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Horticulture (Peaches, Dates, Potatoes, Chilies) Value Chain Assessment Final Report for The Agribusiness Project

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Lists of Acronyms and Local Terms

AOR	Agreement Officer's Representative (USAID)
Arthi	Wholesale commission agent and money lender
ASF	Agribusiness Support Fund
CNFA	Non-governmental organization formerly known as Citizens' Network for Foreign Affairs
Chuhara	Dried dates treated mainly for export to India
FAO	Food and Agricultural Organization
FEG	Farmers Enterprise Group
FSC	Farmer Service Center
Khajoor	Dessert dates
KFS	Kissan Field Schools - a form of farmer field school
Mandi	Pakistani markets where fruit and vegetables are bought and sold
MEDA	Mennonite Economic Development Associates
MFI	Microfinance Institution
Pharia	Wholesaler who buys from arthi and supplies retailers
RH	Relative humidity
SME	Small to medium business enterprise
Tekardar	A Contractor - procures from the farmer and sells through the Arthi
UAE	United Arab Emirates
TAP	The Agribusiness Project
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VC	Value Chain

Executive Summary

The purpose of this assignment was to provide technical assistance to the Agribusiness Support Fund (ASF) in implementing The Agribusiness Project (TAP). The objective was to analyze four value chains with a view to upgrading them to the benefit of all stakeholders and to identify market-driven projects that would have maximum impact to this end. Rupert Knowles was one of several consultants contracted short-term by CNFA to TAP. His specific brief was to examine four crops: peaches, dates, potatoes and chilies¹.

The assignment had two phases. After preparation in the UK, the consultant spent three weeks in Islamabad, Lahore and Karachi. Only one field visit was accomplished (Okara - potatoes), but a number of interviews were held in the cities and an interim report and presentation was given to USAID and ASF/TAP. The consultant returned for a further ten days of interview and analysis. In particular, information was gathered to formulate more detailed projects based on those proposed at the end of the first phase.

At the start of the assignment, a lot of effort was put into designing traditional value chain forms for interviewing stakeholders and recording information. Although these were not used systematically, they are given in Annex 5 Value Chain Worksheets for use by TAP local staff in further analysis. During phase one, it was apparent that to do systematic VC analysis, a whole army of local staff would need to be trained and that there was insufficient time in this short assignment. Also it became apparent that much of the information was already available (some of it from TAP's own baseline survey conducted by the M&E section), and that this information could be used to design projects to upgrade the value chains. Nevertheless, the lack of field visits by the consultant due to security concerns meant that he was not able to verify information derived from secondary sources.

In the main body of this report, there is a general discussion of the value chains and the traditional players in the Pakistani system for marketing and distribution of fresh produce. In particular, it is pointed out that 'farmers' are not always farmers in the European or American sense. Not only are there many absentee landlords and divers sharecropping systems, but also there is the tekardar or contractor who purchases the crop in the field. In planning interventions to improve harvesting and marketing, it may be the contractor who is the key actor.

Another feature of the market is the bureaucratic mandi system with arthis playing a central role. The consultant visited supermarkets belonging to the French Carrefour and the German Metro companies; although Pakistan lags behind other Asian countries, the nascent multiple retailers will soon take a sizeable slice of the market and they will want to bypass the mandi system for fresh produce supplies to achieve hygiene and traceability norms. There is no possibility of the TAP changing the mandi system and so the consultant has proposed projects that will not be affected by the mandi bottleneck.

A key service provided by the arthi in the mandi is finance. Farmers do not like dealing with banks and the arthi is a convenient source of short-term input loans. The consultant has no proposal for solving this problem, but if the projects put forward are to be sustainable, the TAP has to link growers to alternative sources of finance such as rural banks or microfinance institutions (MFIs). In summary, it is important to understand the current marketing system and the services it provides when an alternative is being designed.

¹ On arrival in Pakistan, this was changed from dates, mangoes, bananas and peaches

Peaches

Details of the peach value chain were explained by The Agribusiness Project Peshawar staff after they had conducted in-depth interviews and focus group discussions with growers, tekardars, transporters and NGOs. The consultant discussed peaches with a supermarket in Karachi. Although no reliable figures for postharvest losses were available, it is obvious that there is a huge internal market for peaches, especially in Karachi, if fruit can reach it in good condition.

Dr. Babar Bajwa, TAP Agribusiness Specialist, calculated that growers could get an extra Rs. 20 per kg through bypassing the mandi and supplying direct². Therefore, interventions should concentrate on how to cold-chain peaches from the North to the South, a distance of some 1,500 km taking nearly 24 hours.

As the Swat Valley is already serviced by several aid projects, an alternative is needed. The main criterion is that through varying elevation and selection of varieties, a reliable supply of high quality dessert peaches should be available for at least three months. The interventions will include collection stations with refrigeration and loading bay, mechanical handling, reefer trucks and Farmers Enterprise Group (FEG) grants for training in business management, harvest and postharvest handling.

Dates

Information on dates was gathered from growers, exporters and processors in Karachi and from TAP staff in DI Khan and Multan. It was learned that dates in Sindh were already covered by the USAID FIRMS project and several others; in Multan District date growers were not sufficiently organized; in the end it was decided to focus on Dhakki in DI Khan where there was a growers' cooperative and a niche market product.

Pakistan can produce high quality dates but it is the only country in the Northern Hemisphere with significant rain at harvest, to which dates are highly susceptible. An early monsoon is disastrous for quality so growers opt for picking and drying early and marketing the bulk of the crop to India as low-value Chuhara. For high end markets within Pakistan, dates are imported from Saudi Arabia and other Middle East countries; there is obvious potential for import substitution.

It is proposed to concentrate on producing and marketing Dhakki dates as Khajoor (dessert) instead of Chuhara which would double returns to growers (See Annex 2: Chuhara versus Khajoor). Interventions include bagging of dates on the tree, drying under high tunnels, careful harvesting at the Rutab stage and storage to supply markets ten months later³.

Potatoes

The consultant visited Okara, the centre for potatoes in the Punjab. He also met PepsiCo/Lay's and several potato exporters. Potatoes are an important export crop, not only to neighboring Afghanistan, but also to Russia and to SE Asia. Production is impressive, but there is still a yield gap in comparison with advanced countries at similar latitudes. Although the bulk of production is in the winter from an autumn sowing, the geography of Pakistan allows other cropping systems and is particularly suitable for high health status seed production.

Interventions proposed focus mainly on upgrading seed production as this is seen as one of the yield constraints. Fortunately, in Okara a private sector micro-propagation (tissue culture) laboratory has started business. The intervention described in Annex 3 Potato involves

² See Table 2 - 'Value distribution if retailer is supplied direct'.

³ Note that for the next few years, Ramadan will come before the date harvest. Dates are traditionally consumed to break the fast and will need to be stored from the previous year.

supporting the micro-prop company to supply pre-basic mini-tubers to seed growers (FEGs) in TAP's KPK or Gilgit Baltistan program and after bulking up, Okara Potato Growers Association to provide a sound market for the basic or elite seed. Extension on realizing the potential of improved seed will be provided by the micro-prop company. In addition, it is proposed to set up a private extension scheme for 60 growers in Okara, incorporating some sophisticated technology such as disease (potato blight) forecasting with weather stations and irrigation scheduling with soil moisture measurement. Support to the extension group would be on a declining basis over three years.

Chilies

Sadly the consultant was not allowed to visit the chili harvest in Kunri to form his own firsthand impression but productive meetings were held in Karachi with chili growers and with a leading processor. Pakistan has lost the major part of its export business of red chili powder through failure to meet international standards for aflatoxin⁴ contamination. Two reasons it has been so slow to correct the issue are the lack of communication in the mandi system and the lack of trust between growers and processors. However growers and processors in Sindh have trialed drying chilies off the ground on mats and covering at night with fleece to protect from dew. The results have been dramatic and aflatoxin has been reduced to below EU tolerance level. TAP is now brokering a deal between a processor and a small group of growers to dry chilies with mats and sell them at a fixed price direct to the factory.

When he returned for phase two, the consultant found that local staff were proceeding rapidly so he turned his attention to chili growers in Punjab where a different variety is used that can be marketed as fresh green or as red for processing. The intervention described involves improved drying to eliminate aflatoxin, cold storage to prolong the marketing period, a pack house and linking growers to other major processors mainly based in Lahore. The assistance of the TAP Market Linkages consultant has been sought. The next step is for TAP staff in Multan to conduct focus group discussions with chili growers in South and East Punjab to find out the volumes involved, the stage of grower organization and the existing marketing arrangements. At a supermarket in Lahore, the value chain markup on simple red chili powder was estimated at 650% and the objective would be to capture a portion of this for the growers.

The key projects recommended are: drying for dates and chilies, seed production for potatoes and cold-chain distribution for peaches.

Annexes 1-4 include some preliminary budgets for the interventions proposed in the four value chains. The consultant believes that these interventions will upgrade the value chains for all stakeholders in the areas concerned and will have a significant impact. The impact will be greater if they are then duplicated in other districts incorporating lessons learned.

⁴ Aflatoxin is a carcinogenic contaminant resulting from soil fungi attacking the chilies during drying.

1. Background to the Assignment

The consultant, Rupert Knowles, has been engaged by CNFA to provide short-term technical assistance to Agribusiness Support Fund (ASF) which is implementing The Agribusiness Project (TAP). Originally, the consultant was asked to concentrate on mangoes, dates, peaches and bananas. However, to avoid duplication with other projects, mangoes and bananas were dropped in favor of potatoes and chilies.

The consultant has been supported by Dr. Babar Bajwa, TAP Agribusiness Specialist who has arranged and attended all meetings. He has a vast network of contacts. In addition, survey work for the peach value chain in Peshawar and the Swat Valley has been delegated to TAP Value Chain Specialists, Saeed Iqbal and Hakim Khan. In Sindh, we received input on dates and chilies from TAP Value Chain Specialist, Abdul Majid Khan. Irnum Malik is the TAP Gender and M&E Specialist and was co-opted to the team to interview women stakeholders.

2. Work Completed

In the first week, an itinerary was planned by Dr. Bajwa. The peach team and the gender specialist were briefed and interviews with key informants were conducted in Islamabad. In the second week, the consultant and the agribusiness specialist carried out in-depth interviews in Lahore and visited Okara to meet potato growers and stakeholders. The peach team met growers, tekardars and NGOs in Swat. In the third week, the consultant and the agribusiness specialist travelled to Karachi for meetings with exporters, processors and growers in the chili and date value chains.

We have met: input suppliers for irrigation, seeds, chemicals; growers; processors of potatoes, dates and chilies; exporters; associations; retailers. Much data has been collected from secondary sources, but it needs to be checked. We have been briefed by TAP regional teams from Multan and DI Khan, but we have not been able to go to the field to verify data, see the area or talk to growers. Moreover, we have had little contact with consumers and only the Peshawar team has interviewed middlemen (tekardars) and transport haulers. A meeting with arthis is essential. We have not met sharecroppers. We have met grower and trader associations, but not Kissan Field Schools, Farmer Enterprise Groups or grower producer groups / cooperatives.

This final report contains findings from both phases and ideas for interventions by TAP to upgrade the four value chains. An interim report and presentation were delivered to UAP and USAID on Tuesday, Nov 27. A final presentation incorporating some of the ideas in this report was delivered on Tuesday, Dec 18 to USAID's Agreement Officer's Representative (AOR) and TAP staff.

3. Tools

Various organizations have compiled tools and manuals for conducting value chain assessments. In order to provide a consistent methodology to those working in the field, the Market Research Toolkit developed by the US/Canadian NGO ‘MEDA’ has been adapted.⁵ It is simple and logical for local staff to follow. Example sheets are reproduced in Annex 5 to this report.

4. Overview of the Value Chains

A simple value chain can be represented diagrammatically (see - Figure 1). The chain itself is on the right and the enabling environment is on the left. In Pakistan we can give names to some of these actors (see-Figure 2). The trader is often called a ‘contractor’ or ‘tekardar’. The wholesaler is divided into two: the commission agent in the market, the mandi, is called an ‘arthi’; and the wholesaler who buys and distributes to the retailers is often called a ‘pharia’. We also have to define ‘processor,’ as in Pakistan it often refers to a grader/packer, whereas in UK a processor changes the nature of the produce, for example by canning or making jam.

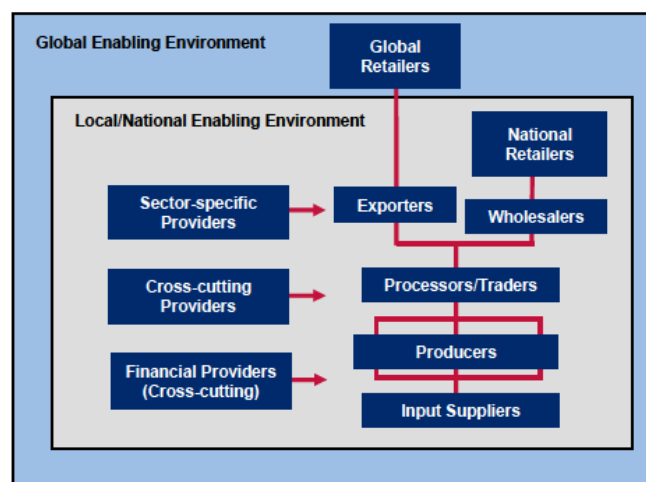


Figure 1 Value Chain Structure – from USAID briefing paper - Value Chain Framework

With regard to the four crops in this study, the input supplier is common to all and so are the actors in the chain after the arthi. There are obviously differences in the growers and their organizations, but in addition, the presence and role of the tekardar varies from crop to crop. In potatoes and chilies, the grower normally supplies direct to the arthi or through a beapari, but in peaches and dates there is often a tekardar, purchasing crop ‘on the tree’.

Not only is the tekardar a middleman, procuring on behalf of an arthi and lending the arthi’s money to the grower, but very often he is a grower himself, either owning an orchard or procuring the crop on the tree and carrying out many of the functions that would be the work of the grower in other countries. This obviously has implications when designing training programs and so on (see below section on Tekardars).

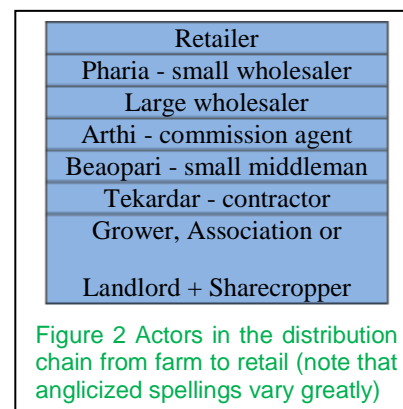


Figure 2 Actors in the distribution chain from farm to retail (note that anglicized spellings vary greatly)

Some groups of stakeholders are loosely organized as associations. For example, we have met the potato growers’ association in Okara and the date and chili growers’ associations in Karachi. These associations disseminate information (technical and market), undertake political lobbying and generally support their members, but the membership fees are low, the officers have not received business training and the associations are not involved in trading either as group buyers or sellers.

⁵ Open access downloadable from the MEDA website: <http://www.meda.org/meda-technical-publications/value-chain/336-market-research-for-value-chain-initiatives-market-development-toolkit>

5. The Role of Mandis

There is a huge body of literature discussing mandis, the arthis and middlemen⁶. Much of this is negative in that arthis are perceived to be rich and to do very little. The role and function of the mandi is enshrined in legislation going back to 1939. The consultant's view is that we are not going to achieve any changes to the mandis in this project, but a discussion is necessary to indicate ways round the constraints of the system.

The essential function of any market is to aggregate produce from growers, set a price for transactions, and then disaggregate to retailers. For example, okra or peaches arrive separately from many small growers and are sold by auction. The retailer buys what he needs and takes back to his shop a mixed collection including okra and peaches. This works best when there are lots of small growers each specializing in one or two crops, and there are lots of small retailers selling a mixed range to the consumer. The main mandis in Lahore function in this way. The many problems include:

- Poor infrastructure - congestion, no access to large trucks
- Unhygienic - poor drainage, rubbish uncollected, rats, no toilets or washing
- Information flow between consumer and grower is interrupted
- Traceability not possible
- No cold storage
- No palletization - manual handling - causes damage
- Postharvest loss

Nevertheless, there is a choice of mandis open to both the grower and the retailer and a huge volume of produce is handled on a daily basis to satisfy consumer needs.

However, there are other mandis which we have not visited, but which do not fit this pattern. For example, in Khairpur during the date season, the mandi is doing far more than supplying local retailers. It is almost exclusively given over to one crop, and the growers have no alternative outlets. Equally the large buyers, exporters and so on, cannot guarantee to find their requirements at a cost that allows them to price their product consistently and to offer the quality specification being demanded by customers. There is little elasticity in either supply or demand and in this situation, the market does not function well; the arthi is supreme!



Figure 3 Congestion and Filth in Lahore Mandi

The value chains are changing. Consumers are demanding higher standards and the retailers, processors and exporters are getting larger. To balance the power in the value chain and cope with this situation, growers have to group into marketing or producer groups.

⁶ A comprehensive view of the mandi marketing system is given in A. F. Ferguson & Co's report related to "Improvements in Agricultural Marketing". This report was a part of the study of the Punjab Resource Management Program (PRMP) under the Resource Management Component of the Technical Assistance Loan 2031-Pak Islamic Republic of Pakistan from the Asian Development Bank under PRMP. The project was initiated in June 2006.

One of the main functions of the TAP will be to facilitate this process and to link the growers directly with the larger buyers. It will take time as there is very little trust between the grower and the buyer, but this process will bypass the current distribution channels, reduce inefficiencies and transaction costs and give rewards to both ends of the value chain. But before this can happen, we need to examine the essential functions carried out by actors in the existing system and ensure that they continue. For example, the arthis are an important source of informal credit for growers and contractors; where will credit come from in the alternative system?

The consultant and the agribusiness specialist had hoped to meet arthis and tekardars during December, but this has not proved possible. Hopefully, the cold chain consultant will be able to meet with transport haulers. We need a good perception of how the trade in fruit and vegetables will change and how through TAP to maximize value for fair distribution to all stakeholders.

6. The Role of the Tekardar or Contractor

In discussions with the peach specialists, the consultant tried to get to the bottom of the relationship between the growers and the tekardars. A 'grower' seldom conforms to our western concept of a farmer who owns or rents land, grows and harvests his crop using his (or his bank's) money, and then either sells through a commission agent in the market, or through a cooperative or producer group, or direct to the public (farm shop) or a retail outlet. The pattern in Pakistan varies according to region and crop. It is common in Swat for a peach 'grower' to sell his crop on the tree. In some cases this can be before blossom and in a few cases, it can be for more than one year at a time. Once sold, the tekardar takes over responsibility for all the work and supplies or contracts labor and materials for pest and disease control, irrigation and other inputs. He harvests the crop and hires a transport company to convey fruit to the market. The tekardar is financed by one or more arthis who sell the crop on commission. In this model it is clear that the tekardar is really the grower and that a project that focuses on 'growers' in the traditional western sense is missing the target.

What does a so-called 'grower' do in the above system? He (it is usually a man but the same applies to a woman) may be a person of leisure, may offer one or two services under contract with the tekardar, e.g. irrigation, or he may have other businesses or employment. The timing and the amount paid by the tekardar may or may not depend on the final weight and price of the harvested crop; in other words, the grower may shoulder some of the risk. He is often not paid in full by the tekardar until after harvest.

However in discussion with the date growers, the situation is slightly different. Many of the tekardars own their own trees but on insufficient scale to run an efficient business. So they contract with other growers who do not want to organize their own harvesting and drying. Thereby the tekardar adds to his crop and achieves economies of scale.

This raises some questions. In TAP, to what extent do we want to change these traditional systems? If we are forming FFSs and FEGs, are we targeting the right people? Often it seems that the tekardar should be participating and not the so-called 'grower'. Once FEGs graduate into marketing groups, they will need to employ professional marketing staff and it would seem that tekardars or arthis could be a good source for recruitment, although they would want to work at least partly on sales bonus. As the banks are mostly failing to supply the finance needed to oil the wheels of trade in horticultural crops, the arthis fulfill this role. How can credit be formalized and less exploitative?

7. The Four Value Chains Overview

This section summarizes what we have gleaned specific to the four chains: peach, date, potato and chili. For each we have listed potential interventions for TAP. After this section, we will discuss some insights that are common to all four chains. In the Annexes, there are more detailed figures and budgets for doable projects.

7.1. Peaches

7.1.1. Background to Peaches

The peach team held in-depth interviews with two NGO project officers, six growers and two middlemen in the Swat Valley. A focus groups discussion was held with growers in Ormar Maina, Peshawar, and a truck owner near the Sabzi Mandi in Peshawar.

Growers interviewed varied in size from one to thirty hectares. Some were members of a farmer service center (FSC), but this was a buying group and did not help with marketing. Some growers sold fruit on the tree to tekardars, but many took their own fruit to the mandi. Growers have received training in orchard management, but nothing in business management.

It was interesting to hear that all growers purchased certified trees to plant new orchards, but some bought them from the research station in Mingora at Rs 38, while others bought from private nurseries at Rs 50-60. The practice of government competing with the private sector and using its subsidized inputs to undercut genuine nursery businesses should not be condoned.

All respondents were aware of the need to reduce postharvest losses, but the growers did not mention refrigeration. The growers were aware of the need for better packaging to protect their peaches in transit, and the transporter was concerned at the lack of training for the laborers loading and unloading. He pointed out the impossibility of introducing mechanical handling in the mandis as they are today, but he was keen to introduce refrigerated vehicles. It is surprising that the growers did not mention refrigeration.

Postharvest losses

It was not the right season to assess postharvest losses in the fields and markets. We have to rely on secondary sources and there is very little published. However in 2008, Munir Khan and a team from Peshawar published results from a study in Swat Valley.⁷ They estimated losses at harvest and losses in transport to market for 5 varieties. Overall average figures were 18% during picking and 5% during transport making a total of 23%. Out of 39 tons picked they estimated that 9 tons were lost. No value was ascribed to this loss.

Peach Value Chains

Dr. Bajwa has collected price information on the traditional value chain for peach. This shows that the major markup is at the retail stage which suggests that the retailer is bearing the biggest part of postharvest losses as he sorts through the boxes of peaches discarding rots and other damaged fruit. The arthi's margin of 13.7% is in fact made up of a percentage commission on the auction price and a handling charge levied per box. Neither he nor the pharia do any repacking or sorting of the fruit: it is sold 'as seen'. It is assumed that the cost of transport to the mandi is borne by the tekardar or grower, and smaller transport costs are incurred by the pharia and/or the retailer.

⁷ Post Harvest Economic Losses in Peach Production in District Swat, Munir Khan *et al*

Table 1 How the retail price of peaches is shared

VC Actors and Stages	Prices Rs. / kg	Markup Rs. / kg	Markup %
Retail price paid by consumer	140.0	60.0	75.0%
Wholesale price paid by retailer to Pharia	80.0	12.0	17.6%
Price at auction paid by Pharia to Arthi	68.0	8.2	13.7%
Price returned to Tekardar/contractor/ grower	59.8		
Total		80.2	134%

The main lesson to be learned from these figures is that if the tekardar or grower graded, packed and transported the fruit carefully, the retailer would not need a 75% margin and would be prepared to pay much more per box. The 75% is not so much if the 23% post-harvest losses reported by Munir and team are deducted. However, if he paid Rs. 100/kg, would the extra Rs. 20 be passed through to the grower in the auction price? Because this cannot be guaranteed, is there a way the tekardar or grower can bypass the mandi?

Table 2 shows a modified structure where fruit is delivered direct to a local supermarket. A wholesale stage has been included, but if the grower himself delivered direct to a supermarket, the markup would only be 40% and the grower would get Rs. 100 / kg. But this is not all profit as he would have much higher packing and distribution costs.

Table 2 Value distribution if retailer is supplied direct

VC Actors and Stages	Prices Rs. / kg	Markup Rs. / kg	Markup %
Retail price paid by consumer	140.0	40.0	40.0%
Wholesale price paid by retailer to wholesaler/distributor	100.0	20.0	25.0%
Price returned to Tekardar/ grower	80.0		
Total		60.0	75%

In Annex 1, the costs for collection/packing centers with refrigeration are explored together with the cost of reefer transport to distant large centers of affluent consumers where supermarkets are expanding rapidly.

7.1.2. Key Strengths in Peaches

- Well-developed industry
 - Certified saplings available from nurseries
- Long season
 - Elevation
 - Varieties
- Unfulfilled domestic market
- Supermarkets keen to handle peaches
- Technology available – ‘off the shelf’

7.1.3. Key Constraints in Peaches

- Delicate and perishable fruit
 - High postharvest losses
- Multiple handling during and post-harvest
 - Poor systems
 - No training
- Unsuitable packaging
- Long distance from market
- Cold chain not developed

7.1.4. Potential Interventions in Peaches

We have learned that there are several donors working in the peach sector and TAP should tread carefully to avoid duplication. It should either look for underserved locations or underserved sections of the value chain. However, the driving force is the market. Here are some preliminary suggestions:

- Identify under-served clusters or sectors (No firms or other project)
- Investigate grower / tekardar relationship to determine target community. Include tekardars.
- Modernize harvest procedures - field picking and packing procedures, maturity index, target training and investment to those who actually do the jobs. The consultant will put together a harvest training handout including best practice from other countries (Annex 7). Training delivery through KFS and FEGs.
- Provide business training to growers and tekardars - FEGs
- Form a value chain group of grower, tekardar, arthi, hauler, supermarket to supply high-end markets in Karachi, Lahore and Islamabad to included Macro and Hyperstar in Karachi. It is understood that Swat Valley has been ruled out as the source of the peaches. The team in Peshawar will put forward districts where there are significant peach production, enthusiastic growers and traders and a range of varieties and altitudes to cover at least 12 weeks marketing.

There will be further investigation of feasibility by the cold chain consultant. As he has an engineering background, it is important that he is allowed to visit the premises of the suppliers of reefers and other refrigeration equipment to assess capacity and reliability first hand.

7.2.Dates

7.2.1. Background to Dates

Pakistan has substantial production of dates, mainly in Sindh and Baluchistan, but also in Punjab and DI Khan. One cluster of the date industry is centered round Sukkur and Khairpur in Sindh. Some 250,000 tons of dates are produced in Khairpur district in Sindh every year and the Khairpur mandi is the national center for date trading. Khairpur mandi is where prices are set. There are

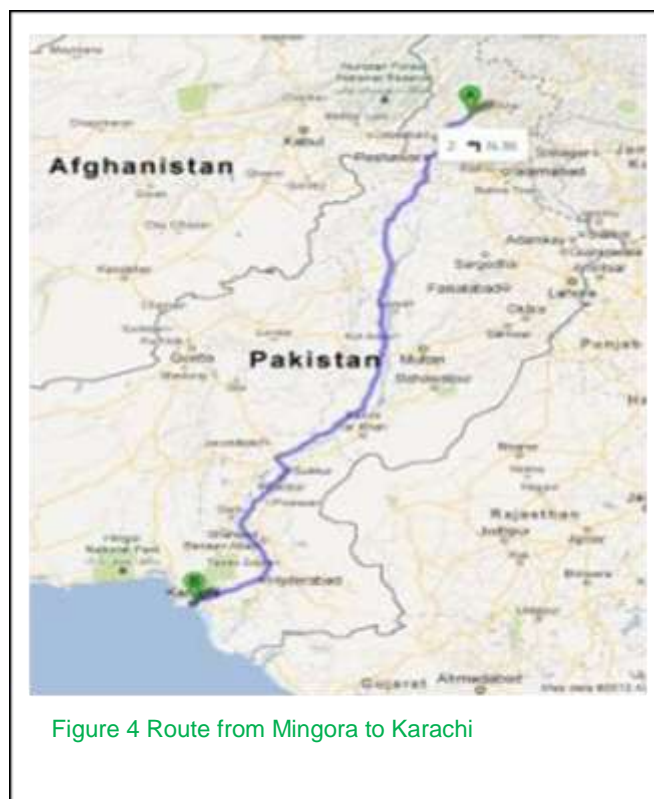
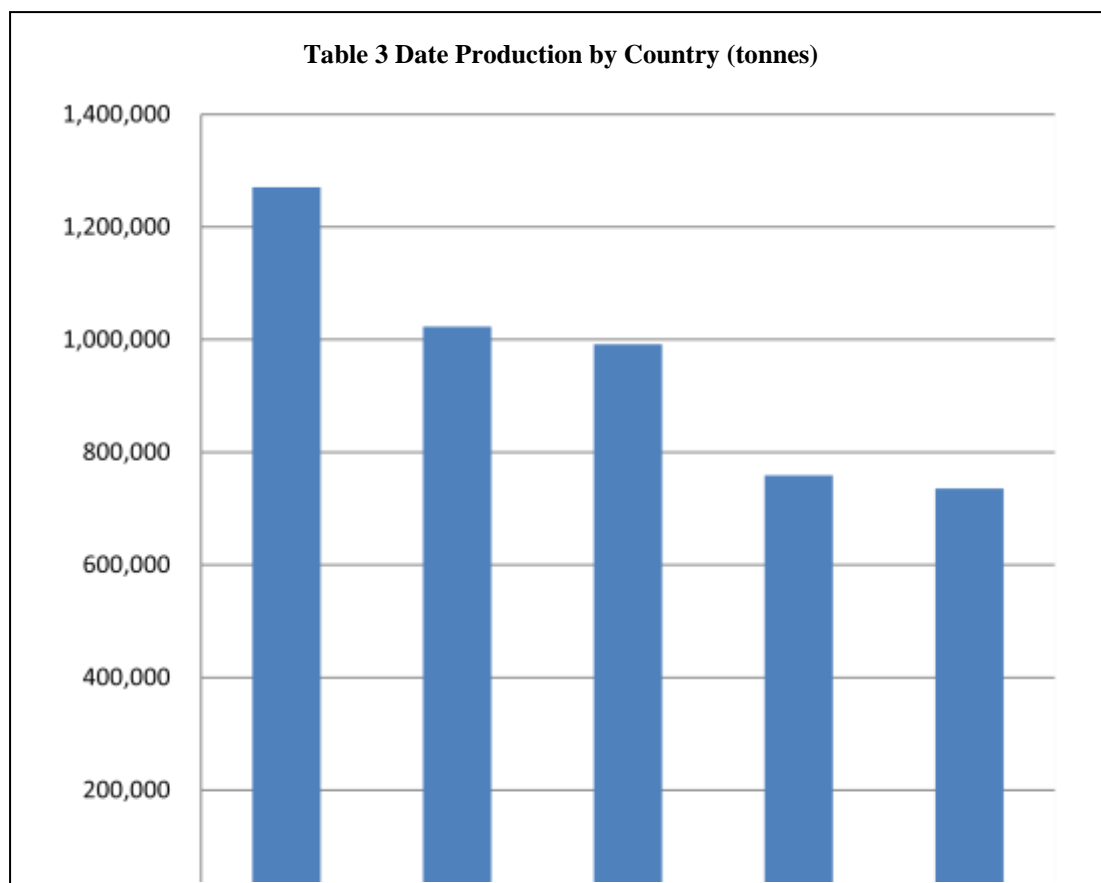


Figure 4 Route from Mingora to Karachi

several date packers and processors in and around Khairpur and there is a proposal for a ‘dry port’ for export. Growers and traders from other date production areas, e.g. Kech (Turbat) in Baluchistan or Dhakki in DI Khan, bring their dates to Khairpur for sale. There are markets for fresh dates and industrial dates, but 80% growers harvest the crop at the Khalal stage and boil fruit⁸ to make ‘Chuhara’. Chuhara is exported to India for ceremonial use. Government statistics (2008-9) put total production at 566,494 tons and FAO (2009-10) places Pakistan as no. 5 in the world.



Saudi dates fetch a high price in Pakistan partly because of good quality and elaborate packaging and partly because of the connection with the holy sites of Islam.

Furthermore, dates are imported from Iran, Iraq and UAE. So, on the one hand Pakistani growers are producing Chuhara, a low grade product for export and on the other hand, importers are fulfilling a demand for Khajoor, high grade dessert dates. There must be scope for import substitution if quality could be improved.

It is understood that TAP will not be working in the main production areas of Khairpur in Sindh and Turbat in Baluchistan. But there are great opportunities to upgrade the value chains in the minor districts of Muzaffargarh and Dhakki where there are distinctive varieties and local markets for dessert dates.

Maturity and Terminology

There are a confusing number of terms used to describe date stages and products. Here we stick to the international terms for maturity: Kimri, Khalal, Rutab and Tamar. At full maturity, Tamar,

⁸ Usually fruit is boiled in Sodium Formaldehyde Sulphonate which maintains the bright yellow color.

dates are dark brown and have very low water content. However, dates may be harvested prior to full maturity for special markets. In the Khalal stage, dates are firm, crisp, moist (45-85% water content) and have their characteristic color, usually red or yellow, but levels of tannin (astringency) can be high. Bunches do not all ripen at the same time and individual date fruits in the bunch can also be at different stages of maturity. The FAO date manual⁹ describes the four stages as follows:

- Kimri: unripe dates on the tree;
- Khalal: physiologically mature, hard and crisp, moisture content: 45 - 85 %, bright yellow or red in color - perishable;
- Rutab: partially browned, reduced moisture content (30 - 45 %), fibers softened - perishable;
- Tamar: color from amber to dark brown, moisture content further reduced (below 25 % down to 10% and less), texture from soft pliable to firm to hard, protected from insects it can be kept without special precautions over longer periods.

In addition the following terms are used in Pakistan:

- Dates at the Khalal stage often called 'Dhoka' can be ripened off the tree, but are normally boiled and dried for sale as Chuhara.
- Dates at the Rutab stage often called 'Dang' can be eaten straight from the tree as fresh dates, but shelf-life is short. If picked at this stage they have to be handled with care.
- Dried but un-boiled and un-processed Dang dates for table consumption are called 'Khajoor'. Shelf-life at ambient temperature depends on variety and extent of drying, but can be 1-2 months. Khajoor can be chilled to 1-4°C or frozen at -18°C.

7.2.2. Postharvest Date Project for Dhakki

Rain Protection and Drying

Growers have very good reasons for harvesting dates unripe and turning them into Chuhara for immediate sale. The monsoon rains are devastating to dates and if the monsoon arrives early, many dates are spoiled and unsalable. When wet, dates absorb moisture and split- fungal growth renders them worthless. Dates can be damaged by rain on the tree or while drying on the ground. In the northern hemisphere, Pakistan is the only date producing country to suffer rain during harvest and drying. From Table 4, it is obvious that if Pakistan is to compete in the international date market, growers have to find a solution to the high rainfall in July and August in the middle of harvest.

⁹ Chapter IX: 'Date Harvesting, Packinghouse Management and Marketing Aspects' by Baruch Buki" Glasner, A. Botes, A. Zaid and J. Emmens.

Table 4 Table showing monthly rainfall in main date producing countries - from FAO Date Manual

Grove/Country	Length of record (years)	Rainfall (mm)				
		Jul.	Aug.	Sept.	Oct.	Nov.
Northern Hemisphere						
Multan/Pakistan	-	60	50	8	0	2
Maskat/Oman	37	0	0	0	2	10
Bushire/Iran	52	0	0	0	2	40
Bahrein/Bahrein	21	0	0	0	0	10
Basra/Iraq	24	0	0	0	2	22
Cairo/Egypt	25	0	0	0	1	3
Tozeur/Tunisia	49	1	2	7	9	12
El Oued/Algeria	25	0	0	3	7	13
Biskra/Algeria	25	1	2	7	9	12
Indio, Ca/USA	33	0	1	1	1	1
Yuma, Ariz/USA	60	1	2	1	1	1
Southern Hemisphere		Jan.	Feb.	Mar.	Apr.	May
Alice Springs/Australia	17	43	41	33	16	13
Finke/Australia	26	22	40	17	14	11
Keetmanshoop/Namibia	37	25.2	43.4	41.3	16.3	4.4
Mariental/Namibia	50	35.9	54.5	47.2	15.7	3.1

The biggest challenge is to protect ripening dates on the tree. High humidity and slow drying after rain contribute toward damage, so training at farmer field schools should focus on cultural practices that improve air circulation in and around bunches. Ripening dates are attacked by birds and insects: these topics should also be addressed at farmer field schools.

In addition to cultural controls, bunch bagging is a necessity for high quality date production in Pakistan's climate. It is understood that bunch covers made of Tyvek have been tried in Khairpur. In older Australian trials, Tyvek gave mixed results and other materials were more effective, but we need more recent data. In some countries, paper bags have been used. In recent research in Saudi Arabia, blue plastic bags gave the best result for early ripening, fruit weight and composition, but the bags were not being used against rain. Nevertheless advancing maturity would reduce the likelihood of damage from pre-harvest monsoon rainfall. From Table 4 it can be seen that growers in Australia and Namibia have a similar problem: it would be worthwhile investigating bunch protection used in these countries.

The market for un-dried loose dates at the Rutab stage is very limited and short lasting. Whether it is for Chuhara production or for Khajoor, the moisture content of dates needs to be reduced to below 25% for storage. To compete with imports for the high value Ramadan market in the coming years, dates will need to be stored for up to ten months. If combined with bunch bagging, drying under cover will open up much more lucrative markets to growers and traders.



Figure 5 Dates being dried and turned into Chuhara.

The literature on systems for drying dates has been studied but often it is the simplest methods that are the best and most likely to be taken up by growers and contractors. The present method of

drying on mats in the open has two drawbacks: the dates are vulnerable to rain and there is contamination from dust and animals. Therefore the use of polytunnels is proposed to keep out rain, dust and animals but there seems to be little reason for introducing racks and complicated methods of forced ventilation. The type of tunnel used should be as high as possible to reduce humidity and should be situated on a gentle slope to encourage an uphill draught through the structure. A suitable multibay tunnel is illustrated in Figure 6.

An analysis for the feasibility of establishing a drying unit for Dhakki dates has been carried out with figures supplied by Munawar Khan, TAP Regional Program Manager, DI Khan. The Dhakki Dates Cooperative Multipurpose Society was formed by SMEDA KHYBER PAKHTUNKHWA with financial support of the Agribusiness Support Fund (ASF) and registered under The Societies Act 1925. The 20 members of the Society are based in Dhakki and the near villages of Mitra, Chora, New Chora, etc. Most of the members are progressive growers having their own date orchards. Members' total area under cultivation is approximately 40 hectares. At average yields, this could give an annual production of 500 tons before drying or 200 tons after drying. It is calculated that a tunnel with 10 bays covering 6,000 m² (0.6 ha) would be required to dry the crop on mats on the ground.



Figure 6 Multibay polytunnels - see <http://www.haygrove.co.uk/polytunnels/farm-polytunnels/4-series>

In the winter, the tunnel could be used for winter vegetable production and the 20 members of the Society could be encouraged to put forward a proposal for initial funding of vegetable irrigation, seeds, fertilizer and equipment for half bay each (300 m²). The cost of such a tunnel would be about USD 36,000 or USD 1,800 per grower or USD 36 per ton of dried dates - Rs 3.5/kg. (See Annex 2 Dhakki Drying for detailed figures on tunnel drying.) Although not as sophisticated, this drying tunnel is more practical than a recent proposal put to the Sindh Board of Investment for a gas dryer capable of handling only 143 tons in one month at a cost of Rs 143/kg¹⁰.

Packing, Processing and Storage

Dates at full maturity store remarkably well compared to other fruits, owing to their low water content. Conditions for storage are described in detail in the 2009 ICARDA manual 'Harvesting and Postharvest Handling of Dates' by Adel A. Kader and Awad M. Hussein which can be

¹⁰ Since writing this paragraph, the consultant is informed that purpose-built tunnel dryers have already been ordered for Dhakki. However, as there will not be sufficient to dry the entire crop, it is proposed that this simpler alternative is tried for comparison.

downloaded from the internet¹¹. Briefly, dates need to be reduced to 23-25% moisture content and held at 0°C and 65-75% relative humidity.

In order to supply dates free of insect pests, it is often necessary to fumigate stores. We discussed fumigation for dates now that methyl bromide has been phased out. Phostoxin has been used but is very dangerous. For organic dates we discussed several options: vacuum chamber, CO₂, or irradiation. A grant for a date fumigation/treatment plant might be an intervention for TAP in future years, but in 2013 we will have to risk insect contamination and seek to minimize it through hygienic packing arrangements and low temperature storage.

Marketing

There is already a cottage industry in and around Dhakki packing dates for retail sale at farm shops on the main Chashma Mianwali road. The volume of throughput is not certain, but initially we are looking to market 5 - 10 tons per month. If family home workers could be used for this, packing costs would be greatly reduced. A small van would be used to deliver and collect dates from home workers.

A marketing agent could be used to develop the market in DI Khan itself or further afield in major cities. His/her first task would be to ascertain the volume of dates currently sold at the roadside in DI Khan, segregating sales of Dhakki Khajoor from sales of imported dates. A sales projection over 10 months would indicate whether new markets need to be explored immediately to absorb Khajoor production from tunnel drying, or whether distant markets can be developed gradually. A marketing agent's remuneration is included in the budget. Date Drying and Marketing - The next step

To be completed before the 2013 date harvest:

- Supply to growers a selection of bags to test under orchard conditions. (5kg/bunch and 500 tons of dates, approximately 100,000 bags required.)
- Training program for growers and contractors on harvesting and handling fruit with minimum losses of first grade (Khajoor).
- Discussion with Society members on how to transport dates quickly in good condition from orchards to drying site.
- Selection of site for Society drying tunnel:
 - Gradient (slope) to ensure natural air circulation
 - Smooth surface with minimum of stones
 - Access for tractors and trucks
 - Room for expansion
 - Hard standing for loading and unloading
 - Clean water for washing dates and for irrigation of winter vegetables (may require a tubewell)
 - Possible adjacent area for packhouse and cold storage in year 2.



Figure 7 Date transport in Dhakki demonstrating poor knowledge of postharvest care

¹¹ <http://postharvest.ucdavis.edu/files/71533.pdf>

- Engage input supplier to import suitable tunnel and arrange training for tunnel erection and management from manufacturer.
- Contract workers (growers' families) to manufacture 6,000 m² drying mats.
- Introduce growers to source of finance to replace traditional role of Arthi. (Munawar Khan has supplied list of local banks able to finance this operation.)
- Identify cold storage facility capable of holding at least 100 tons of dried dates for gradual release of Khajoor onto market over 10 month period.
- Appoint marketing agent. Train agent and facilitate market linkages.

The scenario above has been written for Dhakki. It is suggested that the grower organization is further advanced in and around Dhakki than Muzzafargarh, and that DI Khan would be the best district to pilot the operation.

7.2.3. Other Date Projects

Date Germplasm Selection and Nursery

In DI Khan, there is no certainty that Dhakki dates are all from the same original parent tree. Every time a date seed is planted a new variety or cultivar is created. All subsequent trees of that variety are derived from that tree or its progeny through vegetative propagation. In the case of dates it would be from suckers. The more efficient modern method is by micro-propagation (tissue culture). Even if Dhakki dates are all the same variety¹², over time mutations occur and different clones of the same variety appear. For marketing it is important that a consumer buying Dhakki dates by name gets the same product every time. It is time to start selection of the best clones in the field.

Clonal selection is not complex but it requires good organization and rigorous records. It could easily be handled by a leading member of the Dhakki Dates Cooperative Multipurpose Society supervising an agricultural student from the local college. The steps are:

- Selection of 20 highest yielding Dhakki trees in local orchards. This would be carried out by a working party of Society members. The trees would be numbered and carefully labeled. These are called the '*in situ*' collection.
- At harvest, a student would organize the collection of 5kg of dates at a similar maturity stage from each marked tree. If any tree was ripening earlier or later than the average, this fact would be recorded.
- After careful drying, a group of date marketers and consumers would be invited to a tasting. Tasters would be given a sheet to mark each clone according to criteria such as:

▪ Size	▪ Shape
▪ Color	▪ Texture
▪ Taste	▪ Meatiness
- A further tasting might be held after one month using stored samples of the same batches of dates. Any rots or spoilage would also be recorded.

After this process, the Society should be able to select one clone as the best and truest Dhakki. If there is more than one clone that is outstanding and they are sufficiently different from one another, then two or more clones can be named, Dhakki Clone 1, Dhakki Clone 2 and so on (or given the name of the farmer with the specific tree). Suckers are then taken from the selected trees, the *in situ* collection, and planted in an *ex situ* collection. If flooding, terrorism or other disasters are

¹² This could be determined by DNA analysis.

likely, it is safer to establish more than one *ex situ* collection. Throughout the process secure and consistent labeling is paramount.

The *ex situ* collection is the 'reference library' for Dhakki. The next stage is to establish a mother stock nursery with virus-free true-to-type trees from which to propagate date palm nurseries either taking suckers or more likely through tissue culture. It is not necessary to establish a local micro-propagation laboratory; palms are not easy to propagate, but certain laboratories specialize in them.

Below is a Table 5 list of laboratories¹³ with experience of dates:

Country	Company	Address
United Kingdom	- Date Palm Developments	Baltonsborough, Somerset Ba6. 8qg, United Kingdom Tel: (+44) 1458 850576 Fax: (+44) 1458 851104
France	- Marionnet G.F.A.	21 Rue De Courmemin 41230 Soings - France Tel: (+33) 254 987 103 Fax: (+33) 254 987 523
	- Palmdat - France	"Laboratoire De Physiologie Végétale" "Recherche Et Développement" Marolles 37460, Genille, France Tel: (+33) 247 5952 52 Fax: (+33) 247 59 59 18
Israel	- Rahan Meristem	Propagation Nurseries Kibbutz Rosh Hanikra Western Galilee 22825, Israel Tel: (+972) 4 985 7100 Fax: (+972) 4 982 4333
Morocco	- Domaine Agricole El Bassatine	B.P. 299 Meknes, Morocco Tel: (+212) 5 50 0493 Fax: (+212) 5 50 0730
Namibia	- Palmdat Namibia	P.O. Box 20519 Windhoek, Namibia Tel: (+26461) 230480 Fax: (+26461) 250889
United Arab Emirates	United Arab Emirates University - Date Palm Development Research Unit	P.O. Box 81908-Al-Ain Tel: (+9713) 8732334 Fax: (+9713) 7832472

It is understood that Dhakki date plants are in great demand and are being exported to other regions. It might be a good idea for the Dhakki Society to patent the name and restrict its use for marketing to Dhakki dates growing within a certain area.

¹³ Taken from FAO manual Chapter V. Some of this information may be out of date.

Pollination

Dates are dioecious: male and female flowers are on separate trees. There is some experimental evidence that choice of male for pollination has an effect on the size or quality of date produced on the female tree. This is unusual in fruit growing, but whether or not it is true, there are often some varieties that are better pollen donors than others. In particular, it is usually beneficial to have a male flower that opens just before the female to ensure that the earliest female flowers are pollinated and that the pollen tubes have time to reach the ovaries before the female dies.

The Agribusiness Project could encourage a small pollination trial using local students to determine which, if any, pollen donor is the best for Dhakki. Trees of that variety could then be included in the germplasm project described above.

Cold Storage

There is no documented information on the best storage conditions for Dhakki Khajoor. It would be simple to set up a trial comparing temperatures, atmospheres and treatments at one of the agriculture universities or institutes. Advice would be sought from ICARDA. The aim would be to determine the simplest and cheapest method of storing Dhakki over a 10 month period. Extending the marketing season of a variety which is already in demand is the simplest method of expanding the market. The results would guide the project in building cold stores to complement the drying tunnels.

7.2.4. Key Strengths in Dates

- Well defined clusters
- Niche varieties
- Cottage packing and marketing industry already established for Dhakki
- Ready market
 - Domestic – import substitution
 - Export – only 18% of total production.

7.2.5. Key Constraints in Dates

- No nurseries or certified saplings
- Monsoon rains damage crop
 - On tree
 - While drying
- Poor training in postharvest fruit handling
- 80% growers harvest at Khalal stage and make Chuhara for low end market
- No storage to spread marketing season

7.2.6. Potential Interventions in Dates

- Clonal selection and nursery
- Cluster bagging
- Postharvest training
- Tunnel drying
- Alternatives to methyl bromide / phostoxin in fumigation
- Cold storage
- Packing and Marketing

7.3.Potato

7.3.1. Background to Potatoes

Okara is the main area for potatoes, but production in the north and north-west serves a different season and the climate at high altitudes (Batakundi 2,650m, and Skardu 2,250m) is good for seed production. At lower altitudes, Okara 180m produces autumn crop potatoes. Some spring crop production is in Kallar Kahar 650m and to spread the season and risk, Lay's is working with growers in Soon Valley, Central Punjab (two hours from Islamabad - elevation >750m). Other areas for summer crops at relatively high altitudes include Gilgit 1,500m and Kaghan 2,100m. (There is already a potato growers' association at Kaghan.)

Seed Potatoes

Many of our discussions with growers and processors were about seed potatoes. Although it has been around in Pakistan for more than 10 years, micro-propagation or tissue culture is still seen as the new tool to produce virus-free plants. Nevertheless, bulking up has to be done in the field and care needs to be taken not to re-infect the new stock. There are two tissue culture labs; one in Sahiwal (Punjab Seed Corporation) and one in Okara but their capacity is limited.

We visited the new private Okara tissue culture laboratory belonging to Zamindara Seed Corporation and were quite impressed. The seed company is part of the Sunshine Group which has many interests in agriculture. The seed company was formed in 1994 but has only been in micro-propagation since 2009. The first crop of seed potatoes was produced in 2011. There is a research and breeding program and the first new variety was released into national trials this year. The breeding objectives are:

- Frost resistance using germplasm from Peru and Turkey
- Short maturity (80d) - also to avoid frost

The laboratory for meristem cultures was small but excellent and seemed to be following good procedures. In particular, attention was being paid to sterility and labeling.

Weaning of plantlets was in a gauze (net) tunnel next to the labs. The plants looked healthy and labeling was good. Soil in the tunnel is sterilized between crops by solarization¹⁴ in mid-summer, but staff had been using black plastic which would not be as effective as clear plastic.



Figure 8 Impressive potato crop from Indian seed



Figure 9 UK Potato field protected by fleece

¹⁴ A new book on Solarisation has been published recently: Soil Solarization: Theory and Practice - Edited by Abraham Gamliel and Jaacov Katan. 978-0-89054-418-1 It is available from APS and costs \$199.

It was suggested that production of seed potatoes might be successful in Baluchistan where there is likely to be plenty of fresh, uninfected land to use, but the seed and ware cropping cycles in Pakistan are complex, using different areas and elevations to cover the market all year. Present TAP project focus is on the north, e.g. Batakundi in KPK.

At the moment, certified seed is imported from Holland. Little is planted for bulking up as seed potatoes. Instead it is planted conventionally and then the 35mm - 50mm size is graded out for use as seed and this can continue for several generations. Some growers import seed from India and growers on contract to PepsiCo / Lay's are provided with special chipping varieties. There is a huge difference in price between imported and locally produced seed.

PepsiCo Lay's

Our visit to PepsiCo Lay's was informative. Among subjects discussed was quality control (QC). Previously quality was assessed at the factory gate, but queues were long and often resulted in disputes over who was responsible for the rejection, the farmer or the factory. QC is now done on farm before the truck leaves, thus saving cost in the event of rejection. The system has been further improved by in-field testing so that the farmer knows before lifting whether his crop will meet the standard. If there is a problem, he can choose an alternative marketing plan. The 'Yellow Spring Instrument' is used for checking field quality, especially sugars.

Frost

A major problem for potatoes in Punjab has been frost damage in late December or January when the crop is bulking up. New short maturing varieties are mentioned above, but some form of crop covering, e.g. fleece¹⁵, could be tried. TAP might be interested in supporting this. As well as crop covering, crop insurance is an option to protect growers but it would not help processors.

Reefers

Lay's would like TAP to support investment in reefers to transport potatoes from field to factory in good condition. The factory outside Lahore needs to be in production 12 months of the year, and during the summer months, temperatures in Punjab are high, affecting the quality of potatoes delivered. As well as sourcing from the huge potato cluster around Okara where cold storage is available, better fry quality can be obtained with fresh potatoes from Kallar Kahar or Soon Valley, but the longer journey at high temperatures is affecting quality.

Potato Storage

We visited Ahmad Cold Storage near Okara. This substantial, privately-owned potato store can hold 150,000 bags (17,250 tonnes) in three separate chambers. At the moment there are still some 35,000 bags, including seed potatoes, in store from April / May 2012. Labeling is good on each gunny bag and storage bay as there are many different growers. The store is 10 years old and uses ammonia refrigerant. There are five floors with two layers of 115 kg gunny bags on each. Gunny bags are carried on the backs of laborers up shallow stairs. There is no mechanical handling, no hoist, no forklift. Potatoes are stored at 2°C (this is a little colder than normally recommended but may be right for local conditions and varieties). We did not ask humidity, but there appeared to be no means of measuring and controlling humidity. A training handout on potato storage is in Annex 6.

¹⁵ Horticultural fleece is a thin, unwoven, polypropylene fabric that is used as a floating mulch to protect crops and other delicate plants from cold weather, frost, and insect pests. It admits light, air and rain but creates a microclimate around the developing plants, allowing them to grow faster than unprotected crops.

Technical Extension to Growers

It was apparent in our discussions with growers that there is need for technical extension. For example, the growers did not know when to apply preventative or curative sprays for potato blight or how much and how often to irrigate. A network of weather stations measuring temperature, humidity, precipitation and leaf wetness can give early warning of blight infection which can be sent to growers automatically by SMS. Similarly, soil moisture probes can be programmed with set-points to guide irrigation timing. Both of these apparatuses automatically send data to the internet which can be read by extension workers.¹⁶ These could be managed by a technical extensionist serving a group of growers.

Specialist Help

In the consultant's opinion, there is a need for a potato specialist to examine the production and post-harvest side in detail. I would like to see:

- Verification through lab testing that nematodes are not present in soils
- Assessment of phytosanitary inspectors' competence to evaluate seed potato imports
- Testing of harvest and packing procedures and equipment with electronic potato
- Measurement and control of humidity in store
- the regime for curing potatoes pre-storage
- The procedure for acclimatizing potatoes being withdrawn from store
- Soil moisture measurement and other checks on irrigation timing and volume to establish current water use efficiency
- Prevalence of late blight and other diseases to justify use of weather stations with disease prediction and automatic sms warning
- Visual inspection of fields for virus infection
- Analysis of pesticide application efficiency using simple water-sensitive paper and suggestions for improvement
- Dedicated bulking up of seed potatoes by specialist seed growers
- Benchmarking scheme introduced for potato grower groups to encourage improvement
- Government-backed credit scheme, especially for exporters and government to government pressure to facilitate payment from difficult markets, e.g. Russia



Figure 10 Ahmad Cold Storage near Okara

7.3.2. Key Strengths in Potatoes

- Variations in elevation and latitude
- All year production
- High altitude seed production
- Well defined cluster round Okara
- Nascent micro-propagation (tissue culture) for disease-free seed
- Good quality - ready export market
- Processors ready to invest – PepsiCo / Lay's
- Entrepreneurial exporters

¹⁶ iMetos weather stations and EnviroSCAN soil moisture probes are available from Farm Dynamics, but there are probably other suppliers of meteorological equipment for farmers.

7.3.3. Key Constraints in Potatoes

- Little access to advanced breeding programs
- Yield gap
- Improve water productivity
- Poor rotation
- Extension lacking
- Damage in handling
- No modern storage with mechanical handling

7.3.4. Potential Interventions in Potatoes

The consultant and the agribusiness specialist suggest the following interventions for TAP:

- Linking to international breeding programs
- Expansion of private sector tissue culture lab(s) and establishment of chain for bulking up certified seed to growers using climatic advantage of high altitudes in KPK
- Production - improve water use efficiency, establish private sector extension to groups of larger growers, specifically set up early warning system for late blight.
- Frost Protection - test fleece or other crop coverings, introduce crop insurance
- Assistance to haulage contractors to provide refrigerated transport from field to factory for Lay's and other processors, especially from more distant production areas with a spring crop.

7.4. Chili

7.4.1. Background to Chilies

In Pakistan, chilies are produced seasonally but consumed throughout the year both in green, red and natural form. They are grown throughout the country but Sindh province enjoys an important position regarding the production of red chilies. Main varieties grown in Sindh are Ghotki, Longi, Talhar and Sanam.

“In Sindh, Chilies are grown on an area of 38.4 thousand hectares with production of 53.7 thousand tons. The average yield of 1.7 tons per hectare contributes 1.5 per cent of the country's GDP. In Pakistan, Kunri, a small town of Umer Kot district is the home of red chilies. It contributes around 85% of Pakistan red chili production and is known as one of the largest production centres for red chilies in Asia. The three major types of chilies grown in the chili cluster of Kunri are: Maxi, Desi & Nageena.”

Copied from Sindh Board of Investment - Sector Brief on Red Chilies. Note that in quoting yields it is important to distinguish dried chili from fresh chili. It is difficult to find data to compare yields as experiments often do not state whether it is green chili or red chili and whether it is the fresh yield or dry yield.

Although there are several ways in which the yield of red chilies could be improved, the main problem is that chilies are traditionally share-cropped and neither the landowner nor the sharecropper has much incentive to invest. Most landowners lack interest and the sharecroppers are too poor.



Figure 11 Round Red Chilies drying in Sindh

It is also important to remember that this is a crop grown for processing. Input costs have to be minimized as long as the factory specification is met. Higher inputs may increase yields, but they also increase risk for the grower. Without insurance or resources, poor farmers are risk averse.

Aflatoxin

Aflatoxin is the major problem for chili export. For example, National Foods had a contract to supply McCormick's spices but lost it because it could not satisfy the US aflatoxin requirements. Pakistan has lost many of its international markets to India. European aflatoxin limits are even lower than US. Better drying, off the soil or in solar dryers, could solve the problem, but accredited laboratories for aflatoxin are limited. National Foods has its own lab and has done trials with growers drying on plastic sheets to avoid contamination from soil (see Figure 11) and with an over-cover of fleece (Tyvek or similar) at night to keep off dew. The result has been very successful; it even met European limits.

- Aflatoxin maximum allowable limit (in Parts Per Billion):
 - USA 20
 - EU 05
 - BRAZIL 30
 - AUSTRALIA 15
 - CHINA 10
 - INDIA 30
 - MALAYSIA 35
- In Pakistan, Aflatoxin level in chili crop varies from 02 PPB to 100 PPB.

7.4.2. National Foods

At a meeting with the president of the Red Chili Growers' Association, we discussed how to take the association forward to work with companies like National Foods which are willing to contract growers on flexible terms. A proposal to form a sub-group of 10 progressive growers was mooted. If this were successful, then further similar groups could be formed, but the association is too unwieldy and members hold too many different perspectives to make cooperation with the whole association feasible.

A team of five from TAP met with the CEO of National Foods (NF) for a tight discussion on how to move the chili industry forward. Mr. Hasan is a straight talking manager. He has little patience with academic reports and feasibility studies. This is the second meeting that TAP has had with NF; it is time for action¹⁷ and the next stage is to meet with technical and quality assurance (QA) departments to discuss production to meet company specifications. Working with the sub-group of ten progressive growers mentioned above, there is good potential to link them with National Foods and guide them to a win/win contract. Now that the door has been opened, local TAP staff in Karachi should:

- Meet with QA and R&D at National Foods.
- Obtain National Foods specs for all products and activities.
- Build a model for contract growing with NF and the 10 growers.
- Identify any gaps that need to be filled.

¹⁷ It is understood that Dr. Bajwa and the Karachi team have had several meetings with National Food and with growers and that negotiations for 2013 season are well advanced.

7.4.3. Chilies in Multan

Since writing the above, negotiations with National Foods are in progress. However, discussions with TAP regional staff in Multan reveal that there are other smaller areas where chilies are grown on a significant scale. The variety is different; it is a high yielding imported hybrid called ‘Skyland 2’. As well as red chilies, green chilies are produced for the fresh market. In Phase 1 of the consultant’s visit, we met the CEO of Farm Dynamics Pvt. And were shown photographs of high yielding chili production in Southeast Punjab, probably Bahawalnagar or Bahawalpur District. From the photographs, the variety looks like Skyland 2.

Without further data, it is not possible to proceed at this stage, but TAP staffs in Multan are being sent survey forms for conducting focus group discussions with chili growers in South and East Punjab to find out the volumes involved, the stage of grower organization and the existing marketing arrangements. Staff mentioned two chili processing companies in Lahore, Shan Foods¹⁸ and Perfect Foods, but there also Young’s Food, Ahmed Foods and Mitchell’s active in pickle production and requiring regular supplies of chilies.

The market linkages consultant was brought into the discussions with Multan staff and recommended that more information should be gathered from growers before approaching these large processing companies. However, it would be helpful to know whether any of the companies are experiencing problems with aflatoxin and traceability issues. Once we have the information and we have a model for contract growing from experience with National Foods, then grower groups should be linked to the larger processing companies. In negotiations, efforts should be made to keep some of the pre-processing work in the area of production to help the rural economy and especially to provide work for women. For example, chilies could be dried, stored and graded, chili stalks and/or seeds could be removed before delivery to the factory.



Figure 12 Skyland 2 Chilies ripening photographed in Punjab

Drying and Storage

A change to current practice would be on-farm storage. At present the crop is either stored by the arthi or by the processor. A store containing 5,000 x 30kg bags or 150 tons would be a good start¹⁹. Although initially chilies would be hand loaded in bags, it is suggested that any store constructed should be professionally designed to be convertible to mechanical handling in the future. Farmers could capture value by storage and releasing to the market as required, but would need training and financing to do so.

At harvest chilies have a moisture content of 65-80% depending on whether partially dried on the plant or harvested while still succulent; this must be reduced to 10 - 15% to prepare dried spice. Before drying, even ripening is achieved by stacking in heaps for 2 -3 days at 22 - 25 °C out of

¹⁸ Shan Foods is based in Karachi and has a large export business

¹⁹ It is understood that the current contract being negotiated with National Foods does not included on farm storage. However, in the long term farmers should have their own storage to redress the power balance in the value chain and give them more marketing flexibility.

direct sun. After this, sun drying is best, but to avoid aflatoxin and contamination with dust, chilies should be dried on plastic sheets or a concrete floor and covered at night to keep off dew. Sun drying takes 5 - 15 days depending on weather. 100 kg of fresh chilies dries to 25 - 35 kg. As with dates, consideration could be given to tunnel drying to protect from rain, dust, insects and other vermin.

After drying, chili peppers should be packaged tightly into sacks (gunny bags) holding up to 100 kg²⁰ and are generally stored in non-refrigerated warehouses for up to 6 months. Insect infestation is a major storage problem. In USA, chili and other hot peppers are dried, packaged, and stored at 0 to 10 °C. Storage at low temperature retards loss of red color and slows insect activity. Moisture content of chili and other hot peppers during storage should be low (10 to 15%) to prevent mold growth. A relative humidity (RH) of 60 to 70% is desirable. With high moisture content, pods may be too pliable for grinding and may have to be re-dried. With lower moisture content (< 10%), pods may be so brittle they shatter during handling, causing loss and release of dust, which is irritating to the skin and respiratory system.

Training in drying and storing will be required to enable store managers to achieve and maintain these conditions accurately. Availability of power will be an issue in remote rural areas. Whether the extra cost of refrigerated storage can be recovered will depend on the contracts negotiated with processors.

The use of polyethylene film liners within bags allows better storage and reduces dust. The liners ensure that the pods maintain constant moisture content during storage until the time of grinding. Thus, they permit successful storage or shipment under a wide RH range. Peppers can be stored 6 to 9 months at 0 to 4 °C when packed in this manner.²¹

Credit

Any scheme that removes arthis from the VC also excludes their input as the main providers of credit to the industry. If dry chilies are stored by growers, they not only have to finance growing costs but also have to wait for payment while the crop is in store. A system of warehouse receipts would surmount this difficulty. Warehouse receipt schemes are already operational in Pakistan so there is a working model to follow.

Grading²²

Grading is a pre-requisite for modern marketing of any commodity. Chilies can be graded by farmers on the basis of color and size, before they are brought to market or processor. The damaged, discolored and immature pods are removed depending on market demand. However, for traders other important quality parameters are moisture and stalks. Excess moisture adds weight to the pods but gives room to various fungi to grow. Similarly, if the stalk of the pods is broken, exposing the seeds entirely, the seeds may fall out. On the other hand in absence of optimum moisture the pods may break and let off the seeds. Thus the seed and pod ratio in a lot is also a valuable parameter of grade.

²⁰ Gunny bags of 100 kg should not be handled manually. We prefer 30 kg bags or plastic crates for manual handling or bulk bins for mechanical handling.

²¹ Adapted from <http://www.ba.ars.usda.gov/hb66/108pepper.pdf>

²² Adapted from 'Post Harvest Profile of Chili' published by the Government of India, Ministry of Agriculture (Department of Agriculture & Cooperation) 2009. See <http://agmarknet.nic.in/preface-chhilli.pdf>

The following factors are also important in grading chilies:

- Seed and fruit (pod) ratio
- Seed size and hardness
- Thickness of the skin of the pod and Pungency.

Varieties of chilies are chosen by the end user for different purposes. Manufacturers of chili powder give preference to color and pungency, fleshy skin and less seeds. Visual assessment is important to many buyers in the mandi, but processors will put out a specification and chilies will be inspected at the factory gate by QC before acceptance.

7.4.4. Key Strengths in Red Chilies

- Well defined cluster
 - Kunri has 85% of Pakistan red chili production
 - known as one of the largest production centers for red chilies in Asia
- Other potential chili clusters growing high yielding varieties with support from input dealers
- Ready market
 - Domestic
 - Export
- Processors ready to invest – National Foods
- Strong leader of association in Kunri
 - Small research institute for red chilies in Kunri

7.4.5. Key Constraints in Red Chilies

- Sharecropping – no incentive to invest
 - Grower apathy
 - Sharecropper too poor
- Low yields
- Irrigation – Kunri is at tail-end of canal
- Aflatoxin – meeting European targets
- Lack of trust: grower and processor

7.4.6. Potential Interventions in Red Chilies

- Harvest and drying protocols and training in their use
- Facilitate the establishment of advanced chili grower producer group, provide support and business training
- Contract farming business model
- Storage construction and training in use (not required by National Foods, but could add value for growers)
- Warehouse receipts
- Link progressive growers to National Foods, Shan Foods and other large processors.

Draft budgets for chili drying and storing based on 150 tons are given in Annex 4.

8. Cross-cutting issues

The following general cross-cutting issues have been identified during assessment of the value chains:

- Mandi System – already discussed
- Credit
 - Bank Loans – provide assistance in drawing up business plans
 - Warehouse receipts – introduce system for chilies, dates and potatoes
 - Crop Insurance – discuss with Allianz and SwissRe
- Grants and Loans
- Climate Change
- Certification and Assessments

8.1.Grants and Loans

The consultant would like to make the following points about grants and loans from his experience:

- Government or TAP should give grants for capital items but not operating costs
- Preferably funding should be 3-way
 - Grant (up to 50%)
 - Grower contribution (say 25%)
 - Bank or other loan (say 25%)
- Larger farmer grants should be to
 - Grower Producer Organizations
 - Grower Associations
 - Cooperatives

But

- Asset should be loaned/rented to an individual – provides income for grower group.
- Management of asset should be by an individual – obtains income from contracting to growers.
- Maintenance of asset is assured - an individual will look after an asset better than a group.

8.2.Climate Change

It is very difficult to find any climate change expert who will actually make a firm prediction based on current models. Nevertheless, brave scientists at the Global Change Impact Studies Centre, Islamabad, made the following predictions in 2009²³ and there are probably updates available.

- Expected temperature increase in Pakistan as whole higher than the expected global average increase.
- Projected temperature increase in the north is somewhat higher than in the south Pakistan.
- Projected temperature increase in winter is more than that in summer.
- As yet it is not possible to get a clear picture for precipitation change, due to large model uncertainties.
- The yields of both wheat and rice will decrease everywhere except in the Northern Mountainous areas where wheat yields will increase.

²³ From presentation by Arshad M. Khan of Global Change Impact Studies Centre - Islamabad, given at Regional Conference on Climate Change: Challenges and Opportunities for South Asia, Islamabad 13-14 January 2009

- The situation about the impacts of climate change on Pakistan's water resources is unclear due to the uncertain behavior of Karakoram glaciers.

Here are some further climate possibilities and all value chain experts should take them into account:

- Irregular monsoon
 - Early – destroys dates
 - Late – delays potato planting and interferes with chili harvest and drying
- Frost
 - Damage to potatoes
 - Damage to peach blossom
- Insufficient winter chilling - peaches
- Drought or floods

Possible mitigations:

- Short maturity potatoes or fleece protection
- Date bagging
- On-farm water storage and improved water-use efficiency
- Late flowering peach with low winter chilling requirement
- Crop insurance
- General varietal selection for higher temperatures

8.3.Certification and Assessments

The TAP Environmental Assessment carried out in 2012 only deals with the negative potential of the project. It does not cover potential for environmental improvement through this project. One has only to look at the potato fields round Okara to see that there are few habitats for wildlife. GlobalGAP requires farmers to formulate a conservation plan for their farms. Furthermore, environment is only one aspect of USAID's social responsibility in project design and implementation – little attention is being paid to other important issues. For example, water use efficiency and water productivity, ethical trading, worker / sharecropper pay and conditions, job security, and worker health and safety.

The consultant was appalled to see the heavy loads (115kg) that porters carry to fill the potato store up 5 flights of stairs (Figure 13). The maximum permitted load in many developed countries is 25kg! Any stores constructed in the TAP should incorporate mechanical handling. It was also rumored that on red chili farms, some of the sharecroppers are very badly treated and yet the CEO of National Foods asserted that workers' pay and conditions on farms was not his concern. If National Foods intends to supply chilies to supermarkets in Europe, it will find that workers' pay and conditions are very much its concern!

Most of these issues are covered under modern certification schemes such as GlobalGAP, ETI, GFSI, etc. It might not be necessary to seek certification if not supplying western supermarkets, but



Figure 13 Inside Ahmad Cold Storage

nevertheless the standards are worth aspiring to and should be emphasized throughout The Agribusiness Project.

8.4. Gender

Gender has not been dealt with separately in this report as it is obvious that many of the interventions will employ rural women as well as men. For example, seed potato production, tissue culture, date and chili drying and sorting, peach harvesting and packing all offer employment opportunities to either men or women. It is not up to the consultant to specify that a certain percentage of the labor employed in date drying, for example, should be female, but traditionally large numbers of women are employed.

9. Summary of Recommendations and Interventions

This is a five year project, but one year has passed and we are already in Q2 of PY2. Effectively, PY2, PY3 and PY4 are available for interventions. It is assumed that PY5 will be concerned with ensuring interventions are sustainable and winding down the project. As there is little in common between the interventions for the four VCs, the formatting is again by VC subdivided into four parts for PY2, PY3, PY4 & PY5 respectively. Where critical, PY quarter is given (Q1: Sep - Dec, Q2: Jan - Mar, Q3: Apr - Jun, Q4: Jul - Sep)

9.1.Peach

To deliver peaches to a distant consumer in a hot summer climate, it is essential to develop a cool chain system for first grade fruit picked at its optimal maturity. The mandi market system is not capable of supporting cool chain marketing and so the peach projects are aimed at providing an alternative transport and marketing route to supermarkets in large conurbations such as Karachi. The International Cold Chain Consultant may wish to modify these designs.

Peach Project 1 - Harvest and Orchard Handling

Peach Project 2 - Collection Stations

Peach Project 3 - Cool-chain Transport

Peach Project 4 - Direct Marketing

Project Year Two (Oct 2012 - Sep 2013)

- Identify clusters of peach orchards where there is significant peach production, enthusiastic growers and traders and a range of varieties and altitudes to cover at least 12 weeks marketing. (Q2).
- Assist growers to join KFS and FEGs in collaboration with local NGO. (Q2 - Q3).
- Discuss fruit specifications with target supermarkets and plan harvest procedures and training to meet them. (Q3). (Note draft training handout given as Annex 7)
- Procure penetrometers, spectrometers, trays, ladders, trolleys, pallets, pallet forks and other harvest / maturity aids. (Q3).
- Establish pilot collection centers with cold storage designed for field heat removal and loading bays to facilitate mechanical handling. (Q2 - Q3).
- Procure reefers. (Q2 - Q3).
- Design and procure packaging - market trays. (Q2 - Q3).
- Monitor harvesting, packing, transport and marketing. (Q3 - Q4)

Project Year Three (Oct 2013 - Sep 2014)

- Review 2013 harvest season and plan adjustments for 2014. (Q1).
- Business training to growers, tekardars, haulers and their FEGs or associations. (Q1)
- Link above to alternative sources of short and long term finance. (Q1 - Q2).
- Extend harvesting and cool chain program to other areas and markets. (Q1 - Q3)

Project Year Four (Oct 2014 - Sep 2015)

- Review above and ensure profitability of all stakeholders in the value chain. (Q1)
- Continue training in budgeting and business planning.
- Plan extending the system to other perishable crops (e.g. fresh apricots, strawberries, leafy vegetables). (Q4)

Project Year Five (Oct 2015 - Sep 2016)

- Continue collaboration with multiple retailers in direct supply and extend to 5 more crops.
- Develop and implement exit strategy ensuring sustainability of project.

9.2.Dates

The main foci of date projects are harvesting and drying without spoiling from monsoon rains and bad handling. This will enable a switch from low-value Chuhara to high-value Khajoor and with improved storage, it will enable import substitution and capture of the Ramadan market. A secondary focus is on germplasm improvement. Initially the projects will focus on Dhakki in DI Khan, but they could be expanded to other areas.

Date Project 1 - Date bagging on the tree to protect bunches from rain and pests.

Date Project 2 - Training and equipment to improve harvesting and handling at Rutab stage.

Date Project 3 - Tunnel drying, comparing high naturally-ventilated tunnels with forced air tunnels (as already being supplied to growers by TAP).

Date Project 4 - Storage and marketing to extend season to at least 10 months.

Date Project 5 - Germplasm improvement.

Project Year Two (Oct 2012 - Sep 2013)

(see also above 'Date Drying and Marketing - The next steps)

- Establish FEGs in Dhakki, DI Khan.
- Supply of 100,000 bunch bags and training in use. (Q3).
- Procurement and supply of tunnels for drying. Training in erection and management. (Q3 - Q4).
- Contract supply of 6,000 m² of drying mats from growers' and workers' families. (Q3).
- Connect growers to sources of finance. (Q3).
- Training in harvesting and handling Rutab dates (Q4).
- Planning date storage: storage hire and storage research (Q4)
- Recruit date marketing officer and purchase van for date deliveries. (Q4)
- After grower review and market tasting, select in situ collection of date varieties and/or clones. (Q3 - Q4).

Project Year Three (Oct 2013 - Sep 2014)

- Review date drying procedures and methods in Dhakki. Write harvesting and drying protocol. (Q1).
- Collaboration with Australia or Namibia on rain protection (Q1).
- Investigate other date production areas for project duplication. (Q2).
- Select areas for further expansion and repeat tunnel drying. (Q3).
- Continue storage research and monitoring, including fumigation. (Q1 - Q3).
- Set up date pollination trial (Q3).

- Research, planning and training for date marketing. (Q1 - Q3).
- Micro-propagation from in situ with a view to establishing ex situ collection. (Q1 - Q4).
- Select site and write management and funding plan for ex situ collection for subsequent release of varieties to specialist date palm nurseries. (Q4).
- Investigate protection (trademark) of 'Dhakki' name.

Project Year Four (Oct 2014 - Sep 2015)

- Continue technical and marketing support for Khajoor production in Dhakki with reduced funding.
- Duplicate project in other areas.
- Possible date fumigation plant.
- Plant ex situ collection (Q1 - Q2).
- Plan for specialist date palm nursery association.

Project Year Five (Oct 2015 - Sep 2016)

- Develop and implement exit strategy ensuring sustainability of project.
- Ensure private funding is available for marketing organization, nursery association, extension and for ex situ collection.
- Continue technical and marketing support for Khajoor production in new project areas with reduced funding.

9.3.Potatoes

Major project interventions include:

Potato Project 1 - Expansion of private sector tissue culture laboratory (Zamindara in Okara), with linking to international breeding programs.

Potato Project 2 - Establishing chain for bulking up certified seed to growers. This follows directly from Project 1 using weaned mini-tubers as pre-basic seed, although other seed of similar status could be imported. Bulking would involve large numbers of small growers at high altitude in KPK, Gilgit Baltistan or elsewhere. Work with Okara Potato Growers' Association to guarantee market for certified seed.

Potato Project 3 - Encourage leading growers in Okara District to form a private sector extension group, to include disease warning system (late blight), irrigation scheduling and trials of fleece for frost protection. Extension will also cover other rotational crops - wheat and rice.

Potato Project 4 - Assistance to haulage contractors to provide refrigerated transport from field to factory.

Potato Project 5 - STTA from potato specialist - see above 'Specialist Help' under 'Background to Potatoes'. One to two carefully timed visits.

Project Year Two (Oct 2012 - Sep 2013)

- Negotiate Lead Company Grant to Zamindara (Q2). Should include:
 - Linking to breeding programs in Peru, Canada, Scotland, Holland and US.
 - role as provider of grower extension in seed production and ware planning
 - Improvement of soil solarization procedures for first soil-grown generation (Q4).
- With local NGO, set up KFS and FEGs for seed bulking at high altitude locations (Q2 - Q3).
- Trial shipment of pre-basic mini-tubers to high altitude growers - may be possible for Q3.
- Identify forward thinking members (60?) of Okara Potato Growers' Association keen to form private sector extension group (Q2) and set up management, administration and funding (Q3).

- Recruit and train 3 extension workers (Q3 - Q4). Set up targets and work systems with arrangements for performance monitoring.
- Purchase trial weather station and irrigation scheduling equipment (Q4)
- Set up communication system between extensionists and growers (SMS?) (Q4)
- Grant to haulage contractors for reefers. (Q4)
- Write SoW and recruit potato STTA (Q3) to field in PY2 Q4 and PY3 Q1.

Project Year Three (Oct 2013 - Sep 2014)

- Construct first seed potato stores at high altitude locations (Q4). Critical to decide ownership and management of these stores with implementing NGO.
- Major shipment of pre-basic seed to high altitude growers (Q3).
- Investigate encouraging competing tissue culture labs(s).
- Pilot trial of fleece for frost protection. (Q1 - Q2).
- Further training of Okara extensionists with purchase of technical inputs
- Visit by potato STTA (Q1).
- Expansion of project into other growing areas for year-round supply of fresh potatoes.
- Continue project support to potato exporters, especially into new markets such as Africa.

Project Year Four (Oct 2014 - Sep 2015)

- Continue high level of input to fledgling seed potato industry at high altitude - especially planning and marketing of seed potato crop in collaboration with Okara growers.
- Monitor extension offered by Zamindara to client seed producers.
- Construct remaining seed potato stores at high altitude locations. Store management training. (Q4).
- Continue to expand ware production outside Okara area.
- Ensure transparent government inspection and certification for seed potato industry.
- Continue support to Okara extension with reduced project funding. Business training and development of own funding.
- Major exports push concentrating on direct supplies to multiple retailers in southern Africa and SE Asia.

Project Year Five (Oct 2015 - Sep 2016)

- Review and consolidate export program.
- Develop and implement exit strategy ensuring sustainability of projects.

9.4.Chilies

Chili Project 1 - Collaboration between National Foods and Kunri Chili Growers' Association to supply high quality red chilies complying with international norms for aflatoxin contamination. A model contract will be developed for use by growers and processor.

Chili Project 2 - Following models and contracts developed in Project 1, establish chili growers' association (FEG) in Punjab, replicate aflatoxin control program and link to other major chili processors. It is proposed to improve harvest and handling by growers and construct storage and packing facilities.

Project Year Two (Oct 2012 - Sep 2013)

- Continue negotiations between National Foods and Kunri Chili Growers. Watertight agreement should be in place before planting season (Q3).
- Conduct VC research in Multan, Lodhran and Bahawalpur to identify forward-looking growers for FEGs. (Q2)

- Consolidate information on location, volume, technical know-how and producer grouping in Punjab target areas and coordinate with TAP Market Linkages Consultant for approaching alternative processors. (Q3).

Project Year Three (Oct 2013 - Sep 2014)

- Supply mats and fleece for chili harvest in Kunri (Q1)
- Depending on results of PY2 Q3, design, contract and build pilot cold store with associated pack house and bulk handling equipment. Supply mats and fleece. (Q4)
- Review extension provision to chili growers through KIS, FEGs and input suppliers. Raised beds, drip irrigation, integrated pest and disease management are possible interventions together with better harvest management. (Q2 - Q3)
- Write protocol for postharvest handling, drying, and storage, grading and marketing of chilies. (Q4)
- Link growers to alternative sources of finance for inputs. (Q2)
- Set up warehouse receipt system for chili storage. (Q4).

Project Year Four (Oct 2014 - Sep 2015)

- Extend storage if required and assist FEGs to negotiate with more processors.
- Business training for all FEGs and associations to ensure transparent accounting, funding and future planning for growth.
- Involve processors in linking growers to chili breeding programs worldwide. Conduct variety trials.
- Facilitate variety breeding program in collaboration with major processors, universities or vegetable institutes.

Project Year Five (Oct 2015 - Sep 2016)

- Review and consolidate links between contract growers, associations and processors.
- Develop and implement exit strategy ensuring sustainability of projects.

10. Conclusion

The value chain analysis of the four crops, dates, chilies, potatoes and peaches, was not carried out in the traditional way as an academic exercise. Many such exercises have been carried out in the past without resulting in action. Much of the required information was found to be available already, but the lack of field visits by the consultant meant that he was not able to verify information from secondary sources. Instead the analysis has been directed specifically at identifying market-driven projects. Apart from being doable within the budget and timeframe, these projects have been chosen for maximum impact. The projects' objectives are to upgrade the value chains and benefit all actors.

The key projects recommended are: drying for dates and chilies, seed production for potatoes and cold-chain distribution for peaches. In the previous section, an attempt has been made at prioritizing the interventions according to the three remaining project years; in the Annexes, an attempt has been made at detailed budgets.

It is gratifying to see that by the end of the consultant's assignment progress was already being made on linking chili growers to leading processors with the aim of improving drying and rewarding growers with better prices. For dates too, work on monsoon protection and improved drying has started. It is hoped that other projects will start in time to meet seasonal deadlines.

This report would not be complete without thanking TAP and ASF local staff for their tremendous support. Special thanks are due to Dr. Bajwa for providing most of the background information, arranging all visits and supplying detail for the budgets. In addition, thanks to Shamsheer Khan for keeping a fatherly eye on progress, comfort and safety.

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Annexes

Annex 1	Peach
Annex 2	Dates
Annex 3	Potato
Annex 4	Chili
Annex 5	VC Worksheets
Annex 6	Potato Storage Handouts
Annex 7	Peach Harvest and Postharvest Handout

Annex 1 Peach

The interventions proposed for peaches include:

- Modernize harvest procedures - field picking and packing procedures, maturity index, target training and investment to those who actually do the jobs. The consultant will put together a harvest training handout including best practice from other countries. Training delivery through KFS and FEGs.
- Provide business training to growers and tekardars - FEGs
- Form a value chain group of grower, (tekardar, arthi,) hauler, supermarket to supply high-end markets in Karachi, Lahore and Islamabad to included Macro and Hyperstar in Karachi.

For the latter, collection points will be strategically sited. These will consist of hard standing with loading bay for palletized boxes, a simple pack house or shaded area for inspecting and adjusting fruit, and a pre-cooling unit (adapted reefer). Equipment will include one or more pallet trucks for loading and possibly a rear-mounted pallet transporter to fit the 3-point linkage on MF 240 tractors. Pallet strapping tools, corner guards and straps will be required, funded by the FEG grant, but market trays are an expensive item and have been included separately as seed capital. Part of FEG training would be to budget for replacements on an on-going basis. The cost of trays should include liners and lids if required. Selected transport companies will be provided with 20ft refrigerated containers to fit on their standard 'jingle trucks'. Each truck will carry a hand-pushed pallet truck. The loading bay will be the right height to enable loading to be done with a hand-pushed pallet truck from the hard standing.



Figure 14 Simple hand pallet truck (Hydraulic)

Loading and unloading of boxes by untrained labor will be avoided at all costs!

Table 6 Proposed Budget for Peach Interventions

Item	Grant Rs.	USD @Rs. 97
4 Reefers for Collection Stations	6,208,000	64,000
Hard-standing and shade	1,164,000	12,000
8 Pallet trucks	224,817	2,318
4 Reefer truck backs	3,880,000	40,000
4 Tractor pallet transporters for MF 240	434,020	4,474
8 FEG grants for post-harvest	3,880,000	40,000
Market Trays 10,000 @ \$5	4,850,000	50,000
Total	20,640,837	212,792

Annex 2 Dhakki Drying

On the next page, Table 5 gives expected yields and cost for tunnel drying based on 20 growers in the Dhakki Growers' Cooperative Society and 40 ha of date orchards; 0.71 ha of tunnel would be needed. The costs are based on a quotation from one of the world's leading tunnel makers, Haygrove Ltd., Redbank, Ledbury, HR8 2JL, UK. Tunnels are delivered in containers containing materials for 1.2 ha and the price assumes that one complete container would be supplied and delivered to Karachi. Training on tunnel erection and management would be given.

The table shows that the cost of drying by this method would be USD 79 per ton of dried product, approximately Rs. 8 per kg.

On the following page, Table 6 compares the returns from producing Chuhara and Khajoor.

Tunnel Drying of Dates

Table 7 Tunnel Cost per Ton of Dried Dates

Factor	Unit		
Yield per tree	kg	80	Range is 80 - 120 kg per tree
Tree spacing	m	8	Assumes square planting - trees equidistant in all directions
Tree density	trees/ha	156	Trees are spaced at 8m - 10m square.
Yield per ha	tons	13	
Average Grower Orchard Size	ha	2	
Average Crop per Grower	kg	25,000	Yield x tree density x orchard size
Number of Growers in Association		20	
TOTAL AREA	ha	40	Orchard size x number of growers
TOTAL CROP	kg	500,000	Average crop x number of growers
TOTAL CROP fresh	tons	500	
Weight loss during drying	%	60%	
TOTAL CROP dried	kg	200,000	
TOTAL CROP dried	tons	200	
Price to Grower	Rs/kg	180	Range Rs 40 to Rs 180 per kg
Price to Grower	Rs/Maund	7,200	1 maund = 40 kg
Price to Grower	\$/ton	1,842	
Income to Grower Rs	Rs	1,800,000	Total dried crop x price / number of growers
Exchange		97.72	On Dec 15, 2012
Income to Grower USD	\$USD	18,420	Total dried crop x price / number of growers
Income to Association USD	\$USD	368,398	Total dried crop x price
Drying			
Days to achieve drying	days	7	
Days available for drying	days	45	Assume harvest over 1.5 month
Number of batches dried		6	
Total Crop to Dry	tons	500	
Kg dates per square meter of dry	kg	11.0	
Total Area Required	m2	7,071	Total undried crop / kg per square meter / number of batches
Total Area Required	ha	0.71	1 ha = 10,000 m2
Tunnel			
Bay width	m	7.5	Widths from 5.5 to 9 meters
			Variable according to site conditions
Number of bays		10.0	and area required
Tunnel Width	m	75	Bay width x number of bays
			Variable according to site conditions
Tunnel Length	m	100	and area required
Tunnel Area	m2	7,500	Width x length
Tunnel Cost per square meter	USD	8.10	Deivered Karachi - includes training
Tunnel Delivery	USD	2.43	plus 30%
Total Cost of Tunnel	USD	78,975	Tunnel area x cost per square meter
Cost per Grower	USD	3,949	
			Variable depending on weather and care in use - polythene 3 years but structure ?10 years
Estimated Life of Tunnel	Years	5	
			Cost of tunnel / life of tunnel / total fresh crop
Cost per ton of fresh dates	USD	32	
			Cost of tunnel / life of tunnel / total dry

Chuhara versus Khajoor

Table 8 Estimate of Net Income per Grower for Chuhara vs. Khajoor after deduction of postharvest costs

Item	Chuhara Rs.	Khajoor Rs.
INCOME		
Gross income from sale of 10 tons (25 tons picked) of dates dried to 25% moisture sold for Rs. 80 / kg as Chuhara or Rs. 200 / kg as Khajoor	800,000	2,000,000
COSTS		
Drying @ Rs. 2.5 /kg for Chuhara or Rs. 7.5 / kg for Khajoor	25,000	75,000
Harvest @ Rs.1.0 / kg for Khalal or Rs. 2.0 / kg for Rutab	25,000	50,000
Packaging @ Rs.200 / 5 kg for Khajoor	negligible	400,000
Packing labor @ Rs. 1.0 / kg	-	10,000
Storage 5 months @ Rs. 5,000 per month	-	50,000
Transport	30,000	50,000
Sales Agent @ 5%	40,000	100,000
Total costs	70,000	2,735,000
Net Income per grower	680,000	1,265,000

Notes:

- This simple comparison of Chuhara and Khajoor only takes into account costs and returns relevant to the differences between them, i.e. immediately pre- and post-harvest. To arrive at a grower's gross margin, we would need to take into account growing costs, especially labor, land rent, replanting and so on. Because of the many different relationships between land owner, grower and contractor, more detailed gross margin analysis is very difficult. It is also difficult to include family labor.
- The price for Chuhara has been higher in 2012 owing to flood losses in previous years and low stocks.
- On average, the farmers in the Dhakki Growers' Cooperative Society have 2 hectares of date orchard. Yield before drying is estimated at 12.5 t/ha = 25 t/grower
- Weight loss through drying and through discarding spoiled and low grade fruit is estimated at 60%, i.e. 25 tons gross yield is reduced to 10 tons net yield per farmer. The weight loss in drying may be a little more for Chuhara and less for Khajoor, but Khajoor will require more rigorous grading. No allowance has been made for income from outgrades.
- The cost of harvest is based on the gross yield. The data is from descriptions of the date harvest in Khairpur, but is likely to be similar for Dhakki. However, dates are more sensitive to damage from handling at the Rutab stage than at the Khalal stage and we want high quality dates for the Khajoor market. Therefore picking costs have been doubled to reflect the extra care needed.
- The cost of packaging is a guess but it is highly significant. It will need to be revised once a marketing plan is put forward by the marketing agent with a design for a market pack.
- Transport for Chuhara is by truck to Khairpur. For Khajoor it would be local.
- An agent marketing Khajoor for 20 growers would earn Rs.2m or Rs. 167,000 per month.

Annex 3 Potato

There are four main interventions planned for potatoes:

- Collaboration with PepsiCo/Lay's in improving potato transport in hot weather.
- Collaboration with Zamindara Seed Corporation, the Potato Growers' Society in Okara and farmers in KPK or Gilgit Baltistan to establish a modern seed potato industry.
- Set up a private sector extension service for Okara potato growers.
- Protect ware potatoes from damaging early winter frosts.

PepsiCo/Lay's

Small reefers (20 ft) are most suited to the purpose of transporting potatoes or peaches. If produce is not chilled before loading, heavy-duty refrigeration equipment will be needed.

One reefer is estimated to cost USD 16,000. UAP plan to provide 10 on a cost sharing basis: USD 160,000.

Zamindara and Seed Production

The Pakistan potato seed industry is fragmented and unprofessional. The Potato Growers' Society in Okara wants to change that. Two years ago Zamindara Seed Corporation established a private tissue culture laboratory in Okara. The laboratory produces virus-free seed after weaning in a small tunnel. However the next step - bulking seed for use by growers - is missing. The best sites for seed potato growing are at high altitude in the north and west, for example in Batakundi in KPK. One more essential part of the potato business is also missing: good extension to growers.

Putting all these factors together, it is planned to support the expansion of Zamindara's business, partly through a grant for expanding the tissue culture laboratory and weaning tunnels and partly by guaranteeing a market for seed potatoes through the Potato Growers' Society. In return, Zamindara will provide extension services to growers purchasing their seed, mostly in and around Okara, and they will support a new industry of professional seed growers at high altitude.

In Batakundi and similar sites, mini-tubers or tissue cultured plantlets planted into the field will be the initial source of certified seed potato lots. This generation is sometimes called 'Nuclear' or 'Pre-Elite'. The Scottish seed potato names are given opposite²⁴. These lots will be multiplied through G1 to G8 and increased until a sufficient quantity is available for commercial use. During the increase process, the seed lots will be subjected to visual field inspections and disease testing. The number of generations in seed production will be limited, probably to 7 or 8.

The seed growers in Batakundi²⁵ are likely to be very small, probably averaging 0.4 ha each but this needs verifying. They will need to adopt a five year rotation to avoid build up of soil pests. It is proposed to offer support through KSS and FEGs to 500 farmers. However, no calculations have been done on the scale of seed production needed, the bulking rate per generation, the amount of land available and so on. It is suggested that a small working group is formed with representatives of Zamindara, the Potato Society, TAP Gilgit staff



²⁴ The terminology used to describe different generations varies from country to country and in the US, from state to state. 'G4' in Alaska is 'G3' in California and 'Elite 3' in Canada.

²⁵ Batakundi is on the main N15 Highway from Mansehra to Chilas and some 270 km north of Islamabad by road. It is at an elevation of 2,700m. As the consultant's geographical knowledge of North Pakistan is not very good, 'Batakundi' is used as a symbol for any suitable, high-altitude, accessible location in KPK, Gilgit Baltistan.

and lead farmers from Batakundi, possibly including the NGO responsible for the KSS. Their remit would decide the scale of production needed to support the potato industry with Basic seed.

For this budget, approximate calculations are as follows:

500 seed growers with 0.4 ha each will total 200 ha producing 5,000 tons²⁶ of seed potatoes per year.

If the seed rate for a ware crop is 2.4 t/ha this is sufficient for about 2,083 ha - a drop in the ocean in Okara!

To supply seed to the 60 growers proposed for an extension group below, more than 500 seed growers would be needed in Batakundi and other high elevation areas.

In other words, for every ware crop grower some 8-10 seed crop growers are needed.

This calculation does not allow for intermediate generations in bulking up seed. Sowing rate for seed production is much higher than for ware. A further 50 ha at least will be needed to take mini-tubers from Zamindara and have sufficient pre-basic seed for 200 ha of final seed production.

Private Sector Extension Service

Extension to growers in Okara is badly needed. As the growers are relatively large²⁷, a private sector extension scheme is proposed supported for 3 years on a reducing basis. One extension worker could cover approximately 20 growers, with visits every two weeks (fortnightly). S/he would also be knowledgeable on other common crops in the rotation, wheat, rice or maize. Thus 3 extensionists would cover 60 growers and about 2,250 ha or 75,000 tons of potatoes. It is proposed that a sum be made available for technical equipment for water use efficiency, integrated pest and disease management and an SMS information system.

²⁶ In Scotland, average seed production yield is 42.7 t/ha which is about 85% of ware yield. In Pakistan, yields of 25 t/ha should be achievable for seed production.

²⁷ Guessing at least 25 - 50 ha each

Frost Protection

To protect the ware crop from frost during bulking up, 100 growers will be supplied with 20 ha of fleece.

Table 9 Proposed Budget for Potato Intervention

Item	Grant Rs.	USD @Rs. 97
10 Reefer trucks to Lay's	15,520,000	160,000
Zamindara Challenge Grant	8,000,000	82,475
Batakundi Seed Potato Growers 500 @ Rs. 25,000	12,500,000	128,866
Seed potato stores for 1,250 tons 50 x 25 ton stores ²⁸	24,250,000	250,000
Okara Potato Growers' Society 3 Extension Workers Year One	1,800,000	18,557
Year Two	1,200,000	12,371
Year Three	600,000	6,186
Extension Equipment	2,000,000	20,618
Fleece: 100 x 20 ha = 20 million m ² 20m @ Rs. 65	1,300,000	13,402
Total	67,170,000	692,475

²⁸ 1,250 tons should be sufficient for 2 generations pre-basic seed. The 5,000 tons of basic or elite seed for Okara would only need short-term storage and if necessary, this could be rented in Okara itself.

Annex 4 Chili Drying and Storage

Yields and Prices

100kg of fresh chili dries to 30kg. A maund is 40kg. A good crop of dried chili is 25 maunds per acre. Thus a good crop is 8.25 t/ha fresh drying to 2.5 t/ha. National average yield is 1.7 t/ha.

At the mandi, a low price is Rs. 2,000 per maund (Rs. 50 / kg or USD 521 /tonne) and an average price is Rs. 4,000 per maund (Rs. 100 / kg or USD 1,042 / tonne).

In Karachi in November (mid-season for chilies), the retail price for dried round chilies was Rs. 650 / kg, a massive mark-up of 650%! Red chili powder was selling at Rs. 375 / kg - still a substantial mark-up. Green chilies were selling at about Rs. 39 / kg - equivalent to Rs. 129 / kg of dried product. Prices in Hyperstar in Lahore are in the table below:

Table 10 Chili prices in Hyperstar, Lahore

Product	Calculated Price - Rs /kg
Fresh Green Chilies	38 - 41
Dried Red Chilies (long)	330
Dried Red Chilies (round)	570
Red Chili Powder	380
Chili Flakes	390
Mitchell's Pizza Sauce (green)	254
Omaz Deli Tabasco (USA)	202
Key Chili Sauce (Karachi)	276 (/liter)
Shangri-La Chili Sauce (Karachi)	262
Dawn Chili Garlic Sauce (Lahore)	135

Thai chilies in overwrapped trays in HKB were selling at: red Rs. 2,910 and green Rs. 2,410 / kg.

The objective of the chili drying and storage project is to capture some of this added value.

All figures are based on production and storage of 150 tons of dried chili or 500 tons of fresh chili. This represents an area of 60 - 80 ha. There are some very large chili growers in Kunri: we met one with 120 ha - he would need two stores of his own. However, there are many smaller growers with, say, 5 ha and a group of 12 - 16 would be able to fill a store.

We have no figures for area needed to dry 500 tons of fresh chilies so we have guessed that we can spread 10 kg on 1 m² and it will take 7 days to dry them to 10% moisture. If chilies are harvested over 2 months or 60 days, then we can dry 8 - 9 batches of about 60 tons each and we will need matting to cover 6,000 m².

We have no figures for postharvest losses, but unless there is heavy rain during drying or an infestation of store insects, it is unlikely to be high. The biggest factor is the unavoidable 70% weight loss in drying.

Table 11, Chili Drying, Storage and Packing Project Budget

Item	Unit	Unit Cost Rs.	# Units	Total Rs. 1,000	Notes
Drying Mats	m ²	65	6,000	390	
Fleece or Tyvek	m ²	65	6,000	390	quote needed for fleece
Plastic crates 12kg (or bins 300 kg) with liners	Each	600	12,500	7,500	bins would be much cheaper but require handling equipment
Chili Store (150 tons)	Ton	26,000	150	3,900	
Incidentals - staff-room forklifts, pallets, hard-standing etc	Sum	1m	1	1,000	
Packhouse	Sum	2m	1	2,000	sorting and trimming chilies for processor
Total				15,180	

No estimate has been made of running costs (electricity and labor), but if capital items are written off over 5 years and 10 years for the store and packhouse, then the cost per dry chili would be Rs. 16.3 / kg. The current (mid-season) mandi price for dried ungraded chili is Rs.113 / kg. If growers could deliver sorted dry chili free of aflatoxin, would a processor pay Rs.150 / kg? A grower margin of Rs. 20 for 150 tons would be worth Rs. 3m or about USD 31,000.

Two MF 240 tractors equipped with rear-mounted forklifts would be a great addition to the harvest and storage project and allow transition to handling in bins.

Annex 5 Value Chain Worksheets

In the next pages, the following VC worksheets are included as examples for reference. They are all adapted from the complete set available to download with instructions from <http://www.meda.org/meda-technical-publications/value-chain> :

Worksheet #3 - Generic Version - Getting Ready – Outlining Information Sources and Requirements

Worksheet #4 - Getting Ready – Organizing Information

Worksheet #6 - Secondary Source Research Planning

Worksheet #10 - Key Informants - Interview Guide

Worksheet #13 - Grower - In-Depth Interview - planning

Worksheet #13 - Middlemen - In-Depth Interview - planning

Worksheet #13 - NGO -In-Depth Interview - planning

Worksheet #13 - Transporter - In-Depth Interview - planning

Worksheet #14 - Grower -In-Depth Interview - Guide

Worksheet #14 - Middlemen-In-Depth Interview - Guide

Worksheet #14 - NGO -In-Depth Interview - Guide

Worksheet #14 - Transporter - In-Depth Interview - Guide

Worksheet #15 - Grower- In-Depth Interview - Data Collection

Worksheet #20 - SME Growers - - Focus Group Discussion - planning

Worksheet #21 - SME Growers - Focus Group Discussion - Guide

Worksheet #22 - SME Growers - Focus Group Discussion - Data Collection

Worksheet #23 - SME Growers - Focus Group Discussion - Participants

Worksheet #3 Getting Ready – Outlining Information Sources and Requirements

Impact Goal:

To support improved conditions for broad-based economic growth, create employment opportunities and contribute to poverty alleviation through increase in competitiveness of the horticulture value chains in partnership with all stakeholders

Tentative Project Purpose:

- To strengthen the capacity in the horticulture value chains to increase sales to domestic and foreign markets;
- To strengthen the capacity of smallholders and farmer enterprises to operate autonomously and effectively; and
- To increase efficiency and productivity of growers through adoption of new farming techniques and technological innovation among targeted beneficiaries.

Research Questions	Information Required	Information Sources
<p>Project Purpose 1: <i>Capacity to increase sales to domestic and foreign markets</i></p> <p>What is the current capacity for fruit²⁹ production?</p> <p>What are price trends for fruits?</p> <p>Could yields and prices be increased?</p> <p>Could demand be increased?</p> <p>Which are the key export markets for each fruit?</p> <p>Who are the major exporters of fruit?</p> <p>Who are the major domestic buyers - supermarkets,</p>	<p>Where are fruits grown and how many hectares in each area?</p> <p>How many growers by size (area/volume)?</p> <p>Production volumes?</p> <p>Price trends?</p> <p>Population and income trends in major urban markets?</p> <p>Centers of and numbers in Pakistani diasporas?</p> <p>Name and contact information for key buyers and exporters?</p> <p>Where do large buyers, exporters and processors purchase fruit?</p>	<p>Small scale fruit growers, cooperatives³⁰ / producer groups, large growers</p> <p>Current buyers, wholesalers, and Fruit exporters.</p> <p>Arthis (Arrhti - spelling?),</p> <p>Thekadars, Arhatiyas and Beoparis</p> <p>Association of the Commission Agents (Anjuman Arhatiyan)</p> <p>Dukandars</p>

²⁹ Fruit is used to refer to mango, date, banana or peach - whichever is applicable.

³⁰ 'Cooperative' is used in this worksheet to include all forms of producer organisation, formal or informal

Research Questions	Information Required	Information Sources
<p>caterers, airlines, prepared meals?</p> <p>Who are the processors and what is consumption of fruit for processing?</p> <p>Are all the requirements of the market being met by SME producers and other VC stakeholders?</p>	<p>At the mandi?</p> <p>Direct from farmer or packhouse?</p> <p>What volume/value of fruit bypasses the mandi?</p> <p>What problems do consumers and buyers face in sourcing their requirements for these fruits?</p>	<p>Government / Provincial departments of agriculture, e.g. Directorate of Agriculture (E&M)</p> <p>Governmental statistic</p> <p>Overseas markets - London & Dubai</p> <p>Consumers (Household shoppers / cooks)</p>
<p>Project Purpose 2: <i>Capacity of SME farmers to operate autonomously and effectively</i></p> <p>How well are SME farmers organized? Are there men and women in farmer organizations or separate m/f organizations?</p> <p>How are contacts between growers and buyers made? How many steps are there between them and the consumer?</p> <p>Who owns or is responsible for the fruit at each stage of production? (What are the problems associated with growers selling fruit on the tree)</p> <p>What business training have large farmers or SME growers associations received?</p> <p>How are SME farmers financed?</p> <p>How are contacts between farmers and input suppliers made?</p>	<p>Number of farmers owning own land</p> <p>Number of farmers renting - landlord absent/present</p> <p>Types of farmer organization registered under GoP law</p> <p>Number of farmer cooperatives, producer groups, associations. Names and contact details?</p> <p>Membership numbers m/f.</p> <p>Types of contract between farmers and buyers:</p> <p>Bulk Collection centers</p> <p>Thekardars</p> <p>Direct supply to mandi</p> <p>Types of contract between other vertical links in the VC:</p> <p>Farmer training/extension:</p> <p>numbers receiving private/public extension. training and updating</p> <p>methods of extension used - number of FFS etc.</p>	<p>Small scale fruit growers, cooperatives / producer groups, large growers</p> <p>Current buyers, wholesalers, and Fruit exporters.</p> <p>Arthis (Arrhti - spelling?)</p> <p>Thekadars, Arhatiyas and Beoparis</p> <p>MFIs and SME lenders. Banks³¹</p> <p>NGOs & INGOs</p> <p>PHDEC</p> <p>Extension service</p> <p>Nurserymen and their association.</p> <p>Certification authority.</p>

³¹ GoP report on agricultural lending is very optimistic, but just how easy is it in fact for small businesses and farmers to get credit at reasonable terms without collateral?

Research Questions	Information Required	Information Sources
Is there an independent nursery certification scheme? What is role of government in nursery supply?	Savings and loan schemes, MFIs and bank lending. Methods of informal finance. How many farmers and SMEs use EasyPaesa?	
<p>Project Purpose 3: <i>Efficiency and productivity of growers through innovation.</i></p> <p>Benchmarking yields and prices - international and local. How do growers compare?</p> <p>Water use. What is product yield from irrigation - tons per cubic meter applied? Benchmark against other areas and countries.</p> <p>What are post-harvest losses compared to other countries?</p> <p>What are losses to pests and diseases?</p> <p>Contact between growers and research. How are the results of research disseminated to growers and how are researchers made aware of growers' research needs?</p> <p>How are results of international research conveyed to growers?</p> <p>How many new techniques have been introduced to fruit growers in the last 10 years?</p> <p>How do female growers access all of the above?</p>	<p>Yields and prices per region through season - graphed. Average yields by country. Competitor prices in selected international markets. Volume irrigation water (m³ /ha or mm applied). Irrigation data from competing countries. Estimate of post-harvest losses³². List of major pest and disease problems. Estimate of economic damage. Number of open days held by universities and research institutes and number of participants. What is extent and role of traditional extension in fruit? Number of fruit 'Kissans' (FFS). Average membership. Who are the facilitators - private or government? What other methods of knowledge and skill transfer are used by fruit growers? Radio, TV, Internet, SMS, Leaflets etc. Do input suppliers or traders provide advice? How is this factored into charges?</p>	<p>Small scale fruit growers, cooperatives / producer groups, large growers, female growers</p> <p>Kissans</p> <p>Current buyers, wholesalers, and Fruit exporters.</p> <p>Arthis (Arrhti / Arhatiya - spelling?)</p> <p>Thekadars, Arhatiyas and Beoparis</p> <p>Dukandars</p> <p>Universities and Research Institutes</p> <p>Public and private extension service</p> <p>NGOs and INGOs inc ACIAR & FVDP (Punjab)</p>

³² It is unlikely that there is reliable data for this. Could be a good field research project as part of M&E baseline survey.

Research Questions	Information Required	Information Sources
	Women's access to the above.	
Strengths and Constraints: What are the strengths of the four fruit value chains? What are common constraints in the fruit sector? Does the scale of production need to increase? Does quality need to improve? Which standards are used already and which others are needed? (GAP, SPS, FairTrade, Organic, Nursery certification, Ethical Trading, BRC/GFSI, GLP, MRLs) Does consistency need to improve? Do grading standards need to be enforced? Do local supermarkets, processors etc have written product specifications? Selling fruit on the tree transfers responsibility from the grower to the buyer; to what extent does this affect the quality of fruit available and orchard husbandry? What are constraints on importing modern equipment?	Competitive advantages of the four fruits. Constraints in the four fruit value chains How the price paid at each step in the VC is determined. Is sufficient fruit produced to satisfy market and export demand? Is there potential for import substitution for the four fruits? Options for selling a differentiated product and the process required, e.g. Yellow Dried Dates The standards to be met by high quality fruit Certification standards (public and private) Buyers' specifications (private) National grading standards (size and quality) Who enforces standards? Which ones are/not recognized internationally? Which standards are/not familiar to SMEs in the VC? Percentage of the crop sold on the tree. Stage at which fruit is sold. Import controls, tax, delays	Market analysis reports Government statistics - Government / Provincial departments of agriculture, e.g. Directorate of Agriculture (E&M) VC stakeholders - vertical links Overseas markets and retailers Local certification bodies for standards - if available GlobalGAP farmers BRC/GFSI packhouses GLP pesticide labs Nurserymen or their associations Other certification bodies Produce specifications from supermarkets - local and international National grading standards documentation - Pakistan, EU, other Market Inspectors? Growers and Thekadars Input suppliers

Research Questions	Information Required	Information Sources
Sustainable Solutions: What are potential solutions to production challenges? What kinds of solutions can address these identified constraints? What could interfere with the success and sustainability of the intervention? Can these solutions be sustainable? What mechanisms need to be put in place so that changes are sustained? Are there any benefits in the domestic high end market for SMEs with certification? Are there opportunities to extend the season? Would alternative finance reduce the practice of selling on the tree? Can GoP remove restrictions, delays, tax on imported ag machinery and equipment?	Solutions defined by small / large producers Support services that would be needed Inputs and technologies that would increase quality of produce or extend the season Documentation (translated) for certification process and requirements Inputs and support services needed to enable MSEs to meet standards e.g. Foundation nurseries, GLP accredited laboratories Demand for improved standards and certification in the domestic market. Alternative sources of finance currently available to growers.	Local horticultural specialists SME and large growers Input suppliers - pesticides, fertilizers, machinery, irrigation, cold storage, packhouse etc GlobalGAP CCPs Local certification bodies for standards - if available GlobalGAP farmers BRC/GFSI packhouses GLP pesticide labs Nurserymen or their associations Other certification bodies Produce specifications from supermarkets - local and international National grading standards documentation - Pakistan, EU, other MFIs, SME lenders and other sources of credit Consumers
Intervention Design: What might project do to enable VC actors to realize the opportunities? What linkages need to be created?	Types and strengths of linkages in current value chains List of local suppliers to high end markets including supermarkets (if any). Exporting enterprises able to provide linkage to	Horizontal and vertical VC actors Local supermarkets + Metro, Hyperstar, Spinneys Dukandars

Research Questions	Information Required	Information Sources
<p>Is it difficult to achieve certification for international / domestic sales (including processing)?</p> <p>How easy or difficult is it to sell to these markets once certification is achieved? Why?</p> <p>Is certification beneficial or harmful to producers?</p> <p>How can new sources of credit be incorporated into intervention design?</p> <p>Could a public/private partnership lead to new modern wholesale markets (mandis)?</p> <p>Could more international firms be persuaded to supply the Pakistan market? E.g. Packhouse equipment, processing, cold storage.</p>	<p>international markets serving a wider customer range than the Diaspora.</p> <p>International input suppliers exporting to Pakistan or willing to do so and provide skills and knowledge to local MSEs.</p> <p>Certification processes and costs</p> <p>Location and details of major mandis</p> <p>Trade volume</p> <p>Customers</p> <p>Sourcing</p> <p>Ownership / traders</p> <p>Legal situation</p> <p>Current SME sources of funds (banks, trade credit, MFIs, family etc.)</p> <p>How many farmers and SMEs use Easypaesa?</p>	<p>Reports of export initiatives e.g. Fruit Logistica, Tesco, Harrods</p> <p>Input manufacturers, suppliers and agents</p> <p>Certification bodies</p> <p>Government statistics</p> <p>Mandi / Arthis / Association of the Commission Agents (Anjuman Arhatiyan)</p> <p>SME lenders</p> <p>Easypaesa</p>
<p>Risk Identification and Mitigation:</p> <p>What constraints might small scale producers and other SMEs face?</p> <p>What support systems need to be in place for small scale producers?</p> <p>What external events could impact the success of the project?</p>	<p>Constraints identified by producers and SMEs</p> <p>Systems that can mitigate risks for small producers (e.g. crop insurance, producers groups)</p> <p>External factors that could influence the project (e.g. political, climate change)</p>	<p>Producers and cooperatives</p> <p>NGOs working in sector</p> <p>Exporting enterprises</p> <p>Academic sources</p>
<p>Logical Framework / Indicators:</p> <p>Baseline information</p>	<p>Prices paid to producer for fruit</p> <p>Prices paid to thekadar and other stakeholders in the VC</p>	<p>Producers and cooperatives</p> <p>Exporting enterprises</p>

Research Questions	Information Required	Information Sources
<p>What are the current incomes of producers by size?</p> <p>What is profitability of other vertical links in the VC?</p> <p>What prices are paid for their product at each vertical transaction?</p> <p>What is the cost of inputs to producers?</p> <p>Environmental assessment and impact of productive activities.</p>	<p>Price fluctuations and seasonality</p> <p>Costs of inputs for small and large producers</p> <p>Is there a discount for large purchases? (e.g. by a cooperative)</p> <p>Volume of fruit handled by mandis and alternative routes to high end domestic market</p> <p>Volume of fruit exported and prices</p> <p>How can environmental impacts be minimized (e.g. efficient use of irrigation water)³³</p>	<p>Irrigation experts</p> <p>Government statistics</p> <p>Mandi / Arthis / Association of the Commission Agents (Anjuman Arhatiyan)</p> <p>Large supermarkets</p> <p>EA report</p>
<p>Implementation Plan:</p> <p>How many large and medium sized enterprises are buying fruit from producers at a firm price?</p> <p>How many tekardars are buying fruit?</p> <p>How much fruit is sold through mandis on commission?</p> <p>What prices are these enterprises paying? Who negotiates with the exporting enterprises? How can costs of inputs be reduced?</p>	<p>Number of large and medium enterprises buying direct from producers or cooperatives at firm prices</p> <p>Throughput of tekardars and mandis</p> <p>Prices throughout the VC</p> <p>Costs of production and value addition in the VC</p>	<p>Producers and cooperatives</p> <p>Exporting enterprises</p> <p>Wholesalers</p> <p>Large supermarkets</p> <p>Government statistics</p> <p>Previous project reports</p>
Budget:		

³³ EA assessment is complete, but detail needed on water which is a major issue for horticulture

Worksheet #4 Getting Ready – Organizing Information

Impact Goal:

To support improved conditions for broad-based economic growth, create employment opportunities and contribute to poverty alleviation through increase in competitiveness of the horticulture value chains in partnership with all stakeholders

Tentative Project Purpose:

- To strengthen the capacity in the horticulture value chains to increase sales to domestic and foreign markets;
- To strengthen the capacity of smallholders and farmer enterprises to operate autonomously and effectively; and
- To increase efficiency and productivity of growers through adoption of new farming techniques and technological innovation among targeted beneficiaries.

Research Questions	Information Required	Findings	Research Questions Answers
Project Purpose 1: <i>Capacity to increase sales to domestic and foreign markets</i> What is the current capacity for fruit ³⁴ production? What are price trends for fruits? Could yields and prices be increased? Could demand be increased? Which are the key export markets for each fruit? Who are the major exporters of fruit?	Where are fruits grown and how many hectares in each area?		
	How many growers by size (number/district area)?		
	Production volumes?		
	Price trends?		
	Population and income trends in major urban markets?		
	Centers of and numbers in Pakistani		

³⁴ Fruit is used to refer to mango, date, banana or peach - whichever is applicable.

Research Questions	Information Required	Findings	Research Questions Answers
<p>Who are the major domestic buyers - supermarkets, caterers, airlines, prepared meals?</p> <p>Who are the processors and what is consumption of fruit for processing?</p> <p>Are all the requirements of the market being met by SME producers and other VC stakeholders?</p>	diasporas?		
	Name and contact information for key buyers and exporters?		
	Where do large buyers, exporters and processors purchase fruit? At the mandi? Direct from farmer or packhouse?		
	What volume/value of fruit bypasses the mandi?		
	What problems do consumers and buyers face in sourcing their requirements for these fruits?		

Research Questions	Information Required	Findings	Research Questions Answers
<p>Project Purpose 2: <i>Capacity of SME farmers to operate autonomously and effectively</i></p> <p>How well are SME farmers organized? Are there men and women in farmer organizations or separate m/f organizations?</p> <p>How are contacts between growers and buyers made? How many steps are there between them and the consumer?</p> <p>Who owns or is responsible for the fruit at each stage of production? (What are the problems associated with growers selling fruit on the tree)</p> <p>What business training have large farmers or SME growers associations received?</p> <p>How are SME farmers financed?</p> <p>How are contacts between farmers and input suppliers made?</p> <p>Is there an independent nursery certification scheme? What is role of government in nursery supply?</p>	Number of farmers owning own land Number of farmers renting - landlord absent/present		
	Types of farmer organization registered under GoP law		
	Number of farmer cooperatives, producer groups, associations. Names and contact details? Membership numbers m/f.		
	Types of contract between farmers and buyers: Bulk Collection centers Thekardars Direct supply to mandi		
	Types of contract between other vertical links in the VC:		
	Farmer training/extension: Numbers receiving private/public extension. training and updating methods of extension used - number of FFS etc.		

Research Questions	Information Required	Findings	Research Questions Answers
	Savings and loan schemes, MFIs and bank lending. Methods of informal finance.		
	How many farmers and SMEs use Easypaesa?		

Research Questions	Information Required	Findings	Research Questions Answers
<p>Project Purpose 3: <i>Efficiency and productivity of growers through innovation.</i></p> <p>Benchmarking yields and prices - international and local. How do growers compare?</p> <p>Water use. What is product yield from irrigation - tons per cubic meter applied? Benchmark against other areas and countries.</p> <p>What are post-harvest losses compared to other countries?</p> <p>What are losses to pests and diseases?</p> <p>Contact between growers and research. How are the results of research disseminated to growers and how are researchers made aware of growers' research needs?</p> <p>How are results of international research conveyed to growers?</p> <p>How many new techniques have been</p>	<p>Yields and prices per region through season - graphed.</p> <p>Average yields by country.</p> <p>Competitor prices in selected international markets.</p>		
	<p>Volume irrigation water (m³ /ha or mm applied). Irrigation data from competing countries.</p>		
	<p>Estimate of post-harvest losses³⁵.</p>		
	<p>List of major pest and disease problems.</p> <p>Estimate of economic damage.</p>		
	<p>Number of open days held by universities and research institutes and number of participants.</p>		
	<p>What is extent and role of traditional extension in fruit?</p>		

³⁵ It is unlikely that there is reliable data for this. Could be a good field research project as part of M&E baseline survey.

Research Questions	Information Required	Findings	Research Questions Answers
<p>introduced to fruit growers in the last 10 years?</p> <p>How do female growers access all of the above?</p>	Number of fruit 'Kissans' (FFS). Average membership. Who are the facilitators - private or government?		
	What other methods of knowledge and skill transfer are used by fruit growers? Radio, TV, Internet, SMS, Leaflets etc.		
	Do input suppliers or traders provide advice? How is this factored into charges?		
	Women's access to the above.		

Research Questions	Information Required	Findings	Research Questions Answers
Strengths and Constraints: What are the strengths of the four fruit value chains? What are common constraints in the fruit sector? Does the scale of production need to increase? Does quality need to improve? Which standards are used already and which others are needed? (GAP, SPS, FairTrade, Organic, Nursery certification, Ethical Trading, BRC/GFSI, GLP, MRLs) Does consistency need to improve? Do grading standards need to be enforced? Do local supermarkets, processors etc have written product specifications? Selling fruit on the tree transfers responsibility from the grower to the buyer; to what extent does this affect the quality of fruit available and orchard husbandry? What are constraints on importing modern equipment?	Competitive advantages of the four fruits.		
	Constraints in the four fruit value chains		
	How the price paid at each step in the VC is determined.		
	Is sufficient fruit produced to satisfy market and export demand?		
	Is there potential for import substitution for the four fruits?		
	Options for selling a differentiated product and the process required, e.g. Yellow Dried Dates		
	The standards to be met by high quality fruit Certification standards (public and private) Buyers’ specifications (private) National grading standards (size and quality)		
	Who enforces standards? Which ones are/not recognized internationally?		
	Which standards are/not familiar to SMEs in the VC?		
	Percentage of the crop sold on the tree.Stage at which fruit is sold. Import controls, tax, delays		

Research Questions	Information Required	Findings	Research Questions Answers
Sustainable Solutions: What are potential solutions to production challenges? What kinds of solutions can address these identified constraints? What could interfere with the success and sustainability of the intervention? Can these solutions be sustainable? What mechanisms need to be put in place so that changes are sustained? Are there any benefits in the domestic high end market for SMEs with certification? Are there opportunities to extend the season? Would alternative finance reduce the practice of selling on the tree? Can GoP remove restrictions, delays, tax on imported ag machinery and equipment?	Solutions defined by small / large producers		
	Support services that would be needed		
	Inputs and technologies that would increase quality of produce or extend the season		
	Documentation (translated) for certification process and requirements		
	Inputs and support services needed to enable MSEs to meet standards e.g. Foundation nurseries, GLP accredited laboratories		
	Demand for improved standards and certification in the domestic market.		
	Alternative sources of finance currently available to growers.		

Research Questions	Information Required	Findings	Research Questions Answers
Intervention Design: What might project do to enable VC actors to realize the opportunities? What linkages need to be created? Is it difficult to achieve certification for international / domestic sales (including processing)? How easy or difficult is it to sell to these markets once certification is achieved? Why? Is certification beneficial or harmful to producers? How can new sources of credit be incorporated into intervention design? Could a public/private partnership lead to new modern wholesale markets (mandis)? Could more international firms be persuaded to supply the Pakistan market? E.g. Packhouse equipment, processing, cold storage.	Types and strengths of linkages in current value chains		
	List of local suppliers to high end markets including supermarkets (if any).		
	Exporting enterprises able to provide linkage to international markets serving a wider customer range than the Diaspora.		
	International input suppliers exporting to Pakistan or willing to do so and provide skills and knowledge to local MSEs.		
	Certification processes and costs		
	Location and details of major mandis Trade volume Customers Sourcing Ownership / traders Legal situation		
	Current SME sources of funds (banks, trade credit, MFIs, family etc.)		
	How many farmers and SMEs use Easypaesa?		

Research Questions	Information Required	Findings	Research Questions Answers
Risk Identification and Mitigation: What constraints might small scale producers and other SMEs face? What support systems need to be in place for small scale producers? What external events could impact the success of the project?	Constraints identified by producers and SMEs		
	Systems that can mitigate risks for small producers (e.g. crop insurance, producers groups)		
	External factors that could influence the project (e.g. political, climate change)		

Research Questions	Information Required	Findings	Research Questions Answers
Logical Framework / Indicators: Baseline information What are the current incomes of producers by size? What is profitability of other vertical links in the VC? What prices are paid for their product at each vertical transaction? What is the cost of inputs to producers? Environmental assessment and impact of productive activities.	Prices paid to producer for fruit		
	Prices paid to thekadar and other stakeholders in the VC		
	Price fluctuations and seasonality		
	Costs of inputs for small and large producers		
	Is there a discount for large purchases? (e.g. by a cooperative)		
	Volume of fruit handled by mandis and alternative routes to high end domestic market		
	Volume of fruit exported and prices		
	How can environmental impacts be minimized (e.g. efficient use of irrigation water) ³⁶		

³⁶ EA assessment is complete, but detail needed on water which is a major issue for horticulture

Research Questions	Information Required	Findings	Research Questions Answers
Implementation Plan: How many large and medium sized enterprises are buying fruit from producers at a firm price? How many tekardars are buying fruit? How much fruit is sold through mandis on commission? What prices are these enterprises paying? Who negotiates with the exporting enterprises? How can costs of inputs be reduced?	Number of large and medium enterprises buying direct from producers or cooperatives at firm prices		
	Throughput of tekardars and mandis		
	Prices throughout the VC		
	Costs of production and value addition in the VC		
Budget:			

Worksheet #6 Secondary Source Research – Planning

Lead Researcher and Reviewer - Names	Rupert Knowles + Hort Team	
Start Date for Research:	November 6	Deadline for Report: November 5
Research Questions	Information Sources	
<p><i>Value Chains</i></p> <p>How were the four VCs selected from the original list of 16?</p>	<p>Project Staff</p> <p>Project report</p> <p>FIRMS Mango Briefing Book</p>	
<p><i>National Consumers</i></p> <p>Demographic by income / wealth?</p> <p>Rural / Urban?</p> <p>Private / Business (canteens, hotels etc.) / Public (hospitals, schools, ministries etc)</p> <p>(Note: Once we know approx details of population groups, the growers have to decide which groups to target. The project can facilitate this decision process.)</p>	GoP Statistics	
<p><i>Fruit Retailing - national</i></p> <p>How are fruit retailers classified?</p> <p>Market share of retail types?</p>	<p>GoP statistics</p> <p>Trade body statistics</p> <p>Project staff knowledge</p> <p>PAMCO reports?</p> <p>National grading standards documentation - Pakistan, EU, other</p>	
<p><i>Fruit Export</i></p> <p>Tonnage and value of exports of each of the four fruits by destination?</p> <p>Result of recent promotions - Fruit Logistica, Harrods, Tesco?</p> <p>How many farms, packhouses, laboratories etc. are certified to relevant standards?</p> <p>How many producers/organizations are FairTrade or Organic certified?</p>	<p>GoP statistics</p> <p>PHDEC reports</p> <p>PAMCO reports?</p> <p>Key Informant interview</p> <p>Produce specifications from supermarkets - local and international</p> <p>GlobalGAP CPCCs</p> <p>BRC/GFSI standards</p> <p>Reports of export initiatives e.g. Fruit</p>	

	Logistica, Tesco, Harrods
<p><i>Vertical Linkages</i></p> <p>Who are the stakeholders between grower and customer?</p> <p>What is the nature of the linkage?</p>	<p>Detailed Report on Agricultural Marketing by A. F. Ferguson & Co under the ADB Punjab Resource Management Program (PRMP).</p> <p>Where to get corroboration?</p>
<p><i>Producers</i></p> <p>Demographic by acreage. (Who grows what where, and how large are they?)</p> <p>Number of farmers owning own land?</p> <p>Number of farmers renting - landlord absent/present?</p> <p>Number of registered farmer organizations disaggregated by type (cooperatives, producer groups, farming companies, associations, Kissan/Farmer Field Schools, buying groups etc)</p> <p>Names and contact details of above where available or where situated in project fruit clusters.</p> <p>Membership of above disaggregated by gender.</p> <p>What is the current capacity for fruit production?</p> <p>How does Pakistani fruit production compare benchmarked against similar countries? Pest and disease control? Post-harvest losses? Water Use Efficiency?</p> <p>How many farm workers are employed working on the four fruit crops? Breakdown by:</p> <p style="padding-left: 40px;">Full time / part time / seasonal (casual)</p> <p style="padding-left: 40px;">Male / female</p> <p>Same question for packhouse and processing factory workers</p>	<p>GoP statistics</p> <p>Provincial DoA statistics</p> <p>Ministry of Commerce statistics</p> <p>FAO statistics</p> <p>Project staff</p> <p>Other project reports e.g. FIRMS</p> <p>‘Review of Agriculture Policy Making in the Punjab’ Report to DoA by TAMA</p>
<p><i>Inputs</i></p> <p>Who are input suppliers?</p> <p style="padding-left: 40px;">Size, distribution, sector</p> <p style="padding-left: 40px;">Are there trade associations?</p> <p>How do input VCs work? Importers, Manufacturers, Wholesalers, Retailers?</p> <p>Tax and duty on inputs?</p>	<p>Trade Directory</p> <p>Ministry of Commerce / Chamber of Commerce</p> <p>Project Staff</p>

<p><i>Support Services</i></p> <p>Who are main lenders to horticulture VCs?</p> <p>Infrastructure Investment programs? (e.g. rural electricity supply, irrigation water - dams and canals, Mandis)</p> <p>Water Abstraction controls?</p> <p>Extension and training service providers, in addition to K/FFS?</p> <p>Research Institutions - Universities and Institutes?</p> <p>Education providers - universities, technical and vocational institutions?</p> <p>Which standards are used already and which others are needed? (GAP, SPS, FairTrade, Organic, Nursery certification, Ethical Trading, BRC/GFSI, GLP, MRLs). Is training or certification available locally or through international agencies?</p>	<p>Project staff</p> <p>Press releases</p> <p>Key informants</p> <p>GoP statistics and websites</p> <p>Market analysis reports</p>
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Worksheet #10 Key Informant Interviews – Interview Guide

Name and Role of Respondent	
Welcome, Introductions	<p>Greet the Respondent with a handshake</p> <p>Introduce the team, explain their roles and thank the respondent for meeting you.</p> <p>Begin with informal conversation that permits the interviewers and respondent to become acquainted. Appropriate conversations include family, jobs, the weather, and do not include either international or national politics.</p> <p>Offer the respondent water, coffee or tea and provide a light snack.</p>
Starting the Session	<p>Provide a brief introduction to the project and be sure to use visuals in explaining the project where possible</p> <p>Describe the goals of the project and how the respondent can contribute to their realization.</p> <p>Explain why the respondent was chosen and the importance of his/her contribution.</p> <p>Make sure the respondent understands that the session will be confidential.</p> <p>Explain that you will be taking notes so that you can remember later what was said.</p> <p>To develop rapport with the interviewee, ask about the current state of the agriculture sector and of expected crop or harvest conditions.</p>
Detailed Research Questions	Interview Questions
What are the primary production zones and their volumes?	Date
	Peach
	Potato
	Chili

In Pakistan, what products are made from this crop?	Date
	Peach
	Potato
	Chili
<p>What are the primary domestic markets?</p> <p>Role of women in the domestic markets ... Levels and Extent they are involved</p> <p>How does the VC function from producer to consumer for the 4 crops?</p> <p>Could these markets absorb more product?</p> <p>To what extent do you think supermarkets will replace traditional distribution channels?</p>	Date
	Peach
	Potato
	Chili

<p>What are the primary export markets?</p> <p>Who are the major purchasing countries? What products do they purchase? Fresh/Processed? At what prices? How has this evolved?</p>	Date
	Peach
	Potato
	Chili

<p>What are the characteristics of the major exporting firms? What is their ownership structure? Where are they located? How do they operate?</p>	Date
	Peach
	Potato
	Chili
<p>What is predicted over the next 5 years for sales volumes, prices, primary production zones, and improvements in quality?</p>	Date
	Peach
	Potato
	Chili
<p>Do you think that the way production is currently structured is suitable to serve domestic and export markets efficiently?</p> <p>What constraints are holding the industry back?</p> <p>What external events could impact the success of the project?</p>	Date
	Peach
	Potato
	Chili
<p>Concluding the Interview</p>	<p>Reiterate the respondent's main points.</p> <p>Solicit any final comments from respondent related to the interview</p>

Wrap-Up	<p>Thank the respondent for his/her time and contributions.</p> <p>Explain what will happen with the information he/she has provided and emphasize how the information will contribute to the project.</p> <p>Explain the next steps he can expect from the project and what next steps or support he should not expect from the project (to avoid building unrealistic expectations).</p> <p>Allow time for informal conversation and do not rush the respondent to leave.</p> <p>Thank the respondent again.</p> <p>Walk the respondent out and say goodbye with a handshake (if between men)</p>
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Worksheet #13 In-Depth Interviews - Grower - Planning

(One per type of enterprise / stakeholder to be interviewed)

Research Team: Names and Roles	
Interviewers: Names and Roles	
Type of Respondents	Grower
Research Questions	Detailed Questions
What is farmer/grower's production and income? <i>(the answers to these questions will indicate whether technical or management training is required)</i>	How many hectares do you farm? Do you own or rent your farm? How often do you see your landlord? What crops do you grow? Area of each? How many tons/kilos/other weight of each did you produce last year? Can you give a rough estimate of your average yield for dates/peaches/potatoes/chilies? How does this compare with your neighbors? Who did you sell to? Was it at harvest? Pre-harvest? Out of store? How much did he pay? Did he honor the contract? What does it cost per hectare / per ton / per kilo to grow dates / peaches / potatoes / chilies?
How well are SME farmers organized? Are there men and women in farmer organizations or separate m/f organizations?	Are you a member of a farmer groups or associations? What type/purpose? (E.g. FFS, KFS, FEG, Lead Farmer, Producer Group, Purchasing group, Cooperative) Do you market through a group or independently? How did you join the group? How much did it cost to join? How is your group financed? (e.g. membership fees, % on trading, commercial activities) How many farmers in the group? Who are the officers? Does the group employ any professional staff (e.g. administrator, accountant, salesman, adviser, buyer)? If not, who performs these functions? Are there men and women in the group? What challenges do you think Women FAs face in production?
<i>For Group Members</i> How does group marketing function?	Do you have to take your produce to a collection center or packhouse? Or, do they collect from your farm? Describe the marketing approach used by your group. Do they operate through the traditional Mandi system, or have they found an alternative? Do you get a fair price from the group? Do they negotiate prices for inputs and outputs collectively? Who does this on members' behalf? Do they employ professional marketers? If so, what sort of person? Do they receive business training? Do you borrow money from the group to pay for inputs? Is there a savings and loan scheme?
<i>For Independents</i> How are contacts between growers and buyers made? How many steps are there between them and the consumer?	Who buys your produce? Can you explain the system? When do you sell your produce? During the growing season? At harvest? Out of store? Do you get a fair price? How do you think you could improve the price you get?
What business training have large farmers or SME growers received?	Have you ever written a business plan for your enterprise/farm? Have you ever received training in business, marketing or management?
What training / extension do you receive?	Are you a member of a FFS, KFS? What is average attendance? How many sessions do you attend in one year? Who are the facilitators (NGO staff, Gov Ext)? Do women participate in FFS/KFS? If no, what are the reasons behind no / less participation ? Are you connected with government extension, research, universities, institutes (open days and demos)? Do you use TV, Radio, SMS, leaflets/newsletters etc. to keep up to date? Where else do you get information, advice, extension?

How do farmers get credit and get paid for produce?	<p>Do you need credit and if so where do you get it? Do you have a bank account? Do you take a bank loan? Do you sell your crop pre-harvest?</p> <p>Are you part of a savings and loans schemes?</p> <p>What other credit is available to you? (<i>Input supplier, arthi, family, village shop, MFI, bank</i>)</p> <p>Do you get finance through a group?</p> <p>Do you use EasyPaesa?</p> <p>Do you experience problems getting paid for produce?</p> <p>Have you ever received a grant from government / project / NGO?</p>			
How do you increase the efficiency and productivity of your farm?	<p>How do you compare yields with other farmers? Do you benchmark your farm against other farmers? How? (<i>formal or informal system</i>)</p> <p>Have you introduced any new varieties, equipment, techniques to your farm in the last 10 years? What? When?</p> <p>Have you made any attempt to reduce post-harvest losses?</p> <p>Do you ever meet with researchers? How? (<i>Open days, farm visits</i>)</p> <p>What pest and disease problems do you have in your crops? If so how do you diagnose and solve them?</p> <p>What sort of irrigation system do you use? (<i>flood, furrow, basin, sprinkler, drip</i>)? Have you invested in any new irrigation equipment or system? Have you received irrigation training? How often do you irrigate? How do you decide when to irrigate and how much water to apply?</p> <p>What standards or certification schemes have you heard of and have you applied for accreditation? (<i>e.g. GlobalGAP, grading</i>)</p> <p>Is it easy to buy good seed / saplings? Where from? Do they provide advice? How much do they cost? How do you know the seeds or saplings are good? (<i>visit nursery, certification, visit trials</i>)</p>			
What are the strengths of the sector you are working in?	<p>If you grew a bigger crop (<i>improved your yield, increased your acreage</i>), could you sell it easily?</p> <p>Is your fruit/vegetable better than other growers'?</p> <p>Could you do anything to your produce to make it more valuable? (<i>e.g. change packaging, process it, grow it out of season - in tunnel, improve quality / size</i>)</p>			
What are the weaknesses of the sector you are working in?	<p>What are your three most important problems or challenges?</p> <p>How have/will you solve them?</p> <p>What support services do you think you need most and how can you access them? (<i>e.g. more research, cold storage, drying or processing plants, easier credit, capital grants</i>)</p>			
Schedule of In-Depth Interviews	Place	Name or# of Interviews	Date	Time

Tasks to be Completed		Person Responsible	Deadline
	Task#1 Selecting locations and specific respondents (if applicable)		
	Task#2 Informing communities or arranging appointments as appropriate		

	Task#3 Interview guide		
	Task #4 Recording device, transportation		
	Other		

Worksheet #13 In-Depth Interviews - Middlemen - Planning

(One per type of enterprise / stakeholder to be interviewed)

Research Team: Names and Roles	
Interviewers: Names and Roles	
Type of Respondents	MIDDLEMEN - Arthis, Tekardars, Pharia etc.
Research Questions	Detailed Questions
What is middleman's business and how does it work?	<p>Whose produce do you handle (<i>buy or sell</i>)? How many growers?</p> <p>Where does it come from? (<i>Geographical area</i>)</p> <p>Do you operate as a company, partnership or sole trader? Describe your business set-up.</p> <p>What crops do you handle?</p> <p>How many tons/kilos/other weight of each did you handle last year?</p> <p>Can you give a rough estimate of the farmers' average yield for dates/peaches/potatoes/chilies?</p> <p>If you bought directly from a farmer, was it at harvest? Pre-harvest (<i>when</i>)? Out of store?</p> <p>Who did you sell to? (<i>Pharia, street vendor, small Shopkeeper, local supermarket, international supermarket, exporter, processor, caterer or institution e.g. army, school or hospital</i>)</p> <p>From memory, can you give some examples of prices you paid and prices you received for dates, peaches, potatoes or chilies?</p> <p>Have prices risen or fallen in recent years? Examples?</p>
How does Tekardar business work?	<p>What is the difference between Thekadars, Arhatiyas and Beoparis?</p> <p>If you bought produce pre-harvest, at what stage did you buy it?</p> <p>How did you agree a price with the farmer? What flexibility was there in the contract?</p> <p>What work did you do or organize in the field and what did the farmer do after the deal? (<i>e.g. Who did spraying, irrigation, harvesting etc.</i>)</p> <p>By purchasing fruit pre-harvest, you were effectively lending the farmer money on the security of the crop. Did you finance this yourself or did you borrow the money from another person (<i>e.g. an arthi</i>)?</p> <p>What security (collateral) does the arthi demand from you?</p> <p>Does the arthi deduct the money lent to you from the proceeds of the sale or is there some other method for loan repayment?</p> <p>Do you always sell through an arthi or do you also sell direct to exporters, processors or local retailers?</p> <p>What costs do you incur in your business both in the field and in marketing? (<i>E.g. Who pays and how much for harvest labor, transport, packaging?</i>)</p> <p>What capital equipment do you need for your business? (<i>e.g. picking ladders, tractor, road transport</i>)</p> <p>What sort of problems do you have dealing with farmers? Do they honor their side of the deal?</p> <p>Are there any female tekardars in your area? (<i>If so, get contact details and try to arrange interview for Irnum</i>)</p>
How does Arthi business work?	<p>Do you own your pitch (sales stand) in the market? How big is your pitch? Do you have pitches in other markets?</p> <p>I understand that you sell produce on commission. Do you ever buy produce yourself to sell? Is this legal?</p> <p>It seems that commission rates are fairly standard around 13%. Is that correct? Is that traditional or controlled by government? Is there any competition between arthis offering to sell at lower rates? Do you charge a handling fee as well (<i>Rs/box</i>)?</p> <p>Do you lend money to tekardars to finance their purchases from farmers? What rate of interest? Or, if it is Islamic lending, how do you recover the cost of lending and the risk factor?</p> <p>What costs do you incur in your business? (<i>Do you pay the porters? Auctioneers? Market rent?</i>)</p> <p>Do you only sell to pharias or can anyone bid for produce at an auction?</p> <p>When does settlement take place? Do you pay the tekardar or grower immediately?</p> <p>When does the pharia or buyer pay you?</p>

	<p>Is payment always in cash? What other methods of payment are used?</p> <p>What is the function of the Association of the Commission Agents (Anjuman Arhatiyani)?</p> <p>Do you know the total turnover for your mandi? Is it bigger or smaller than other mandis?</p> <p>Are there any female arthis in your market? <i>(If so, get contact details and try to arrange interview for Irnum)</i></p>
How does Pharia business work?	<p>Do you own or rent premises? Where - in the market, nearby or elsewhere? How large?</p> <p>Do you store produce there? If so, do you have refrigerated storage? Do you have premises in or near other markets?</p> <p>I understand that you buy produce at auction in the market. Who pays the arthi's commission - you or the seller?</p> <p>It seems that commission rates are fairly standard around 13%. Is that correct? Is that traditional or controlled by government? Is there any competition between arthis offering to sell at lower rates? Do they charge a handling fee as well <i>(Rs/box)</i>?</p> <p>Do you only buy at the auction or do you also buy direct from tekardars or growers?</p> <p>Do you lend or borrow money to finance your purchases? Who from? What rate of interest? Or, if it is Islamic lending, how do you recover the cost of lending and the risk factor?</p> <p>What costs do you incur in your business? <i>(Do you pay porters? Auctioneers? Rent? Transport?)</i></p> <p>Who did you sell to? <i>(other pharia or secondary wholesaler, street vendor, small shopkeeper, local supermarket, international supermarket, exporter, processor, caterer or institution e.g. army, school or hospital)</i></p> <p>How do you find new customers? <i>(Advertising, personal contact, internet)</i></p> <p>From memory, can you give some examples of prices you paid and prices you received for dates, peaches, potatoes or chilies?</p> <p>Do you pay the auction, tekardar or grower immediately? When do your customers pay you?</p> <p>Is payment always in cash? What other methods of payment are used?</p> <p>Are there any female pharias in your area? <i>(If so, get contact details and try to arrange interview for Irnum)</i></p>
<i>For Group Members</i> How does group marketing function?	<p>Do you belong to any professional organization or group?</p> <p>What services and benefit does it provide? <i>(political pressure, information, research, commercial activity)</i></p> <p>What does it cost to join? How is it financed? Subscription? Trading? Selling services?</p> <p>Does the group undertake any collective buying or selling?</p>
What business training have you received?	<p>Have you ever written a business plan for your enterprise?</p> <p>Have you ever received training in business, marketing or management?</p>
What other training do you receive?	<p>Are you connected with government, research, universities, institutes <i>(open days and demos)</i>?</p> <p>Do you use TV, Radio, SMS, leaflets/newsletters etc. to keep up to date?</p> <p>Where else do you get information, advice?</p>
How do you get credit and get paid for produce?	<p>Do you need credit and if so where do you get it? Do you have a bank account? Do you take a bank loan?</p> <p>What other credit is available to you? <i>(arthi, family, MFI, bank)</i></p> <p>Can you get finance through a group?</p> <p>Do you use EasyPaesa?</p> <p>Do you experience problems getting paid for produce?</p> <p>Have you ever received a grant from government / project / NGO?</p>
How do you intend to increase the efficiency and profitability of your business?	<p>How do you compare prices with other middlemen?</p> <p>Have you introduced any new crops, equipment, techniques to your business in the last 10 years? What? When?</p> <p>Have you made any attempt to reduce post-harvest losses of produce when it is in your control?</p> <p>Have you considered entering a cold-chain or investing in refrigeration?</p> <p>What standards or certification schemes have you heard of and have you or your clients applied for accreditation? <i>(e.g. BRC, GFSI, GlobalGAP, HACCP, grading)</i></p> <p>Do you have access to the internet? How could it help you?</p>

What are the strengths of the sector you are working in?	If you could buy more produce, could you sell it easily? Is your fruit/vegetable better quality than other middlemen? Could you do anything to your produce to make it more valuable? (e.g. change packaging, process it, procure it out of season - in tunnel, improve quality / size)			
What are the weaknesses of the sector you are working in?	What are your three most important problems or challenges? How have/will you solve them? It has been proved by research that every time produce is handled or moved, quality is reduced. How can you reduce physical handling of produce to improve quality? Could handling be mechanized with pallets and forklifts? Could produce (especially peaches) be picked directly into market containers? Are you concerned about the future of the mandi system? Do you think trade will bypass it? If so, what would you do? What support services do you think you need most and how can you access them? (e.g. market research, cold storage, drying or processing plants, easier credit, capital grants)			
Schedule of In-Depth Interviews	Place	Name or# of Interviews	Date	Time

Tasks to be Completed		Person Responsible	Deadline
	Task#1 Selecting locations and specific respondents (if applicable)		
	Task#2 Informing communities or arranging appointments as appropriate		
	Task#3 Interview guide		
	Task #4 Recording device, transportation		
	Other		

Worksheet #13 In-Depth Interviews - NGO - Planning

(One per type of enterprise / stakeholder to be interviewed)

Research Team: Names and Roles	
Interviewers: Names and Roles	
Type of Respondents	NGO, Dev Contractor, Project
Research Questions	Detailed Questions
How well are SME farmers organized? Are there men and women in farmer organizations or separate m/f organizations?	Are you working with farmer groups or associations? What type/purpose? (<i>E.g. FFS, KFS, FEG, Lead Farmer, Producer Group, Purchasing group, Cooperative</i>) Do/Did you form the groups? How? Where? (<i>Top down / Bottom up</i>) Have you worked with the women farmers of the area? What interventions have been done and what are the challenges they have faced in carrying out different interventions.
How are contacts between growers and buyers made? How many steps are there between them and the consumer?	(<i>For marketing groups</i>) Describe the marketing approach used by your groups. Do they operate through the traditional Mandi system, or have they found an alternative? Do they negotiate prices for inputs and outputs collectively? Who does this on members' behalf? Do they employ professional marketers? If so, what sort of person?
What business training have large farmers or SME growers associations received?	What sort of business training have group members, officers and employees received? Do you offer business training or out-source it? How are groups financed? (<i>e.g. membership fees, % on trading, commercial activities</i>)
What training / extension do farmers receive in your programs?	Do you facilitate FFS, KFS? What is average membership? What is average attendance? How many sessions in one year? Who are the facilitators (<i>NGO staff, Gov Ext</i>)? What training do you provide specifically for women? Do they participate? Are farmers connected with government extension, research, universities, institutes (<i>open days and demos</i>)? Do you use TV, Radio, SMS, leaflets/newsletters etc for farmer training and updating? Where else do you think your farmers get information, advice, and extension?
How do farmers get credit and get paid for produce?	Do any of your farmer groups have savings and loans schemes? What other credit is available to your farmers? Through the group? Do any of your farmers use EasyPaesa? Do farmers experience problems getting paid for produce?
How do you help to improve the efficiency and productivity of your farmers?	Do you benchmark your farmers against each other or with outside farmers? Have you made any attempt to reduce post-harvest losses? Have you facilitated two way exchange with researchers? Have you encountered pest and disease problems? If so how were they solved? Have you worked to improve the efficiency of irrigation?
What are the strengths of the sector you are working in?	Can you give examples of success stories for your farmers? Other VC actors? How have you built on these successes?
What are the weaknesses of the sector you are working in?	Can you give examples of problems faced by your growers? Clients? How have they solved them? What support services are needed most and how can they be provided? (<i>e.g. more research, cold storage, drying or processing plants, easier credit, capital grants</i>) If you have worked with women, what are the key constraints they face?
Do you work with other stakeholders in the VC?	What other value chain actors do you work with? (<i>Exporters, Input suppliers, Tekardars, Arthis, Shop-keepers, women traders / processors etc</i>) Can you tell us about it?

Schedule of In-Depth Interviews	Place	Name or# of Interviews	Date	Time

Tasks to be Completed		Person Responsible	Deadline
	Task#1 Selecting locations and specific respondents (if applicable)		
	Task#2 Informing communities or arranging appointments as appropriate		
	Task#3 Interview guide		
	Task #4 Recording device, transportation		
	Other		

Worksheet #13 In-Depth Interviews - Transport - Planning

(One per type of enterprise / stakeholder to be interviewed)

Research Team: Names and Roles	
Interviewers: Names and Roles	
Type of Respondents	Transport Large Company CEO , owns several trucks and hires drivers Small transport business , owns and drives the truck, does not employ staff Other - specify:
Research Questions	Detailed Questions
What is transporter's business and how does it work?	Whose produce do you handle? How many growers? Where does it come from? (<i>Geographical area</i>) Where do you pick up produce? (<i>from the field, at the road side, from a collection center, from a refrigerated / non-refrigerated store?</i>) Do you operate as a company, partnership or sole trader? Describe your business set-up. How many tons / kilos / crates do your trucks carry? Are your trucks refrigerated? Open? Closed? Do you own or rent your trucks? What did you pay for your truck(s)? Did you buy new or secondhand? What crops do you handle? How many loads of each did you handle last year? Who and where did you deliver produce to? (<i>local supermarket, international supermarket, exporter, processor, mandi</i>) (<i>which city</i>) How much do you charge? Who pays for transport? (<i>Grower, tekardar, group, arthi.....?</i>) When do they pay? (<i>At collection of produce or after delivery</i>) Who loads and unloads the truck? (<i>driver, farmer, laborer, porter</i>) Do you use any mechanical handling equipment? (<i>forklift, hoist, barrow</i>) What sort of problems do you have dealing with farmers? Do they honor their side of the deal? Are there any female transporters / drivers in your area? (<i>If so, get contact details and try to arrange interview for Irnum</i>)
For Group Members How does group function?	Do you belong to any professional organization or group? What services and benefit does it provide? (<i>political pressure, information, research, commercial activity</i>) What does it cost to join? How is it financed? Subscription? Trading? Selling services? Does the group undertake any collective buying or selling?
What business training have you received?	Have you ever written a business plan for your enterprise? Have you ever received training in business, marketing or management? Have you received training in careful handling of fruit? Vegetables? How are laborers / porters trained in loading and unloading trucks carefully?
How do you get credit?	Do you need credit and if so where do you get it? Do you have a bank account? Do you take a bank loan? What other credit is available to you? (<i>arthi, family, MFI, bank</i>) Can you get finance through a group? Do you use EasyPaesa? Do you experience problems getting paid for transport? Have you ever received a grant from government / project / NGO?
What are the strengths of the sector you are working in?	Do you have capacity to handle more produce? Is your business more efficient than other transporters? In what way?
What are the weaknesses of the sector you are working in?	What are your three most important problems or challenges? How have/will you solve them? It has been proved by research that every time produce is handled or moved, quality is reduced. How can you reduce physical handling of produce to improve quality? Could handling be mechanized with pallets and forklifts? What do you do out of season? Do you transport other goods and produce?

	What support services do you think you need most and how can you access them? (e.g. training, easier credit, capital grants)			
Schedule of In-Depth Interviews	Place	Name or# of Interviews	Date	Time

Tasks to be Completed		Person Responsible	Deadline
	Task#1 Selecting locations and specific respondents (if applicable)		
	Task#2 Informing communities or arranging appointments as appropriate		
	Task#3 Interview guide		
	Task #4 Recording device, transportation		
	Other		

Worksheet #14 In-Depth Interview Guide - Grower

(One per type of enterprise/stakeholder to be interviewed)

Type of Respondents	Grower
Welcome, Introductions	Thank the respondent for meeting with you. Introduce the team.
Starting the Session	Provide a simple explanation of the project. Make sure the respondent understands that the session will be confidential. Explain that you will be taking notes or using a recording device (if appropriate) so that you can later remember what was said. Start with a relatively general question that you think the respondent would be interested in saying something about.
Detailed Research Questions	Interview Questions
What is farmer's/grower's production and income?	How many hectares (<i>use farmer's unit</i>) do you farm?
	Do you own, share-crop or rent your farm? How often do you see your landlord?
	What crops do you grow? Area of each?
	How many tons/kilos/other weight of each did you produce last year?
	Can you give a rough estimate of your average yield for dates/peaches/potatoes/chilies? (<i>Kg/ha or farmer units</i>)
	How does this compare with your neighbors?
	Who did you sell to? Was it at harvest? Pre-harvest? Out of store?
	How much did he pay? Did he honor the contract?
	What does it cost per hectare / per ton / per kilo to grow dates / peaches / potatoes / chilies?
How well are SME farmers organized? Are there men and women in farmer organizations or separate m/f organizations?	Are you a member of a farmer groups or associations? What type/purpose? (<i>E.g. FFS, KFS, FEG, Lead Farmer, Producer Group, Purchasing group, Cooperative</i>) (<i>If no, go to independents' questions</i>)
	Do you sell through a group or independently?
	How did you join the group? How much did it cost to join?
	How is your group financed? (<i>e.g. membership fees, % on trading, commercial activities</i>)
	How many farmers in the group? Who are the officers?
	Does the group employ any professional staff (<i>e.g. administrator, accountant, salesman, adviser, buyer</i>)? If not, who performs these functions?
	Are there men and women in the group?
<i>For Group Members</i> How does group marketing function?	Do you have to take your produce to a collection center or packhouse? Or, do they collect from your farm?
	Describe the marketing approach used by your group.
	Do they operate through the traditional Mandi system, or have they found an alternative?
	Do you get a fair price from the group?
	Do they negotiate prices for inputs and outputs collectively?
	Who does this on members' behalf? Do they employ professional marketers? If so, what sort of person? Do they receive business training?
	Do you borrow money from the group to pay for inputs? Is there a savings and loan scheme?
<i>For Independents</i> How are contacts between	Who buys your produce? Can you explain the system?
	When do you sell your produce? During the growing season? At harvest? Out of

growers and buyers made? How many steps are there between them and the consumer?	store?
	Do you get a fair price?
	How do you think you could improve the price you get?
What business training have large farmers or SME growers received?	Have you ever written a business plan for your enterprise/farm?
	Have you ever received training in business, marketing or management?
What training / extension do you receive?	Are you a member of a FFS, KFS? What is average attendance? How many sessions do you attend in one year? Who are the facilitators (<i>NGO staff, Gov Ext</i>)?
	Are you connected with government extension, research, universities, institutes (<i>open days and demos</i>)?
	Do you use TV, Radio, SMS, leaflets/newsletters etc. to keep up to date?
	Where else do you get information, advice, extension?
	Where else do you get information, advice, and extension? (<i>e.g. input suppliers</i>)
How do farmers get credit and get paid for produce?	Do you need credit and if so where do you get it?
	Do you have a bank account? Do you take a bank loan?
	Do you sell your crop pre-harvest? To whom? At what stage?
	Are you part of a savings and loans schemes?
	What other credit is available to you? (<i>Input supplier, arthi, family, village shop, MFI, bank</i>)
	Do you get finance through a group?
	Do you use EasyPaesa?
	Do you experience problems getting paid for produce?
	Have you ever received a grant from government / project / NGO? What for? Building? Machinery? Trees?
How do you increase the efficiency and productivity of your farm?	How do you compare yields with other farmers?
	Do you benchmark your farm against other farmers? How? (<i>formal or informal system</i>)
	Have you introduced any new varieties, equipment, techniques to your farm in the last 10 years?
	What? When?
	Have you made any attempt to reduce post-harvest losses?
	How? (<i>cold chain, picker training, improved packaging, chemical treatment</i>)
	Do you ever meet with researchers? How? (<i>Open days, farm visits</i>)
	What pest and disease problems do you have in your crops?
	How do you diagnose and solve them?
	What sort of irrigation system do you use? (<i>flood, furrow, basin, sprinkler, drip</i>)?
	Have you invested in any new irrigation equipment or system?
	Have you received irrigation training?
	How often do you irrigate?
	How do you decide when to irrigate and how much water to apply?
	What standards or certification schemes have you heard of and have you used any or applied for accreditation? (<i>e.g. GlobalGAP, grading, FairTrade</i>)
	Is it easy to buy good seed / saplings?
	Where from?
	Do they provide advice?
	How much do they cost?
	How do you know the seeds or saplings are good? (<i>visit nursery, certification, visit trials</i>)

What are the strengths of the sector you are working in?	If you grew a bigger crop (<i>improved your yield, increased your acreage</i>), could you sell it easily?
	Is your fruit/vegetable better than other growers'?
	Could you do anything to your produce to make it more valuable? (<i>e.g. change packaging, process it, grow it out of season - in tunnel, improve quality / size</i>)
What are the weaknesses of the sector you are working in?	What are your three most important problems or challenges?
	How have/will you solve them?
	What support services do you think you need most and how can you access them? (<i>e.g. more research, cold storage, drying or processing plants, easier credit, capital grants</i>)
Concluding the Interview	<p>Reiterate the respondent's main points.</p> <p>Solicit any final comments from the respondent related to the interview.</p>
Wrap-Up	<p>Thank the respondent for his/her time and contributions.</p> <p>Explain what will happen with the information he/she has provided.</p> <p>Explain any other next steps he/she can expect from the project and what next steps or support he/she should not expect from the project (to avoid building unrealistic expectations).</p> <p>Thank the respondent again.</p>

Worksheet #14 In-Depth Interview Guide - Middlemen

(One per type of enterprise/stakeholder to be interviewed)

Type of Respondents	Middlemen
Welcome, Introductions	Thank the respondent for meeting with you. Introduce the team.
Starting the Session	Provide a simple explanation of the project. Make sure the respondent understands that the session will be confidential. Explain that you will be taking notes or using a recording device (if appropriate) so that you can later remember what was said. Start with a relatively general question that you think the respondent would be interested in saying something about.
Detailed Research Questions	Interview Questions
What is middleman's business and how does it work?	Whose produce do you handle (<i>buy or sell</i>)? How many growers?
	Where does it come from? (<i>Geographical area</i>)
	Do you operate as a company, partnership or sole trader? Describe your business set-up.
	What crops do you handle?
	How many tons/kilos/other weight of each did you handle last year?
	Can you give a rough estimate of the farmers' average yield for dates/peaches/potatoes/chilies?
	If you bought directly from a farmer, was it at harvest? Pre-harvest (<i>when</i>)? Out of store?
	Who did you sell to? (<i>Pharia, street vendor, small Shopkeeper, local supermarket, international supermarket, exporter, processor, caterer or institution e.g. army, school or hospital</i>)
	From memory, can you give some examples of prices you paid and prices you received for dates, peaches, potatoes or chilies?
	Have prices risen or fallen in recent years? Examples?
(For Tekardar interview only)	What is the difference between Thekaders, Arhatiyas and Beoparis?
	If you bought produce pre-harvest, at what stage did you buy it?
	How did you agree a price with the farmer? What flexibility was there in the contract?
	What work did you do or organize in the field and what did the farmer do after the deal? (<i>e.g. Who did spraying, irrigation, harvesting etc.</i>)
	By purchasing fruit pre-harvest, you were effectively lending the farmer money on the security of the crop. Did you finance this yourself or did you borrow the money from another person (<i>e.g. an arthi</i>)?
	What security (collateral) does the arthi demand from you?
	Does the arthi deduct the money lent to you from the proceeds of the sale or is there some other method for loan repayment?
	Do you always sell through an arthi or do you also sell direct to exporters, processors or local retailers?
	What costs do you incur in your business both in the field and in marketing? (<i>E.g. Who pays and how much for harvest labor, transport, packaging?</i>)
	What capital equipment do you need for your business? (<i>e.g. picking ladders, tractor, road transport</i>)
	What sort of problems do you have dealing with farmers? Do they honor their side of the deal?
	Are there any female tekardars in your area? (<i>If so, get contact details and try to arrange interview for Irnum</i>)
(For Arthi interview only)	Do you own your pitch (sales stand) in the market? How big is your pitch? Do you have pitches in other markets?

How does Arthi business work?	I understand that you sell produce on commission. Do you ever buy produce yourself to sell? Is this legal?
	It seems that commission rates are fairly standard around 13%. Is that correct? Is that traditional or controlled by government?
	Is there any competition between arthis offering to sell at lower rates?
	Do you charge a handling fee as well (<i>Rs/box</i>)?
	Do you lend money to tekardars to finance their purchases from farmers?
	What rate of interest? Or, if it is Islamic lending, how do you recover the cost of lending and the risk factor?
	What costs do you incur in your business? (<i>Do you pay the porters? Auctioneers? Market rent?</i>)
	Do you only sell to pharias or can anyone bid for produce at an auction?
	When does settlement take place? Do you pay the tekardar or grower immediately? When does the pharia or buyer pay you?
	Is payment always in cash? What other methods of payment are used?
	What is the function of the Association of the Commission Agents (Anjuman Arhatiyani)?
	Do you know the total turnover for your mandi? Is it bigger or smaller than other mandis?
	Are there any female arthis in your market? (<i>If so, get contact details and try to arrange interview for Irnum</i>)
(For Phara interview only) How does Pharia business work?	Do you own or rent premises? Where - in the market, nearby or elsewhere?
	How large? Do you store produce there?
	If so, do you have refrigerated storage?
	Do you have premises in or near other markets?
	I understand that you buy produce at auction in the market. Who pays the arthi's commission - you or the seller?
	It seems that commission rates are fairly standard around 13%. Is that correct? Is that traditional or controlled by government?
	Is there any competition between arthis offering to sell at lower rates? Do they charge a handling fee as well (<i>Rs/box</i>)?
	Do you only buy at the auction or do you also buy direct from tekardars, local markets or growers?
	Do you lend or borrow money to finance your purchases? Who from?
	What rate of interest? Or, if it is Islamic lending, how do you recover the cost of lending and the risk factor?
	What costs do you incur in your business? (<i>Do you pay porters? Auctioneers? Rent? Transport?</i>)
	Who did you sell to? (<i>other pharia or secondary wholesaler, street vendor, small shopkeeper, local supermarket, international supermarket, exporter, processor, caterer or institution e.g. army, school or hospital</i>)
	How do you find new customers? (<i>Advertising, personal contact, internet</i>)
	From memory, can you give some examples of prices you paid and prices you received for dates, peaches, potatoes or chilies?
	Do you pay the auction, tekardar or grower immediately? When do your customers pay you?
For Group Members How does group function?	Is payment always in cash? What other methods of payment are used?
	Are there any female pharias in your area? (<i>If so, get contact details and try to arrange interview for Irnum</i>)
	Do you belong to any professional organization or group?
	What services and benefit does it provide? (<i>political pressure, information, research, commercial activity</i>)

	What does it cost to join? How is it financed? Subscription? Trading? Selling services?
	Does the group undertake any collective buying or selling?
What business training have you received?	Have you ever written a business plan for your enterprise?
	Was it for your own use or was it demanded by a bank or other organization?
	Have you ever received training in business, marketing or management?
What other training do you receive?	Are you connected with government, research, universities, institutes (<i>open days and demos</i>)?
	Do you use TV, Radio, SMS, leaflets/newsletters etc. to keep up to date?
	Where else do you get information, advice?
How do you get credit and get paid for produce?	Do you need credit and if so where do you get it?
	Do you have a bank account? Do you take a bank loan?
	What other credit is available to you? (<i>arhi, family, MFI, bank</i>)
	Can you get finance through a group?
	Do you use EasyPaesa?
	Do you experience problems getting paid for produce?
	Have you ever received a grant from government / project / NGO? Details?
How do you intend to increase the efficiency and profitability of your business?	How do you compare prices with other middlemen?
	Have you introduced any new crops, equipment, techniques to your business in the last 10 years? What? When?
	Have you made any attempt to reduce post-harvest losses of produce when it is in your control?
	Have you considered entering a cold-chain or investing in refrigeration?
	What standards or certification schemes have you heard of and have you or your clients applied for accreditation? (<i>e.g. BRC, GFSI, GlobalGAP, HACCP, grading</i>)
	Do you have access to the internet? How could it help you?
What are the strengths of the sector you are working in?	If you could buy more produce, could you sell it easily?
	Is your fruit/vegetable better quality than other middlemen?
	Could you do anything to your produce to make it more valuable? (<i>e.g. change packaging, process it, procure it out of season - in tunnel, improve quality / size</i>)
What are the weaknesses of the sector you are working in?	What are your three most important problems or challenges?
	How have/will you solve them?
	It has been proved by research that every time produce is handled or moved, quality is reduced. How can you reduce physical handling of produce to improve quality?
	Could handling be mechanized with pallets and forklifts?
	Could produce (<i>especially peaches</i>) be picked directly into market containers?
Concluding the Interview	Reiterate the respondent's main points. Solicit any final comments from the respondent related to the interview.

Wrap-Up	<p>Thank the respondent for his/her time and contributions.</p> <p>Explain what will happen with the information he/she has provided.</p> <p>Explain any other next steps he/she can expect from the project and what next steps or support he/she should not expect from the project (to avoid building unrealistic expectations).</p> <p>Thank the respondent again.</p>
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Worksheet #14 In-Depth Interview Guide - NGO, Dev Contractor, Project

(One per type of enterprise/stakeholder to be interviewed)

Type of Respondents	NGO, Dev Contractor, Project
Welcome, Introductions	Thank the respondent for meeting with you. Introduce the team.
Starting the Session	Provide a simple explanation of the project. Make sure the respondent understands that the session will be confidential. Explain that you will be taking notes or using a recording device (if appropriate) so that you can later remember what was said. Start with a relatively general question that you think the respondent would be interested in saying something about.
Detailed Research Questions	Interview Questions
How well are SME farmers organized? Are there men and women in farmer organizations or separate m/f organizations?	Are you working with farmer groups or associations?
	What type/purpose? (<i>E.g. FFS, KFS, FEG, Lead Farmer, Producer Group, Purchasing group, Cooperative</i>)
	Do/Did you form the groups?
	How? Where? (<i>Top down / Bottom up</i>)
	Do you have separate male and female or combined groups?
How are contacts between growers and buyers made? How many steps are there between them and the consumer?	Describe the marketing approach used by your groups.
	Do they operate through the traditional Mandi system, or have they found an alternative?
	Do they negotiate prices for inputs and outputs collectively?
	Who does this on members' behalf? Do they employ professional marketers? If so, what sort of person?
What business training have large farmers or SME growers associations received?	What sort of business training have group members, officers and employees received?
	Do you offer business training or out-source it?
	How are groups financed? (<i>e.g. membership fees, % on trading, commercial activities</i>)
What training / extension do farmers receive in your programs?	Do you facilitate FFS, KFS? What is average membership? What is average attendance? How many sessions in one year? Who are the facilitators (<i>NGO staff, Gov Ext</i>)?
	Are farmers connected with government extension, research, universities, institutes (<i>open days and demos</i>)?
	Do you use TV, Radio, SMS, leaflets/newsletters etc for farmer training and updating?
	Where else do you think your farmers get information, advice, and extension?
How do farmers get credit and get paid for produce?	Do any of your farmer groups have savings and loans schemes? Can you describe how they work? Have they accessed outside capital?
	What other credit is available to your farmers? Through the group?
	Do any of your farmers use EasyPaesa?
	Do farmers experience problems getting paid for produce?
How do you help to improve the efficiency and productivity of your farmers?	Do you benchmark your farmers against each other or with outside farmers?
	Have you made any attempt to reduce post-harvest losses?
	Have you facilitated two way exchange with researchers?
	Have you encountered pest and disease problems? If so how were they solved?
	Have you worked to improve the efficiency of irrigation?
	How have you/they built on these successes?
What are the weaknesses of	Can you give examples of problems faced by your growers? Clients?

the sector you are working in?	How have they solved them?
	What support services are needed most and how can they be provided? (<i>e.g. more research, cold storage, drying or processing plants, easier credit, capital grants</i>)
Do you work with other stakeholders in the VC?	What other value chain actors do you work with? (<i>Exporters, Input suppliers, Tekardars, Arthis, Shop-keepers, women traders / processors etc</i>)
	Can you tell us about it?
Concluding the Interview	<p>Reiterate the respondent's main points.</p> <p>Solicit any final comments from the respondent related to the interview.</p>
Wrap-Up	<p>Thank the respondent for his/her time and contributions.</p> <p>Explain what will happen with the information he/she has provided.</p> <p>Explain any other next steps he/she can expect from the project and what next steps or support he/she should not expect from the project (to avoid building unrealistic expectations).</p> <p>Thank the respondent again.</p>

Worksheet #14 In-Depth Interview Guide - Transporter

(One per type of enterprise/stakeholder to be interviewed)

Type of Respondents	Transporter
Welcome, Introductions	Thank the respondent for meeting with you. Introduce the team.
Starting the Session	Provide a simple explanation of the project. Make sure the respondent understands that the session will be confidential. Explain that you will be taking notes or using a recording device (if appropriate) so that you can later remember what was said. Start with a relatively general question that you think the respondent would be interested in saying something about.
Detailed Research Questions	Interview Questions
What is transporter's business and how does it work?	Whose produce do you handle? How many growers?
	Where does it come from? (<i>Geographical area</i>)
	Where do you pick up produce? (<i>from the field, at the road side, from a collection center, from a refrigerated / non-refrigerated store?</i>)
	Do you operate as a company, partnership or sole trader? Describe your business set-up.
	How many tons / kilos / crates do your trucks carry?
	Do you own or rent your trucks? What did you pay for your truck(s)? Did you buy new or secondhand?
	Are your trucks refrigerated? Open? Closed?
	What crops do you handle?
	How many loads of each did you handle last year?
	Who and where did you deliver produce to? (<i>local supermarket, international supermarket, exporter, processor, mandi</i>) (<i>which city</i>)
	How much do you charge?
	Who pays for transport? (<i>Grower, tekardar, group, arthi.....?</i>)
	When do they pay? (<i>At collection of produce or after delivery or do you give credit?</i>)
	Who loads and unloads the truck? (<i>driver, farmer, laborer, porter</i>)
	Do you use any mechanical handling equipment? (<i>forklift, hoist, barrow</i>)
	What sort of problems do you have dealing with farmers? Do they honor their side of the deal?
	Are there any female transporters / drivers in your area? (<i>If so, get contact details and try to arrange interview for Irnum</i>)
<i>For Group Members</i>	Do you belong to any professional organization or group?
How does group function?	What services and benefit does it provide? (<i>political pressure, information, research, commercial activity</i>)
	What does it cost to join? How is it financed? Subscription? Trading? Selling services?
	Does the group undertake any collective buying or selling or arranging large contracts?
What business training have you received?	Have you ever written a business plan for your enterprise?
	Was it for your own use or was it demanded by a bank or other organization?
	Have you ever received training in business, marketing or management?
	Have you received training in careful handling of fruit? Vegetables?
	How are laborers / porters trained in loading and unloading trucks carefully?
How do you get credit and get paid for produce?	Do you need credit and if so where do you get it?
	Do you have a bank account? Do you take a bank loan?

	What other credit is available to you? (<i>arhi, family, MFI, bank</i>)
	Can you get finance through a group?
	Do you use EasyPaesa?
	Do you experience problems getting paid for transport?
	Have you ever received a grant from government / project / NGO? Details?
How do you intend to increase the efficiency and profitability of your business?	How do you compare prices with other transporters?
	Have you introduced any new crops, equipment, techniques to your business in the last 10 years? What? When?
	Have you made any attempt to reduce post-harvest losses of produce when it is in your control?
	Have you considered entering a cold-chain or investing in refrigeration?
	What standards or certification schemes have you heard of and have you or your clients applied for accreditation? (<i>e.g. BRC, GFSI, GlobalGAP, HACCP, grading</i>)
	Do you have access to the internet? How could it help you?
What are the strengths of the sector you are working in?	Do you have capacity to handle more produce?
	Is your business more efficient than other transporters? In what way?
What are the weaknesses of the sector you are working in?	What are your three most important problems or challenges?
	How have/will you solve them?
	It has been proved by research that every time produce is handled or moved, quality is reduced. How can you reduce physical handling of produce to improve quality?
	Could handling be mechanized with pallets and forklifts?
	What do you do out of season? Do you transport other goods and produce?
	What support services do you think you need most and how can you access them? (<i>e.g. training, easier credit, capital grants</i>)
Concluding the Interview	<p>Reiterate the respondent's main points.</p> <p>Solicit any final comments from the respondent related to the interview.</p>
Wrap-Up	<p>Thank the respondent for his/her time and contributions.</p> <p>Explain what will happen with the information he/she has provided.</p> <p>Explain any other next steps he/she can expect from the project and what next steps or support he/she should not expect from the project (to avoid building unrealistic expectations).</p> <p>Thank the respondent again.</p>

Worksheet #15 In-Depth Interviews – Collecting Information - Grower

(One per interview)

Name of Respondent	
Type of Respondent	Grower
Interview Date/Time	
Contact Information	
General Comment	
Follow-up Required	
Research Questions	Information Gathered from Respondent
What is farmer's/grower's production and income?	
How well are SME farmers organized? Are there men and women in farmer organizations or separate m/f organizations?	
<i>For Group Members</i> How does group marketing function?	
<i>For Independents</i> How are contacts between growers and buyers made? How many steps are there between them and the consumer?	

What business training have large farmers or SME growers received?	
What training / extension do you receive?	
How do farmers get credit and get paid for produce?	
How do you increase the efficiency and productivity of your farm?	
What are the strengths of the sector you are working in?	

What are the weaknesses of the sector you are working in?	
Other Comments, Observations, Questions Raised and Follow-Up Ideas	

Worksheet #20 Focus Group Discussions – Planning - SME Growers

(One per type of stakeholder with whom FGDs will be conducted)

Facilitation Team				
Moderator: Name and Roles				
Observer: Name and Roles				
Assistant: Name and Roles				
Type of Participants and Qualifying Characteristics	SME Growers			
Main Focus of Discussion: How do farmers participate in the value chain and how could their profitability be improved?				
Research Questions	<p>How are farmers connected to the market and what alternatives are there to the present system?</p> <p>How well are farmers organized?</p> <p>How do farmers finance their businesses? Why?</p> <p>How can farmers increase productivity in a sustainable way?</p> <p>What are the strengths and weaknesses (constraints) in the value chain?</p>			
Schedule of FGDs	FGD #	Place	Date	Time
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			

FGD Place and Time			
	Person Responsible / Deadline		
Task#1 Invitations / confirmations			
Task#2 Arranging venues including seating and snacks			
Task#3 Discussion guide			
Task#4 Recording device, transportation			

Worksheet #21 Focus Group Discussions – Discussion Guide - SME Growers

(One for all FGDs with a particular type of stakeholder)

Topic	Details	Time
Welcome, Introductions	Thank the farmers for meeting with you. Introduce the team.	
Getting Ready for the Session	Explain the project. Confidentiality Don't raise expectation of project handouts!	
Starting the Session	Go round the room and ask about size and type of farm. Start with yourself. Make sure everyone speaks.	
Research Questions	FGD Questions <i>(these questions are to help you keep on track and guide the discussion. You don't need to follow them exactly)</i>	
How are farmers connected to the market and what alternatives are there to the present system?	Who do you sell your crop to? Find out if everyone markets produce the same way. Is it all auctioned at the mandi? (Draw out differences) What other channels could you use? Have you ever been in touch with a local or international supermarket? Does anyone sell their crop in the field / on the tree? At what stage is it best to sell? Why do farmers sell before harvest? (Is it because they need cash or is it to share risk? Or do they not want the work of looking after it and harvesting?) Who pays for what? Does buyer come to village or do you have to go and find him? Who arranges transport and employs pickers? Is it difficult to buy good packaging? How do you sort your produce? What price did you get? Did you negotiate alone? How did you know how much to ask? Were you happy with that? Can you think of a way of getting a higher price?	20 mins
How well are farmers organized? Only for marketing or purchasing groups.	Is anyone a member of a farmer group or organization? What sort of group? <i>(E.g. FFS, KFS, FEG, Lead Farmer, Producer Group, Purchasing group, Cooperative)</i> Are there men and women in the group? What are the benefits of membership? What does it cost to be a member? How is that calculated? Do you sell through the group? How does that work? Is there a group packhouse? Do you have to take your produce to the packhouse or is it collected? Are there refrigerated stores? transport? Describe the marketing approach used by your group. Do you get a fair price through the group? Do they negotiate prices for inputs and outputs collectively? Who does this on members' behalf? Do they employ professional marketers? If so, what sort of person? Do they receive business training? Do you borrow money from the group to pay for inputs? Is there a savings and loan scheme?	15 mins
How do farmers finance their businesses? Why?	What does it cost per hectare / per ton / per kilo to grow dates / peaches / potatoes / chilies? Where do farmers get credit for annual inputs <i>(e.g. fertilizer)</i> and for long-term investment <i>(e.g. new orchard, tractor)</i> ? Who has a bank account? Can you get a bank loan? What does it cost? What other credit is available to you? <i>(Input supplier, arthi, family, village)</i>	15 mins

	<p><i>shop, MFI, bank</i>) Are you part of a savings and loan scheme?</p> <p>Why do you choose to get credit from an arthi / bank / family? Which charges least interest? Which is most flexible and convenient? Which one requires collateral? Are you strict about choosing Islamic lending only?</p> <p>Do you experience problems getting paid for produce? Does anyone use EasyPaesa/</p> <p>Have any of you ever received a grant from government / project / NGO? What for? Building? Machinery? Trees?</p>	
How can farmers increase productivity in a sustainable way?	<p>Do you compare yields with each other?</p> <p>Has anyone introduced any new varieties, equipment, techniques to his farm in the last 10 years? What? When?</p> <p>Have you made any attempt to reduce post-harvest losses?</p> <p>How? (<i>cold chain, picker training, improved packaging, chemical treatment</i>)</p> <p>Do you ever meet with researchers? How? (Open days, farm visits)</p> <p>Is it easy to buy good seed / saplings? Where from? Do they provide advice? How much do they cost?</p> <p>How do you know the seeds or saplings are good? (<i>visit nursery, certification, visit trials</i>)</p>	20 mins
What are the strengths and weaknesses (constraints) in the value chain?	<p>If you grew a bigger crop (improved your yield, increased your acreage), could you sell it easily?</p> <p>Could you do anything to your produce to make it more valuable? (<i>e.g. change packaging, process it, grow it out of season - in tunnel, improve quality / size</i>)</p> <p>If you had to prioritize, which are the three most important problems or challenges you face as growers and how will you solve them?</p> <p>What support services do you think you need most and how can you access them? (<i>e.g. more research, cold storage, drying or processing plants, easier credit, capital grants</i>)</p>	20 mins
Synthesize Discussion		
Wrap-Up		

Worksheet #22 Focus Group Discussions – Collecting Information - SME Growers

(One per FGD)

FGD Place and Time	
Research Questions	Information Gathered from Participants
Other Comments, Observations, Questions Raised and Follow-Up Ideas	

Worksheet #23 Focus Group Discussions – Participants - SME Growers

(One per FGD)

FGD Place and Time				
Name	Enterprise Name	Contact Info	Your Comments	Follow-Up (if any)

Annex 6 Potato Storage Training Handout

Physiology

The potato tuber is the natural organ of vegetative reproduction of potatoes. Thus in wild varieties the tuber is designed to store food reserves and remain dormant in the soil during winter so it can start growth again in the spring when conditions are right. During dormancy respiration rates slow down to conserve food reserves which are in the form of starch.

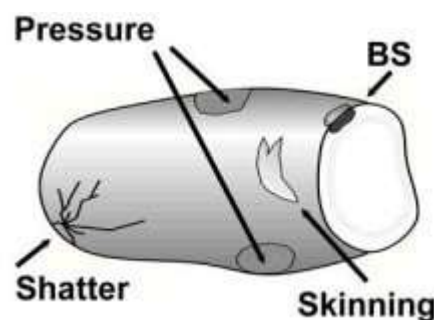
The purpose of potato storage is to maintain tuber quality to supply markets in the autumn, winter and spring. Good storage should prevent excessive dehydration, decay and sprouting. It should also prevent high sugar concentrations which result in dark colored fried products. A potato store should have good insulation, outside waterproofing, ventilation, air distribution, humidification, and instruments for precisely maintaining store conditions.

Temperature, humidity, and air movement are the most important environmental factors affecting storage. Respiration rate is proportional to temperature, so maintaining a cool temperature in store prolongs storage life. High humidity slows water loss and prevents desiccation and shrivel. Air movement is necessary to ensure that conditions are the same throughout the store.

Harvest and Pre-Storage

Although potatoes have a tough-looking skin, they are still liable to bruising. During and after harvest, potatoes should be handled with great care. One of the main ways to extend the post-harvest life of potatoes is by reducing mechanical damage (bruises, scrapes, cuts, compression, etc.) The following factors reduce bruising:

- Potatoes should be harvested when the skins are 'set', i.e. the skin has stopped growing and has become tough. Harvesting before skins are set results in 'skinning' and scuffing. Skins are set 14 days after the haulm (leaves and stems above ground) is dead. Sometimes the haulm dies naturally or is frosted; otherwise it is cut and removed or burned with desiccant (e.g. sulphuric acid). Leaving potatoes in the ground after 14 days can lead to rots.
- Soil Temperature at harvest should be 10 - 16°C. Potatoes are much more likely to bruise if their temperature is below 7°C. If their temperature is over 16°C, potatoes are more susceptible to rots and it is difficult to cool them in store. Therefore in cold weather, potatoes should be harvested in the afternoon and in warm weather they should be harvested in early morning.
- Soil moisture should be at 60 – 65%. If the soil is wet and cold, potatoes are more susceptible to 'shatter' bruising; if the soil is too dry, potatoes are more susceptible to 'black spot' bruising (BS). In addition, if the soil is wet it sticks to the potatoes and is difficult to remove.
- Careful handling means that potatoes should never be dropped more than 15 cm.
- Do not walk on tubers in field, truck or store.



Before loading into store, damaged, rotting or wet potatoes should be removed.

Store Loading

Before loading, the store should be thoroughly cleaned by brushing and removal of loose soil from previous crop. If infection by disease has been a problem in previous years, chlorine can be used to sterilize the store structure and containers before loading. (See box on right).

Potatoes can be stored loose or in nets, bags or crates. In bulk, the heap can be up to 3m high, but good air-circulation is important. If several growers are using the same store, labeled nets or crates are best, but the use of crates will cut down the volume of storage. For bulk storage, there are 650 kg potatoes in one cubic meter (m³).

Chlorine

Sodium Hypochlorite (NaOCl) is the active ingredient in bleach. Household bleach is usually 5.25% NaOCl. For sterilising stores and crates, it is normally used diluted one part bleach to nine parts water which makes a 10% solution of bleach or 0.52% NaOCl.

Storage Conditions

If stored and handled carefully, late varieties of potato can be kept in good condition in a simple underground store for at least 5 months. Storage to 8 months may be possible.

Curing

Curing is the process of healing wounds from harvesting. Immediately after loading into store, potatoes should be cured by holding at 10°C to 16°C and very high relative humidity (95-99% RH) with good air movement for 3 weeks to permit healing of cuts and bruises. During curing, respiration is high and good ventilation is needed to prevent too much CO₂. Curing reduces subsequent weight loss and decay by preventing the entry of decay organisms.

Temperature

After curing, potatoes for fresh market should be stored at 3.5 - 8°C. Tubers for processing need to be cooled slowly. Seed potatoes should be stored at 3.5 - 4°C. During storage, potatoes are dormant and respiration is slow. The length of dormancy depends on variety, tuber maturity at harvest and temperature and can vary from 2 to 4 months.

Humidity

High humidity - 90-95% - will reduce weight loss and shrivel. However, potatoes should not be allowed to get wet either from condensation, leaking roof or direct sprinkling with water.

Atmosphere

Good ventilation and air circulation is needed in the curing period when respiration is high and CO₂ can build to damaging levels. During dormancy, ventilation can be reduced.

Sprouting

Potatoes start to sprout when dormancy is broken. Because respiration rate increases, temperatures may rise in store and more ventilation may be needed. Sprout suppressants can be used except on seed potatoes.

Unloading and Marketing

Before removing potatoes from store, the temperature must be raised slowly to 10 - 16°C over 3 weeks. This will prevent bruising when handling the tubers. All those handling potatoes from store to market should be made aware of the damage caused by carelessness e.g. dropping sacks when unloading trucks.

Storage problems

Most storage problems are due to

- Poor handling, dropping potatoes more than 15 cm
- Disregard to temperatures and moisture from harvest to dormancy and poor curing
- Allowing tubers to become wet through condensation, leaking roofs etc.
- Poor air circulation in store
- Removing cold potatoes from store.



Figure 15 Skinning and Scuffing caused by Harvest skin



Figure 17 Black Spot bruising caused by Harvesting In warm, dry conditions

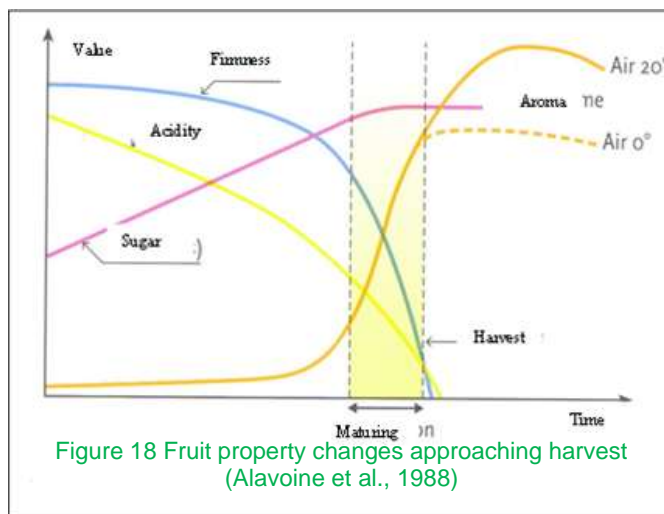


Figure 16 Shatter bruising caused by harvestina

Annex 7 Harvest and Post-Harvest Peach Training Handout

Maturity Index - Picking date

Peaches do not all mature at once, yet for each individual fruit there is only a very short time-window best for harvest. If a fruit is picked too soon, it never ripens to its full flavor; if a fruit is picked too late, it is soft and impossible to handle without damage. Time of maturity varies from orchard to orchard according to soil and climate, and from tree to tree according to variety, age and rootstock. Within the tree, there is variation according to fruit position: the south side may ripen before the north, the high branches before the low, the outside branches before the inside and the old wood before the young wood.



To determine maturity, several criteria may be used:

- Grower experience, including taste.
- Color: the background color should be starting to yellow - green background is unripe.
 - But modern varieties have high cheek color and this can obscure the background making it difficult for pickers.
 - Fruit with split stones colors and matures early. It should be discarded.
- Fruit shape rounding or filling out. Uneven halves and a prominent ridge indicate fruit is not quite ready for harvesting
- Firmness, acidity and sugar are objective measures of maturity.
 - Fruit loses firmness after picking depending on storage. Firmness for long distance marketing: 6.0 - 4.0 kg / 0.5 cm²; for medium distance: 5.5 - 3.5 kg / 0.5 cm² (see below).
 - Once picked, sugar does not change significantly. US and EU measurements for sugar are almost identical. Sugar is measured with a refractometer and usually given as % or ° Brix. Minimum brix for customer satisfaction: 9.5° (9.5%), but 11° (11%) is preferable.

There is more detail on monitoring peach and nectarine ripening on the Michigan State University website: http://msue.anr.msu.edu/news/monitoring_peach_and_nectarine_ripening

Firmness

Fruit firmness is measured using a penetrometer. Interpreting advice on firmness is difficult because of the mixture of units used in America, Europe and elsewhere.

The Table 12 may help:

Item	Imperial (USA)	Metric (Europe, Australia, South Africa)
Probe Size recommended for peaches	5/16" diameter	8 mm diameter = 0.5 cm ² area
Picking for medium distance market	12 to 8 lbs	5.5 - 3.5 kg / 0.5 cm ²
EU maximum fruit firmness at sale	11 lbs	5.0 kg / 0.5 cm ²
Firmness for retail display	8 to 6 lbs	3.6 - 2.7 kg / 0.5 cm ²
Firmness for eating	2¼ to 4½ lbs	1.0 - 2.0 kg

Picking Frequency

It is necessary to 'pick over' the orchard 3 - 6 times; picking over is expensive but worthwhile.

- Early varieties - pick every two to three days
- Late varieties - pick every four to six days

Preparation

Picking buckets are not recommended: it is better to pick into a crate, or best to pick into the market tray.

Sometimes a harness is used to suspend the tray from the picker's shoulders. Sometimes a trolley is used to hold several trays or crates. The picking trolley may have steps to reach upper branches and a bucket for substandard fruit. The trolley should be stable on uneven ground and it should have a large wheel to make maneuvering easy.

Clean empty crates should be placed under trees before picking.

Train picking team on how to pick fruit carefully, how to judge fruit maturity and not to damage tree. If picking into market trays, pickers should be familiar with national grading standards or supermarket specification.

Employ enough supervisors to check pickers and fruit quality. Two supervisors can manage a team of 30 pickers - maximum ratio is 1:15. Supervisors should only supervise and not be given other jobs!

Allocate ID number to each picker and ensure that every tray or crate is marked with a picker's ID.

Ensure that there are clean toilets with hand-washing and soap in the field.



Figure 19 Trolley with steps for picking peaches

Picking Technique

In hot weather, pick in early morning or late evening

Pick fruit from outside lower branches first, and then use steps or ladder to reach top of tree. Fruit in center of tree will mature last. Take care with ladder not to damage immature fruit remaining on tree.

DO NOT CLIMB TREE!

- Climbing may be dangerous.
- Mud and earth from boots infects branches with fungal disease.
- Immature fruit is knocked off and falls to ground.
- Branches are broken or damaged.

Wash hands with soap before starting work and after every visit to the toilet.

Pick fruit with palm of hand. Fingertips bruise fruit.

Roll or tilt the fruit towards the branch while lifting gently. Do not pull fruit.

Place fruit gently in crate or tray without dropping or throwing.

Place full crates in shade under tree. Do not overfill crates and stack carefully.

Supervisors should sample fruit from each picker and examine later for bruising

All fruit, whatever quality, should be removed from orchard during final pick. (Fruit left unpicked or on ground carries *Monilia* infection creating branch and blossom cankers and fruit rot next year)

From Orchard to Collection Station

Fruit should be collected from orchard frequently and transported to cold store to remove field heat - ideally within 30 minutes of harvest.

All crates should be marked with picker ID, date, variety, name of orchard and farm.

Every time fruit or crates are handled between orchard and consumer, more damage is caused.

Therefore, wherever possible fruit handling should be minimized. Mechanized handling using pallets reduces damage from poor stacking. A small tractor with rear pallet forks is ideal for short distance transport.

At the collection station, fruit should be placed in cold store immediately.

Pallets of fruit are removed for checking and packing and then returned to cold store:

Fruit picked into market trays is visually checked and out of grade or damaged fruit is removed. There is no need to handle good fruit.

Fruit picked into crates is hand-graded by size and quality into market trays according to national grading standard or supermarket specification.



Figure 20 Tractor rear-mounted pallet forks

All trays should be marked with picker ID, date, variety, grade, fruit size, name of orchard and farm
Workers at collection station need training in fruit standards, handling care and personal hygiene.

Refrigeration

Removal of field heat should start as soon as possible after picking and most 'reefer' trucks are not designed for this purpose - they only maintain low temperature. Therefore a cold store adapted for field heat removal is needed at the collection station. Fruit ripening is 8 to 10 times faster at 25°C than at 4°C. Specialized refrigerators can remove field heat in 1 to 2 hours - see internet or literature. Good air circulation is vital.

For long-term storage - one to two weeks - a temperature between 0°C and 1°C is recommended.

Temperatures between 3°C and 7°C should be avoided as some peach varieties develop a floury texture. Note that 4°C is a common temperature for storing and transporting fruit and vegetables. Therefore it is often not possible to combine peaches with other fruits during storage and transport.

For storage and distribution lasting 4 to 6 days, 8°C is a good compromise temperature. If fruit is stored at 8°C and then displayed at 22°C by a retailer, ripening is slow and pressure loss is between 1% and 2% per day.

Relative humidity of 90 to 95% is recommended.

Transport

Transport to market should be by reefer with a temperature of 8°C and RH 95%.

Size of market tray should exactly fit international pallet size: 1,000 x 1,200 mm

Pallets should be carefully stacked to an agreed maximum height depending on the strength of the trays, vehicle suspension and the state of the road.

Pallets should have corner guards and should be firmly strapped. Film wrapping will increase humidity.

It is recommended that a miniature recording thermometer is placed in each load to check that driver has maintained correct temperature. Large rapid changes in temperature must be avoided - they cause condensation of moisture on the fruit and hasten ripening.

If there is a loading bay at the collection station and at the delivery end, then loading can be done with a simple hand pallet truck. It is recommended that reefers carry their own pallet truck.



Secure load
on pallets



Transport from orchard