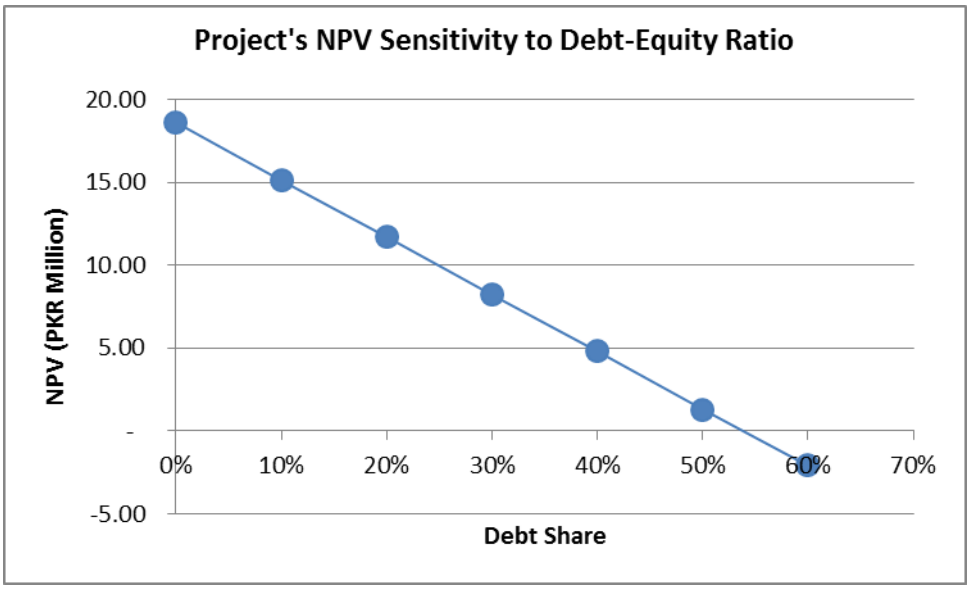


Figure 37 – Project's NPV Capacity to Absorb Debt

Impact of debt on profitability ratio was also analyzed. Net profit margin was found to be falling by about 1.2% with every 10% increase of debt in capital structure. Figure 38 shows the results.

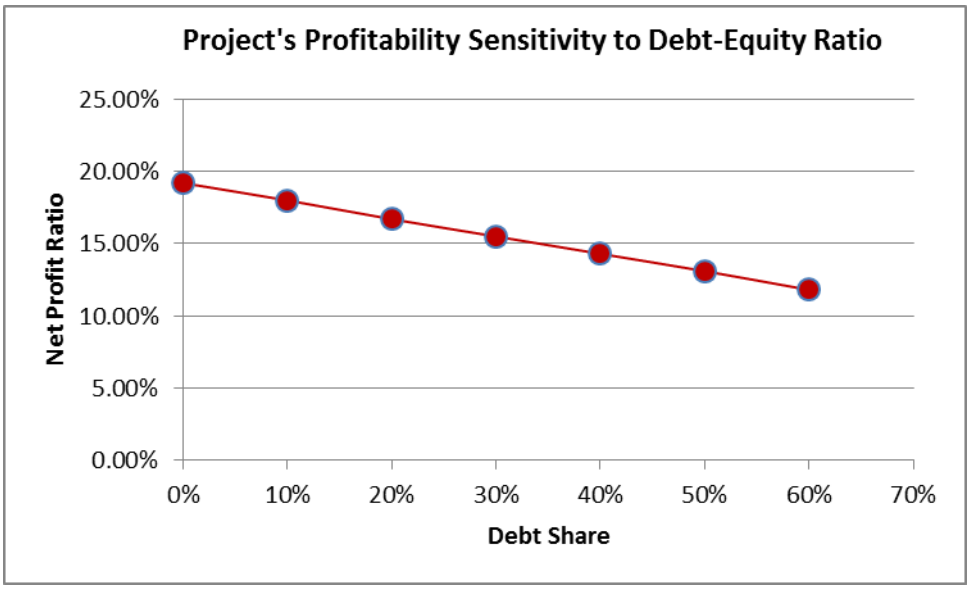
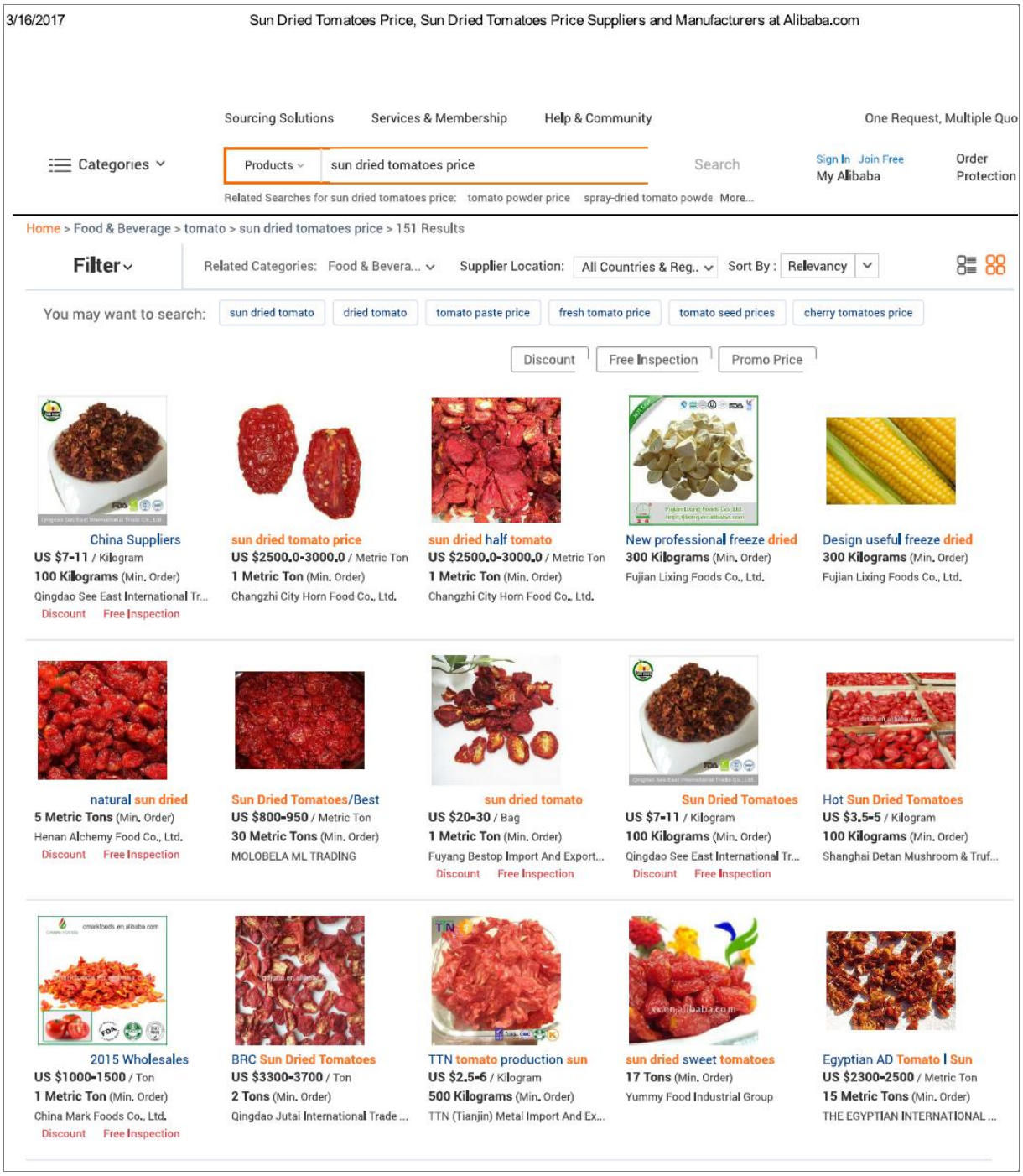


Figure 38 – Project's Profit Margin's Sensitivity to Debt Share

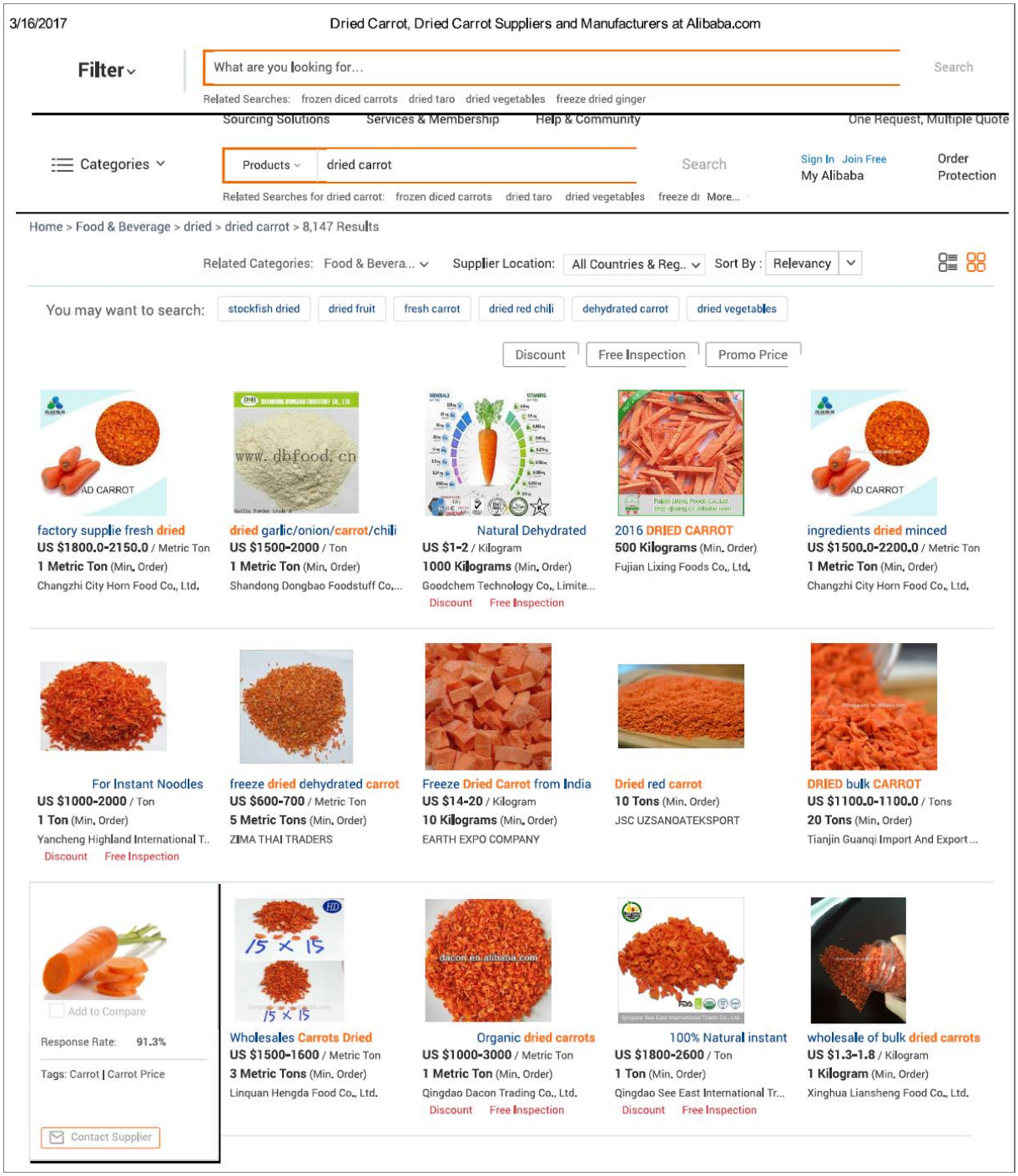
7.0 ANNEXES

7.1 Annex I – Online Prices of Dried Vegetables

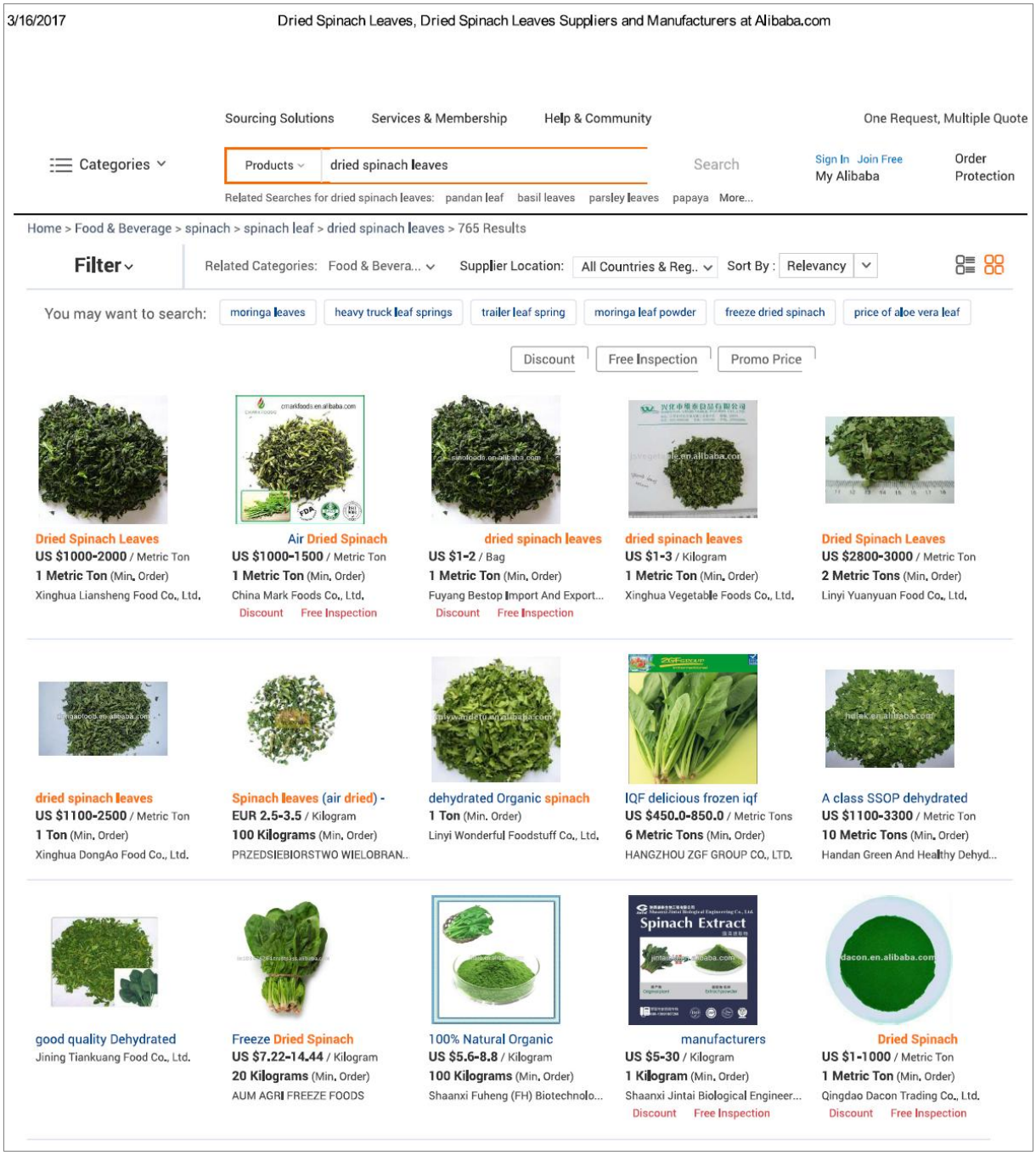
7.1.1 Annex IA - Online Prices of Dried Tomato



7.1.2 Annex I-B - Online Prices of Dried Carrot



7.1.3 Annex I-C - Online Prices of Dried Spinach



7.2 Annex II – Solar Dryer Specifications

Detailed specifications of tunnel solar dryer have been obtained from the work done by 'The Agribusiness Project' of USAID; implemented by the Agribusiness Support Fund (ASF). Details are shown in Figure 39 to Figure 41.

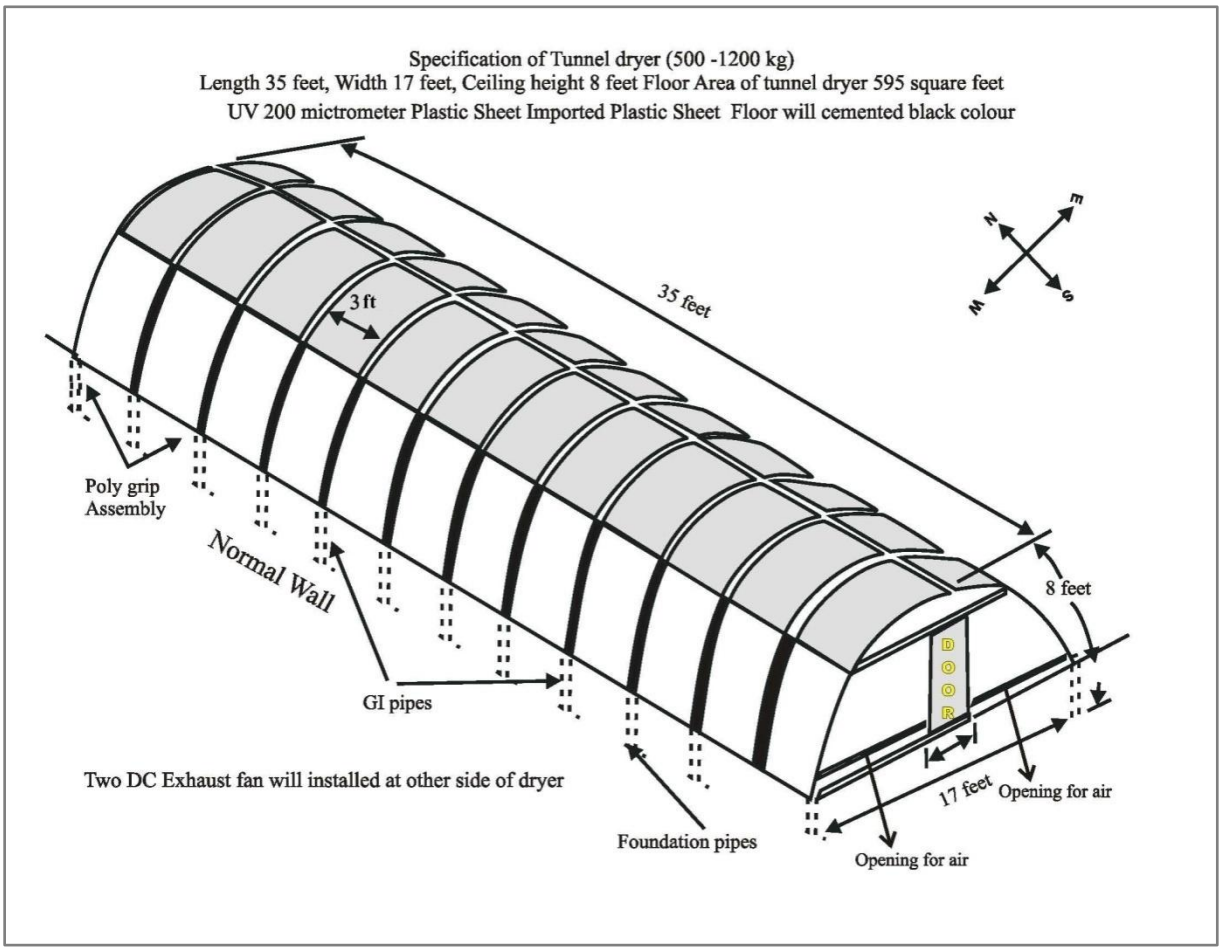


Figure 39 – Specifications of Solar Tunnel Dryer

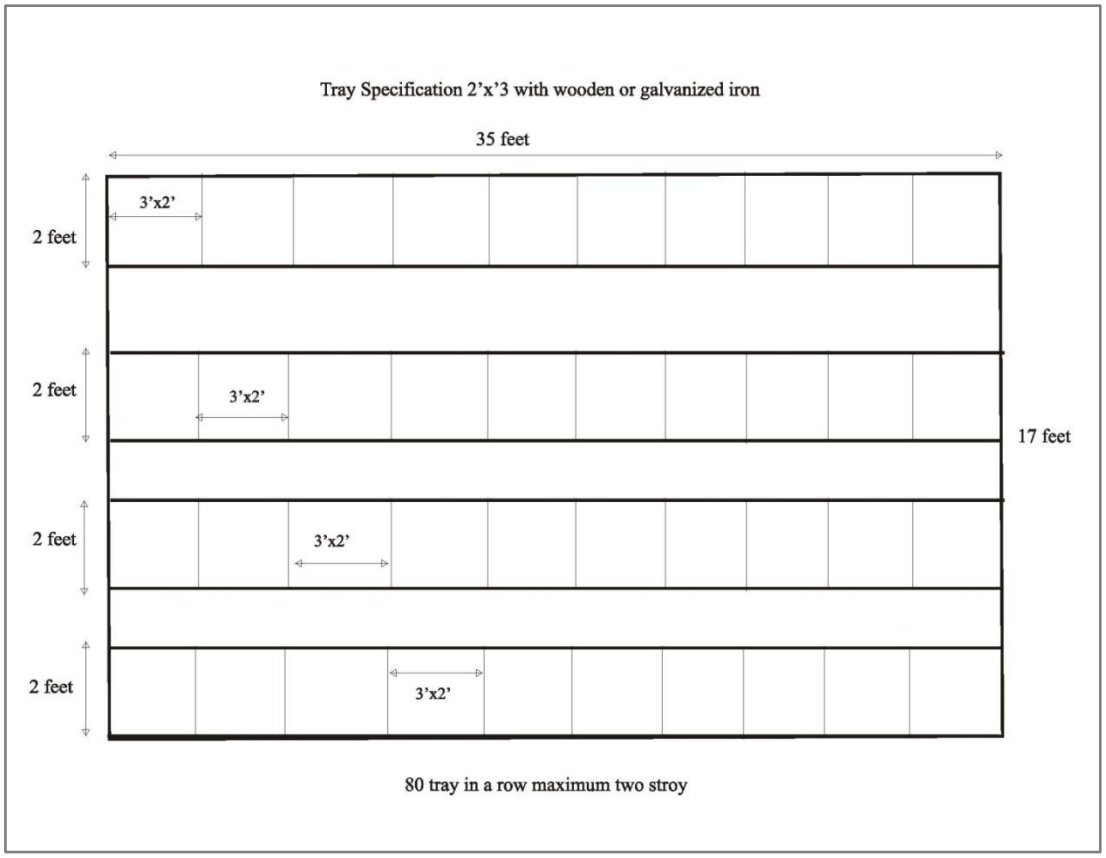


Figure 40 – Specifications of Wooden/GI Trays Layout in Tunnel Dryer

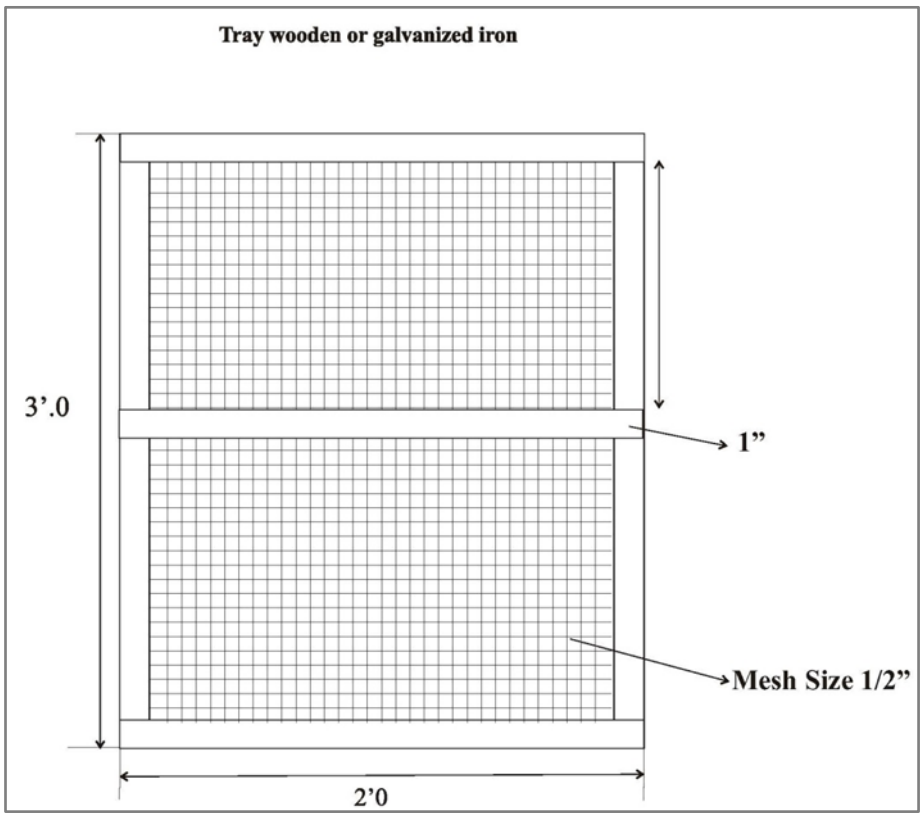


Figure 41 - Specifications of a Single Tray for Solar Tunnel Dryer

7.3 Annex III – Details ofFeasibility Calculations

7.3.1 Annex III-A - Revenue Calculations

Dried Onion	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Volume produced (kg)	37,125	42,075	49,500	49,500	49,500	49,500	49,500	49,500	49,500	49,500
Selling price (Rs/kg)	280	308	339	373	410	451	496	546	600	660
Revenues from Dried Onion	10,395,000	12,959,100	16,770,600	18,447,660	20,292,426	22,321,669	24,553,835	27,009,219	29,710,141	32,681,155
Dried Tomato	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Volume produced (kg)	27,450	31,110	36,600	36,600	36,600	36,600	36,600	36,600	36,600	36,600
Selling price (Rs/kg)	250	275	303	333	366	403	443	487	536	589
Revenues from Dried Tomato	6,862,500	8,555,250	11,071,500	12,178,650	13,396,515	14,736,167	16,209,783	17,830,761	19,613,838	21,575,221
Dried Carrot	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Volume produced (kg)	28,275	32,045	37,700	37,700	37,700	37,700	37,700	37,700	37,700	37,700
Selling price (Rs/kg)	150	165	182	200	220	242	266	292	322	354
Revenues from Dried Carrot	4,241,250	5,287,425	6,842,550	7,526,805	8,279,486	9,107,434	10,018,177	11,019,995	12,121,995	13,334,194
Dried Spinach	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Volume produced (kg)	12,375	14,025	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500
Selling price (Rs/kg)	175	193	212	233	256	282	310	341	375	413
Revenues from Dried Spinach	2,165,625	2,699,813	3,493,875	3,843,263	4,227,589	4,650,348	5,115,382	5,626,921	6,189,613	6,808,574
Dried Chillies	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Volume produced (kg)	112,613	127,628	150,150	150,150	150,150	150,150	150,150	150,150	150,150	150,150
Selling price (Rs/kg)	230	253	278	306	337	370	407	448	493	542
Revenues from Dried Chillies	25,900,875	32,289,758	41,786,745	45,965,420	50,561,961	55,618,158	61,179,973	67,297,971	74,027,768	81,430,545
Total Revenues (PKR)	**49,565,250**	**61,791,345**	**79,965,270**	**87,961,797**	**96,757,977**	**106,433,774**	**117,077,152**	**128,784,867**	**141,663,354**	**155,829,689**

7.3.2 Annex III-B - Vegetables Cost Calculations

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Dried Onion										
Volume produced (kg)	37,125	42,075	49,500	49,500	49,500	49,500	49,500	49,500	49,500	49,500
Vegetables required for processing (kg)	337,500	382,500	450,000	450,000	450,000	450,000	450,000	450,000	450,000	450,000
Vegetable unit Cost (Rs/kg)	15.6	17.1	18.8	20.7	22.8	25.1	27.6	30.3	33.3	36.7
Onion cost (Rs)	5,250,263	6,545,327	8,470,424	9,317,466	10,249,212	11,274,134	12,401,547	13,641,702	15,005,872	16,506,459
Dried Tomato										
Volume produced (kg)	27,450	31,110	36,600	36,600	36,600	36,600	36,600	36,600	36,600	36,600
Vegetables required for processing (kg)	228,750	259,250	305,000	305,000	305,000	305,000	305,000	305,000	305,000	305,000
Vegetable unit Cost (Rs/kg)	14.392	16	17	19	21	23	25	28	31	34
Tomato cost (Rs)	3,292,170	4,104,239	5,311,368	5,842,504	6,426,755	7,069,430	7,776,373	8,554,011	9,409,412	10,350,353
Dried Carrot										
Volume produced (kg)	28,275	32,045	37,700	37,700	37,700	37,700	37,700	37,700	37,700	37,700
Vegetables required for processing (kg)	217,500	246,500	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000
Vegetable unit Cost (Rs/kg)	8.883	10	11	12	13	14	16	17	19	21
Carrot cost (Rs)	1,932,053	2,408,625	3,117,045	3,428,749	3,771,624	4,148,786	4,563,665	5,020,032	5,522,035	6,074,238
Dried Spinach										
Volume produced (kg)	12,375	14,025	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500
Vegetables required for processing (kg)	112,500	127,500	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Vegetable unit Cost (Rs/kg)	16.751	18	20	22	25	27	30	33	36	39
Spinach cost	1,884,488	2,349,328	3,040,307	3,344,337	3,678,771	4,046,648	4,451,313	4,896,444	5,386,088	5,924,697
Dried Chillies										
Volume produced (kg)	112,613	127,628	150,150	150,150	150,150	150,150	150,150	150,150	150,150	150,150
Vegetables required for processing (kg)	341,250	386,750	455,000	455,000	455,000	455,000	455,000	455,000	455,000	455,000
Vegetable unit Cost (Rs/kg)	23.10233333	25	28	31	34	37	41	45	50	54
Chillies cost	7,883,671	9,828,310	12,718,990	13,990,889	15,389,977	16,928,975	18,621,873	20,484,060	22,532,466	24,785,713
Total Vegetables Cost (PKR)	**20,242,644**	**25,235,829**	**32,658,132**	**35,923,945**	**39,516,340**	**43,467,974**	**47,814,771**	**52,596,248**	**57,855,873**	**63,641,460**

7.3.3 Annex III-C - Electricity Supply Tariff

B Industrial Supply Tariff									
					GOP Tarrif Rtionalization				
					Government Subsidy			Surcharge	
Sr. No.	Tariff Category/Particulars	Fixed Charges Rs/KW/M	Variable Charges (Rs/KWh)		Fixed Charges Rs/Kw/M	Variable Charges Rs/Kw/M		Variable Charges Rs/Kw/M	
B1 (a	Up to 25 kw (at 400/230 volts)	-	12		-	-	-		2.5
B2(a)	exceeding 25-500 Kw (at 400	400	11.5		-	-	-		2.5
	Time of Use		Peak	Off-Peak		Peak	Off-Peak	Peak	Off-Peak
B1 (b)	Up to 25 kw	-	15	9.5	-	-	-	3	3
B2 (b)	exceeding 25-500 Kw (at 400	400	15	9.5	-	-	-	3	2.99
B3	For All Loads up to 5000 KW(at 11,33 KV)	380	15	9.5	-	-	-	3	3.1
B4	For All Loads (at 66,132 KV & above)	360	15	9.5	-	-	-	3	3.1
For B1 consumers there shall be fixed minimum charge of Rs. 350 per month.									
For B2 consumers there shall be fixed minimum charge of Rs. 2,000 per month.									
For B3 consumers there shall be fixed minimum charge of Rs. 50,000 per month.									
For B4 consumers there shall be fixed minimum charge of Rs. 500,000 per month.									

PEAK / OFF PEAK TIMINGS		
Season	Peak Timing	Off-Peak Timing
Dec to Feb	5 PM to 9 PM	Remaining 20 hours
Mar to	6 PM to 10 PM	-do-
Jun to	7 PM to 11 PM	-do-
Sep to	6 PM to 10 PM	-do-

7.3.4 Annex III-D - Depreciation/Amortization Schedule

DEPRECIATION SCHEDULE

PKR		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Rate	Opening Balance	Depreciation	Depreciation	Depreciation	Depreciation	Depreciation	Depreciation	Depreciation	Depreciation	Depreciation	Depreciation
Land	0%	10,000,000	-	-	-	-	-	-	-	-	-	-
Solar Dryers	20%	13,000,000	2,600,000	2,600,000	2,600,000	2,600,000	2,600,000	-	-	-	-	-
Building & Civil Works	5%	10,392,250	519,613	519,613	519,613	519,613	519,613	519,613	519,613	519,613	519,613	519,613
Preparation/Allied Machinery	10%	11,825,000	1,182,500	1,182,500	1,182,500	1,182,500	1,182,500	1,182,500	1,182,500	1,182,500	1,182,500	1,182,500
Office Equipment	20%	755,000	151,000	151,000	151,000	151,000	151,000	-	-	-	-	-
Vehicles	20%	-	-	-	-	-	-	-	-	-	-	-
Total		**45,972,250**	**4,453,113**	**4,453,113**	**4,453,113**	**4,453,113**	**4,453,113**	**1,702,113**	**1,702,113**	**1,702,113**	**1,702,113**	**1,702,113**

Year End Value

		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Land		10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000
Solar Dryers		13,000,000	10,400,000	7,800,000	5,200,000	2,600,000	-	-	-	-	-	-
Building & Civil Works		10,392,250	9,872,638	9,353,025	8,833,413	8,313,800	7,794,188	7,274,575	6,754,963	6,235,350	5,715,738	5,196,125
Preparation/Allied Machinery		11,825,000	10,642,500	9,460,000	8,277,500	7,095,000	5,912,500	4,730,000	3,547,500	2,365,000	1,182,500	-
Office Equipment		755,000	604,000	453,000	302,000	151,000	-	-	-	-	-	-
Vehicles		-	-	-	-	-	-	-	-	-	-	-
Total		**45,972,250**	**41,519,138**	**37,066,025**	**32,612,913**	**28,159,800**	**23,706,688**	**22,004,575**	**20,302,463**	**18,600,350**	**16,898,238**	**15,196,125**

AMORTIZATION SCHEDULE

	Rate	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Pre-operating Expenses	20%	1,409,613	281,923	281,923	281,923	281,923	281,923	-	-	-	-	-
Accumulated Amortization cost			281,923	563,845	845,768	1,127,690	1,409,613	1,409,613	1,409,613	1,409,613	1,409,613	1,409,613
Year end value		1,409,613	1,127,690	845,768	563,845	281,923	-	-	-	-	-	-

7.3.5 Annex III-E - Key Assumptions Summary

7.3.5.1 Working Capital Assumptions

	No. of Months
Accounts Receivables	6
Accounts Payables	
Vegetables	3
Packing Material	3
Electricity bill	1

Table 28 – Working Capital Assumptions

7.3.5.2 Operating Assumptions

Sale price growth rate per year	10%
Vegetable cost growth rate per year	10%
Electricity Cost growth	10%
LPG cost growth rate	10%
Chemicals cost growth rate	10%
Packing material growth rate	10%
Payroll growth rate	10%
Machine maintenance (% of machine cost)	1%
Machine maintenance increase per year	0.10%
Diesel cost (PKR/liter)	80

Table 29 – Operating Assumptions

7.3.5.3 Financial Assumptions

Cost of capital (for discounting)	20%
Amortization rate	10%
Depreciation rate	10%
Tax Rate	35%

Table 30 – Financial Assumptions