



**Australian Government**

**Australian Centre for  
International Agricultural Research**

# Final report

Small research and development activity

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*SRA*

## **A constraints analysis of mango supply chain improvement in Pakistan**

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*date published*

November 2007

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*project number*    PLIA/2005/159

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*ISBN*                978 1 921434 05 1

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*published by*        ACIAR  
                              GPO Box 1571  
                              Canberra ACT 2601  
                              Australia

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## **Executive Summary**

### Objectives and Approach

This Short Research Activity (SRA PLIA/2005/159) was undertaken as part of an Agriculture Sector Linkage Program (ASLP) between Pakistan and Australia, bringing together stakeholders involved in mango research, development and extension (RD&E). The aim of this SRA was to broadly identify and analyse the constraints currently limiting the competitiveness of supply chains for Pakistan mangoes. The specific objectives of this constraints analysis were to:

1. broadly identify the types of markets and their needs;
2. broadly identify the various components and associated impediments in representative supply chains;
3. identify options to build better commercial linkages between all components of the supply chain;
4. provide recommendations for an R&D project PLIA/2005/159 'A constraints analysis of mango supply chain improvement in Pakistan (scoping study)' to improve the competitiveness of mango supply chains in Pakistan; and
5. review the policy environment influencing mango production, distribution and marketing and assess whether this is likely to hinder development of more competitive mango supply chains.

A project team comprising Associate Professors Ray Collins (team leader) and Tony Dunne from the University of Queensland, Ms Jodie Campbell from the Queensland Department of Primary Industries and Fisheries, Mr Peter Johnson from the Western Australia Department of Agriculture, and Dr Aman Ullah Malik from the University of Agriculture Faisalabad, Pakistan, undertook the research in Pakistan and Singapore from 25 March to 9 April 2006. Valuable assistance was provided by the Pakistan Horticulture Development and Export Board (PHDEB). A parallel small research activity (HORT2005/154) was carried out by a six-member Australian team whose task was to investigate mango production systems with an emphasis on disease and pest management. The results from this team's findings provided input to the activities of the supply chain team. Linking the two teams' activities and findings reflects the systems-based approach that is being proposed to improve the Pakistan mango industry.

Scoping study activities began with a four day workshop in Multan, attended by a wide range of industry and government stakeholders. The objective of the workshop was to consider the present Pakistani mango industry, the Australian mango industry, the prospects for future development of the Pakistan industry, and any implications for development of the Australian industry.

Following the workshop, the team undertook field visits, interviews and observations involving the full range of participants in mango supply chains, including growers, contractors, commission agents, transport operators, exporters, importers (Singapore), retailers (Singapore), quality management companies, freight forwarders, shippers, and support agencies such as

PHDEB, universities, government departments and wholesale market committees. This phase of the project took a further nine days.

### Industry Background

Pakistan is the world's fifth largest mango producer with an annual crop of around one million tonnes. It exports about 80 000 tonnes, mainly to the Middle East and the UK. Less than 3 per cent of the crop is used for processing, mostly into mango pulp. Production is centred in the regions of the Punjab and the Sindh. Harvest begins in the Sindh in late May and finishes in the Punjab in late August. The principal varieties are Sindhri, which dominates Sindh production, and Chaunsa, which dominates Punjab production. Pakistan mangoes are sweet, aromatic, yellow skinned and soft. Mango farms range in size from less than 2ha to more than 400ha.

Production, postharvest and marketing systems are poorly developed and returns are distributed quite unevenly, favouring middlemen. Fruit quality is generally poor and 30 to 40 per cent of fruit is wasted in the harvest-to-market system. Modern infrastructure for cool storage, grading, postharvest treatment and transport is almost non-existent. Periodic gluts occur on domestic markets and with no capacity to store fruit, heavy discounting of retail prices is common. The export market faces similar challenges. Pakistan mangoes have a reputation as being cheap and of poor quality, and exporters have a tendency to dump fruit in markets such as the UAE. In general, there is little evidence of a value-oriented approach to supply chain management and there are concerns that current returns for growers are unviable. Compounding this situation, mango tree dieback and decline is beginning to further reduce productivity.

### Existing Supply Chains and Impediments

Domestic retailers include street hawkers, fruit and vegetable shops, supermarkets, roadside stalls and food service outlets. Most mangoes in Pakistan are sold by street hawkers, who purchase their daily requirements from local wholesale markets. Specialist fruit and vegetable shops are uncommon, but are found in larger cities. Very few supermarkets operate in Pakistan but multinationals are expected to open in 2-3 years. Roadside stalls in mango production areas sell fourth or reject grade fruit at low prices. Food service outlets include better quality hotels, which may include mangoes in fruit baskets in guests' rooms, and restaurants that serve mangoes in season. The major export destinations for Pakistan mangoes are the Middle East, the U.K. and Europe. The majority of exports are consumed by expatriate Pakistanis and other Asian communities living abroad. On export markets, Pakistan mangoes have a reputation as low priced, of low postharvest quality, yet with inherently good eating properties.

Domestic chains are fragmented and involve numerous stakeholders. Most chain activities are controlled by commission agents, who provide finance to the contractors and determine the scheduling and flow of fruit from the contractor to the wholesale market. The major impediments identified in domestic supply chains were:

- The product subsystem: the poor quality of mangoes that reach the final consumer is a result of poor production systems coupled with inadequate handling, storage and transport systems;
- The communication subsystem: the absence of effective information flows within the chain inhibits feedback from markets;
- The value subsystem: the wide variations among prices at farm, wholesale market and retail levels point to a system where there are few rewards for quality; and
- The governance subsystem: the dominant role of commission agents indicates a system where it may be difficult to change the status quo.

The major export supply chain impediments were found to be:

- The product subsystem: there was no effective quality management or trace-back system available for product sourced from the wholesale markets; there is a lack of knowledge concerning appropriate handling, storage and transport systems;
- The communication subsystem: there was little evidence of effective information flows within the chain; there was an absence of market research on existing or potential export markets;
- The value subsystem: while the inherently superior eating quality of Pakistani mangoes was widely recognized, market development and profitability were reported as being undermined by low product quality, inconsistency and unreliable supply; and
- The governance subsystem: there was a perception that many exporters were not interested in developing long term marketing partnerships with importers.

#### Improving Supply Chain performance

*Growers*, whether large or small, need better access to information, specific skills training and more incentive to take responsibility for the quality of mangoes they produce. Growers are relatively disempowered in the supply chain and would benefit from belonging to alliances for skills development, as well as through-chain commercial alliances. *Contractors'* performance was rated low in terms of its impact on product quality. Their operations are guided and financed by commission agents, and they have little power to voluntarily change their present practices. Improving commercial linkages between contractors and other chain members would require the support and encouragement of commission agents. *Commission agents* hold most of the power in the supply chain, and any chain improvement strategy would depend on their support and involvement. *Processors* expressed concern that they were seen as a dumping ground for lowest quality fruit when in fact their requirement was for sound, fully mature mangoes. Improving commercial linkages with processors will involve education of suppliers about processors' needs and their ability to pay for fruit that meets those needs. *Exporters* expressed a wide range of concerns over fruit quality and the performance of the supply chain. Some of their practices had no scientific basis, each exporter doing what they thought to be 'the right things'. They were eager to learn how to extend mango shelf life and how to access new markets. There is a clear need for technical information to improve exporters' practices.

### Recommendations for RD&E

Improving product quality and reducing losses is the highest priority, requiring a multi-faceted strategy spanning pre-harvest and postharvest practices, training, R&D, and demonstrations. Value creation and appropriation is characterised by low overall levels of value, distributed asymmetrically. Improvements in quality will drive improvements in value. Information systems must be improved so that they become the vehicle for messages about improving product quality, the needs of other chain members and feedback from markets. Overarching these improvements is the need for integrated supply chain governance. Governance will focus on issues such as rules of operation, efficiency and equity in chain performance, and the chain's ability to respond to changing circumstances.

Four possible R&D approaches are identified. They are training, research, demonstrations and capacity building. Each can be applied at the industry-wide level, at the level of specific operators in the supply chain such as growers, transport operators, contractors, etc., or at the level of a specific supply chain. Not all approaches can be used at all levels. Training will be targeted at specific chains and levels in chains; research will focus on industry-wide problems; demonstration activities will be oriented towards specific chains; and capacity building will be at the industry-wide and specific chain levels.

Three research objectives emerge from this scoping study. They are:

1. mango quality improvement and maintenance
2. market research (domestic and export)
3. developing demonstration supply chains (domestic and export).

Objective 1 will be informed by a parallel SRA project, HORT2005/154, which is focused on mango pest and disease management. Objectives 1 and 2 will feed into objective 3, which will provide examples of how the four supply chain sub-systems (see above) can be integrated so as to produce mangoes of improved quality, generate improved market returns for this quality, distribute that value equitably, gather and feed back information that encourages continuation of improved practices, and govern the supply chain as a single competitive unit. Participants for these demonstration supply chains have been identified during this scoping study.

### Institutional frameworks

A study of institutional frameworks has become the subject of a separate project. In brief, the mango industry in Pakistan operates in a largely unregulated environment. The country's Rapid Export Growth Strategy could provide considerable impetus to developing the mango industry. The main supporting agency for the mango industry is the Pakistan Horticulture Development and Export Board, which is doing an excellent job. Opportunities exist to strengthen institutions such as the University of Agriculture Faisalabad.

# 1. Context and Background

## 1.1 The Agriculture Sector Linkage Program

The Agriculture Sector Linkages Program (ASLP), managed by ACIAR, aims to build linkages between the agriculture sectors of Australia and Pakistan.

The ASLP, with a budget of AUD6.6M over 4 years, has the following goals:

1. To transfer Australian knowledge and expertise to key sectors of Pakistan agribusiness to increase profitability and enhance export potential
2. To contribute to poverty alleviation of small-holder farmers through collaborative research and development
3. To enhance the capacity of the Pakistan research, development and extension system to deliver targeted and practical research outputs to agribusiness and farmers.

Under the ASLP, priorities for the Pakistan mango industry were identified as:

1. Technical support to increase mango production, especially focusing on diagnosis and control of diseases (in particular dieback)
2. Technical support for the supply chain, value adding and marketing

To meet these ASLP goals and priorities and to ensure the program delivers early impacts, the program was configured by ACIAR into the following activities:

1. Initial short term scoping study and constraints analysis
2. Agro-enterprise exposure and fact finding trips to Australia
3. Technical and scientific workshops
4. Tailored training and capacity building packages delivered in Pakistan and in Australia
5. 1-3 yr technical intervention and/or research and development projects

This study reports on activity 1, the initial short term scoping study and constraints analysis, carried out from 25 March to 9 April 2006. The scoping study team was

Assoc Prof Ray Collins (Team Leader)	University of Queensland Gatton	Industry development, supply chain management
Associate Professor Tony Dunne	University of Queensland Gatton	Marketing, supply chain management
Ms Jodie Campbell	Queensland Department of primary Industries and Fisheries	Quality management systems and postharvest technologies
Mr Peter Johnson	Agriculture Western Australia	Product quality systems, industry development
Dr Aman Ullah Malik	University of Agriculture Faisalabad	Postharvest technology, product quality systems



## **1.2 Scoping Study Objectives**

The aim of this SRA was to broadly identify and analyse the constraints currently limiting the competitiveness of supply chains for Pakistan mangoes, with particular emphasis on how Pakistani mango growers could create and receive increased value from the supply chains to which they belong. The specific objectives of this constraints analysis were to:

1. broadly identify the types of markets and their needs;
2. broadly identify the various components and associated impediments in representative supply chains;
3. identify options to build better commercial linkages between all components of the supply chain;
4. provide recommendations for an R&D project PLIA/2005/159 'A constraints analysis of mango supply chain improvement in Pakistan (scoping study)' to improve the competitiveness of mango supply chains in Pakistan; and
5. review the policy environment influencing mango production, distribution and marketing and assess whether this is likely to hinder development of more competitive mango supply chains.

## **1.3 The Pakistan Mango Industry**

Mangoes have been produced in Pakistan for well over two thousand years, and the country is now the fifth largest producer in the world behind India, China, Mexico and Thailand. Officially, annual production is recorded at just over 1 million tonnes, although estimates range from 1 million tonnes (PHEDB) to 1.7 million tonnes (FAO). Pakistan is also a significant exporter of mangoes, with approximately 80,000 tonnes being exported annually, making it the third largest exporter in the world. Small quantities are also used for processing.

Production is centred on two regions, the Punjab and the Sindh, producing 67% and 32% of the total production respectively. Harvest begins in the Sindh in late May and finishes in the Punjab in late August. The principal varieties are Sindhri, which dominates Sindh production, and Chaunsa, which dominates Punjab production. Other varieties commonly grown are Began Pali, Langra and Anwar Ratol. All varieties grown in Pakistan are of Indian origin and are characterised by high brix and aroma, with monoembryonic seeds. Whilst both Chaunsa and Sindhri are considered by industry as excellent varieties, Sindhri appears to have better postharvest attributes for export markets.

The main markets for Pakistan mangoes are the domestic markets in large cities such as Lahore and Karachi, with much of the produce going through central wholesale markets. The main export market is the Middle East, particularly the UAE. Other export markets are emerging in the EU, SE Asia and Eastern Europe.

Most farms in Pakistan have a mix of enterprises with very few producing only mangoes. Mango plantations (called 'gardens') range in size from small 2 hectare holdings up to 400 hectares. The industry has a forward contract system where most farmers sell their crop at flowering or soon after to

contractors acting on behalf of commission agents. Thus very few mango farmers in Pakistan are responsible for selling or marketing their own crop.

The industry faces a number of major challenges, particularly in postharvest handling systems, where fruit losses of 30 to 40 per cent are common and overall quality is dramatically impacted. There is no cool chain management and with ambient temperatures often around 50°C during harvest, fruit has a very short shelf life. Periodic gluts occur on domestic markets and with no capacity to store fruit, heavy discounting of retail prices is common. The export market is facing similar challenges. Pakistan mangoes have a reputation as being cheap and of poor quality, and exporters have a tendency to dump fruit in markets such as the UAE. Sales of Pakistan fruit in many export markets are to the local expatriate (Pakistani/Indian) communities and it is not clear if substantial inroads are being made in the wider global supermarket trade.

In general, there is little evidence of a value-oriented approach to supply chain management and the industry is concerned that current levels of returns for growers are making the crop unviable. Compounding this situation, poor mango tree management practices further reduce farmers' returns.

## **2. Methodology**

This scoping study was carried out by a team of four Australians and one Pakistani (see section 1.1 above) with significant inputs and assistance from various Pakistani agencies, particularly the PHDEB. A parallel investigation (HORT2005/154) was carried out by a five-member Australian team whose task was to investigate mango production systems with an emphasis on disease and pest management. The results from this team's findings provide an important source of data for activities of the supply chain team. Linking the two teams' activities and findings reflects the systems-based approach that is being proposed to improve the Pakistan mango industry.

Scoping study activities began with a four day workshop in Multan, attended by a wide range of industry and government stakeholders. The objective of the workshop was to consider the present Pakistani mango industry, the Australian mango industry, the prospects for future development of the Pakistan industry, and any implications for development of the Australian industry.

Following the workshop, the team undertook field visits, interviews and observations involving the full range of participants in mango supply chains, including growers, contractors, commission agents, transport operators, exporters, importers (Singapore), retailers (Singapore), quality management companies, freight forwarders, shippers, and support agencies such as PHDEB, universities, government departments and wholesale market committees. This phase of the project took a further nine days.

### **3. Addressing Objective 1: Pakistan mango markets and their characteristics**

#### **3.1 The Pakistan domestic mango market**

##### **3.1.1 Overview**

Among Pakistan's estimated population of 162 million (July 2005) there is a wide discrepancy in income levels, with around 35% of the population said to be living below the poverty line. Locally produced mangoes are the main fruit eaten between June and September. There is little infrastructure, little knowledge about handling of mangoes and very limited cool storage. The majority of mangoes are therefore retailed in poor quality and with a short shelf life.

##### **3.1.2 Types of retailers and their requirements**

###### **Street vendors/hawkers**

Street vendors are by far the major source of fruit and vegetables for households in Pakistan. Street vendors purchase product daily from wholesale markets and have little storage space and no cool room facilities. Sale of fruit and vegetables is from mobile carts or street stands mostly shaded by umbrellas or tarpaulins. The lack of facilities and storage space means that fruit and vegetables must be purchased daily and sold by the end of the day. At the start of the day the price of mangoes starts high at around 30Rp/kg and as the day progresses fruit is discounted, perhaps selling for as little as 5Rp/kg by the end of the day.

As there is little differentiation of mangoes at wholesale according to quality, street vendors will purchase at a price and then regrade according to customer requirements. Street vendors who service higher income areas try to purchase better quality mangoes if they are available.

###### **Fruit and vegetable shops**

There are very few fruit and vegetable shops, mainly in larger cities. Again purchase is determined by what is available in the market. Storage area, while still minimal, allows for purchase of larger quantities. Some are air-conditioned which allows some cooling for fruit and vegetables.

###### **Roadside stalls**

Fourth or reject grade mangoes are sold by roadside stalls usually close to or associated with mango orchards. These mangoes are mainly brought by local people who are prepared to take the lowest quality mangoes at the lowest price.

###### **Food service**

It is common practice for better quality hotels to provide mangoes as part of fruit baskets in guests' rooms. Most restaurants serve fresh mangoes in season.

###### **Supermarket chains**

Major retail chains such as Metro and Makro are looking to enter the Pakistan market within the next two years. The implications for the mango industry will be the necessity to provide a product to quality specifications set down by the

supermarkets. There will also be a need for product traceability and HACCP to ensure mangoes meet food safety standards. Other multinational companies (South African) are also looking to source Pakistan mangoes for supply to multi national supermarkets. This would also require quality standard, food safety and traceability adherence. Additionally, as Pakistan phases out tariffs on imported fruit in next few years, local exporters see this as an opportunity to diversify their business to include fruit imports – Philippines mangoes are already imported.

### **Specialty fruit and vegetable retailers**

In competition with supermarket chains, some fruit and vegetable entrepreneurs are looking to set up high quality fruit and vegetable retail stores in wealthier socio-economic areas. These stores will also require high quality, safe produce, whether imported or produced locally.

### **3.1.3 Mango processing**

Currently approximately 3 per cent of mangoes are processed into value added products such as pulp for use in drinks and ice cream, canned mangoes and dried mangoes. Three processors were visited, producing 1 000 to 5 000 tonnes of pulp annually. Pulp was held in 200-250 litre drums in cold storage. One processor had an aseptic UHT line producing 250 litre bag-in-drum mango pulp to export standards. The same processor was developing a canned mango slice product for the domestic market.

Mangoes are generally purchased from the wholesale market at normal wholesale prices. No quality standards are communicated to potential suppliers; mangoes are purchased mature green and ripened using calcium carbide on the processor's premises. Fruit is then graded for processing. Bruised, rotten or unripened fruit are removed. After processing, skins are discarded and seeds supplied to the nursery industry.

Although its inherent quality is suitable and supply is available, very little processed mango is exported from Pakistan, mainly due to competition from a more organised mango industry in India.

*Note: In Pakistan, the word 'processing' is often used to refer to postharvest treatment, grading and packing rather than to the accepted meaning as manufacture of secondary products from fresh produce.*

## **3.2 The Pakistan export market for mangoes**

### **3.2.1 Overview**

Pakistan currently exports 7 to 10 per cent of its total crop, in 2004 equating to 77 400 tonnes with a total value of USD23.4M. This had grown from 47 600 tonnes in 2000 with a total value of USD11.6M ( Fig 1).

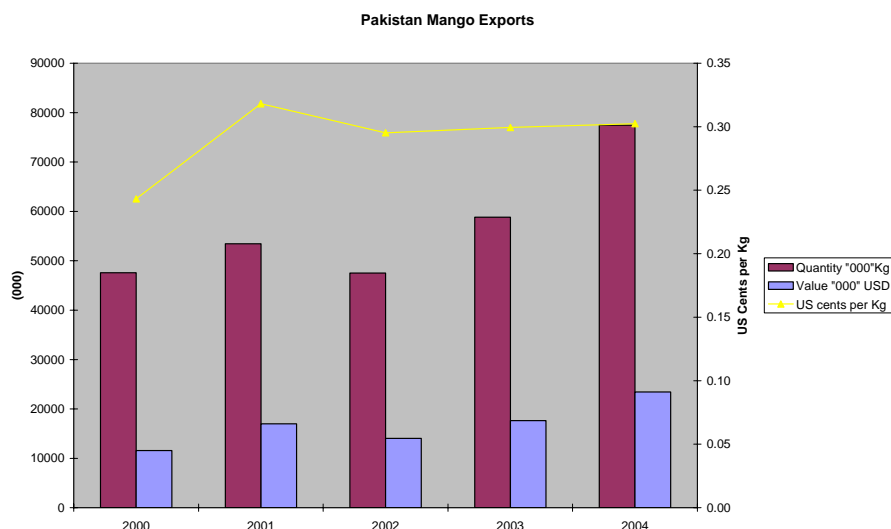


Figure 3.1: Pakistan mango exports 2000-2004.

Whilst volumes have grown over the past five seasons the returns per kilogram have not, remaining relatively static at around USD0.30 per kg, giving Pakistan mangoes the lowest return per kilogram of any major mango exporter in the world (Table 3.1). Exports are heavily focused on Middle East markets, particularly Dubai, Saudi Arabia and Oman, largely due to Pakistan's close proximity. As the supplier of some 63 per cent of total exports to the region, Pakistan plays a dominant role.

Table 3.1: Returns for major mango exporting nations, and Australia

Country	USD/kg
Australia	1.79
Philippines	1.59
China	0.91
South Africa	0.79
Brazil	0.55
Mexico	0.54
India	0.48
Thailand	0.46
Pakistan	0.30

Source: FAO ([faostst.fao.org/faostst](http://faostst.fao.org/faostst))

It is interesting to note (Table 3.2) that Pakistan mangoes are receiving very low prices in two major markets that are generally considered higher priced markets, the EU and the Middle East. This not only emphasises the impact of Pakistan's present low quality production and marketing systems, but also the potential returns from improving these systems.

Table 3.2: Export destinations, volumes and values for Pakistan mangoes

	Quantity ('000kg)	Value (USD'000)	Value (USD/kg)
Bangladesh	50	29	0.58

Belgium	27	13	0.48
Sweden	158	74	0.47
Norway	615	276	0.45
Germany	806	343	0.43
Bahrain	1453	590	0.41
Italy	116	46	0.40
Singapore	265	100	0.38
Netherlands	366	137	0.37
Switzerland	196	73	0.37
Denmark	154	57	0.37
Saudi Arabia	13224	4810	0.36
Malaysia	267	96	0.36
UK	8052	2834	0.35
Qatar	667	212	0.32
Kuwait	2568	739	0.29
UAE	33604	9395	0.28
France	950	259	0.27
Others	4685	1245	0.27
Oman	9245	2098	0.23
TOTAL	77 468	23 426	0.30

Source: PHDEB

### 3.2.2 Modes of transport

The majority of mango exports from Pakistan are sent via Karachi, either by air or sea (Table 3.3). All exports to Europe and the eastern Asian markets are by air although in 2005 three trial container shipments were sent to Singapore by sea with mixed results (P. Koh, Freshmart Singapore, pers comm). Airlines operating freight services out of Pakistan are PIA, Emirates and Singapore Airlines.

Sea shipments use standard 40 foot refrigerated containers, dry containers or open containers (with sides but no roof). Vessels range from large container ships owned by global shippers such as Maersk, to locally owned small barges. Significant changes to the Dubai trade are being made after the 2006 season when open containers will no longer be allowed. This may mean that open containers are diverted through ports such as Oman.

It is believed that in the near future, exports to China, ex-soviet states and Eastern Europe will be possible via road over the Himalayas. Trade with Iran has just opened up with promising results from road shipment.

**Table 3.3: Modes and shares of mango export trade from Pakistan.**

Destination	Air	Sea	
		Reefer	Non-reefer (includes open containers)
Middle East	40%	30%	30%
Eastern Asia	100%		
Europe	100%		
Others	75%	10%	15%

Source: PHDEB

### Transport issues

- There is limited Air space out of Pakistan during the mango season, as all airfreight currently goes on passenger planes, and there are no dedicated cargo flights for mangoes (consistent with experiences in other countries where the cost of dedicated cargo flights is generally too high for mangoes). Short notice given to exporters regarding air space availability means that they are forced to source from nearby Karachi and Sindh markets.
- There is limited suitable lifting equipment for air pallets at Karachi Airport.
- Many exporters complained about the limited cool storage capacity at Karachi airport and that loads were often left sitting on the Tarmac when ambient temperatures could exceed 40°C.
- Karachi Port is not particularly efficient and delays are common for both arrivals and departures. Mearsk indicated there were sometimes difficulties in locating enough containers in Karachi to meet peak demands, but they believed that this was being adequately addressed.
- Many of the small vessels sending fruit to the Middle East are slow, inefficient and barely seaworthy, but continue to be used due to cost.
- Open containers offer no protection or temperature control.
- Many exporters have no cooling facilities and rely on reefers for cooling.
- There is limited knowledge about storage and shipping conditions and temperatures.
- Insurance for Pakistan mango sea shipments is not available.

### 3.2.3 Packaging

Most of the exports to the Middle East are in the locally made, roughly nailed wooden crates which are designed to hold about 10kg, but are overloaded to 13-15kg as it is believed that this minimizes the chance of fruit moving in the crate during transport. Fibreboard cartons are used for other export markets and some Middle Eastern markets, their sizes ranging from 1.5kg gift packs to 9kg bulk boxes. Each exporter appears to have a preferred packaging system (see Plate 3.1). Some were importing cartons from the UAE. No waxed or water resistant cartons were mentioned or observed. Design of cartons for adequate airflow was poor and carton strength was mostly inadequate.



**Plate 3.1: Variations in export carton sizes and specifications**

### **Issues with packaging**

- Lack of consistency among exporters.
- Exports to the Middle East were mostly in rough wooden crates.
- Carton design strength and airflow is inadequate for sea freight.
- No moisture resistant cartons appear to be available
- Carton collapse is a common complaint along the export supply chain.

### **3.2.4 The export cool chain**

Currently there is no effective cool chain between the farm and the exporter, with fruit arriving at exporters' premises at ambient temperature. Only one exporter visited had a forced air cooling system, a few had conventional cool rooms, some relied on reefers for cooling, others used open containers and had no interest in cooling fruit. Most exporters were not cooling fruit shipped by air. Mearsk indicated they are able to organize refrigerated transport to pick up fruit from growing regions if consolidation cool rooms were available in those locations.

### **Issues with the cool chain**

- Little cool chain infrastructure pre-shipment.
- Limited knowledge and understanding of mango cool storage requirements.
- Consignments sent at inappropriate temperatures.

### **3.2.5 Product outturns**

As noted above, Pakistan has a reputation for poor quality cheap mangoes, particularly in the Middle East and the UK (Plate 3.2). In other markets such as Singapore they are considered to deliver fruit of inconsistent quality and short shelf life. However there is wide consensus that Pakistan varieties do have excellent eating qualities.





**Plate 3.2: Pakistan mangoes in UK (left) and Dubai (right) wholesale markets**

### **Issues with outturns**

- Carton collapse
- Short shelf life and breakdown from disease
- Dehydration and shrivelling
- Physical damage (bruising, crushed fruit, nail damage)
- Sap burn
- Contamination, for example by calcium carbide residues.
- Inconsistent sizing and wide variation within the same carton.
- Pulp temperature on arrival - both extremely high and low.
- Inconsistent ripening
- Overripe fruit.

### **3.2.6 Exporters**

There is very little regulation and no accreditation of mango exporters in Pakistan. Consequently there are many exporters undertaking various roles in the system from specialist exporter, to exporter and commission agent, to exporter and importer, to exporter commission agent and contractor. Apart from the general requirement to register as a business (Sales Tax Number and National Tax Number), and the specific requirements of destinations that require certified disinfestation treatments, there appear to be no other impediments to exporting.

The Pakistan government has a policy of substantially increasing export earnings and has announced a five-pillar development strategy. Mango exporters could benefit under this strategy by gaining preferential access to newly negotiated markets (Iran was such a case in 2005 and China is a current example), and by benefiting from government investment in infrastructure and capacity building ([www.commerce.gov.pk](http://www.commerce.gov.pk)).

### **Issues with exporters**

- Limited knowledge of appropriate use of existing infrastructure, graders, hot water treatment and cool rooms in relation to mangoes
- Most exports are on consignment
- General poor knowledge of product outturn and performance
- No consistency of packaging among exporters
- Limited knowledge of export market requirements

### **3.3 Market characteristics**

#### **3.3.1 Europe**

The UK is by far the largest importer of Pakistan mangoes in the EU, and almost all of the business is conducted between Pakistani exporters and family importers in the UK. None of the exporters interviewed indicated that they were conducting business with any of the three main importers in the UK: Minor Wear & Willis, Utopia or Weelmore. To access major supermarket chains in the UK, exporters would have to work with one of these companies. Pakistan mangoes are therefore being sent to wholesale markets servicing expatriate Pakistanis and Indians in the UK. This is considered a very price sensitive segment of the UK market and on arrival fruit moves very quickly through the chain due to its short self life. None of the exporters interviewed were able to discuss claims or quality outturns in the UK market.

Significant exports are also being directed to continental Europe, for example to the Rungis markets in Paris. This market is very discerning about quality and is conservative about new or unfamiliar products (eg. it is unfamiliar with soft yellow mango varieties) and can discount heavily under these circumstances. It was not possible to identify which consumer segment is purchasing Pakistan mangoes in continental EU. There was no evidence that major EU supermarket chains were carrying Pakistan mangoes.

#### **3.3.2 Middle East**

The Middle East, particularly Dubai, has become a dumping ground for Pakistan mangoes. The sheer volumes and poor quality, particularly from open container shipments, drives the whole market down to a point where it is very difficult for exporters with better quality product to achieve profitable margins. The vast majority of Pakistan mangoes entering the Middle East appear to be consumed by expatriate workers through the wholesale market system. Like the UK, this is a price sensitive market, accustomed to poor quality fruit at cheap prices. Only one exporter interviewed was supplying Spinneys supermarkets and Carrefour in Dubai and was prepared to produce to a quality standard. Future growth of the supermarket sector in the Middle East, combined with the ban on open container shipments, could see increased demand for higher quality mangoes in this market.

#### **3.3.3 Singapore**

Whilst this is not a large market for Pakistan mangoes it is a good indicator of their performance in other markets. Almost all of the fruit is received by air, with variable outturns. Carton collapse, shrinkage and disease breakdown appear to be the major problems. Three trial shipments were sent by sea in 2005 and the importer was pleased with two of them. Supermarkets are very cautious about receiving Pakistan mangoes by sea. There appears to be widespread appreciation of the sweetness and flavour of Pakistan mangoes in Singapore, counterbalanced by widespread agreement that quality is not often up to standard. Mangoes are sold through wet markets as well as supermarkets, and both importers and retailers agree that if quality were improved, there is significant potential to expand this market.

### **3.3.4 Emerging Markets**

There is considerable optimism about new and emerging markets, particularly China and Iran, which are both accessible by land. Both of these markets require fruit fly disinfestations and suitable facilities are currently available with three Karachi exporters. However, there are significant knowledge gaps as to how to apply treatments such as hot water treatment. Eastern Europe and the ex-Soviet states are also seen as emerging markets.

## **4. Addressing Objective 2: Components and impediments in representative supply chains for mangoes in Pakistan**

### **4.1 Introduction**

In this section, the roles of the various participants in the supply chain are described and analysed in terms of their impact on fruit quality. Then three types of supply chains are analysed in detail, from the point of view of four sub-systems: product, value creation; information and governance.

### **4.2 Supply chains: participants' roles, functions and effects on quality**

#### **4.2.1 Growers**

Pakistan mango growers operate that range in size from less than two hectares to over 400 hectares. It was suggested that growers fall into three groups: small growers (greatest in number) manage up to 20 hectares, medium sized growers manage 20 to 40 hectares and large growers (smallest in number) manage more than 100 hectares. The same source suggested that 20 per cent of the growers produce 80 per cent of total production. As noted above, mango growers in Pakistan do not usually harvest their own crops, relying instead on contractors.

#### **Grower practices and activities that can affect mango quality**

- No tree pruning causing
  - skin damage/rub from branches
  - increased disease inoculum and postharvest rot development
  - difficulty of harvest leading to bruising during harvesting.
- Poor pest and disease management practices leading to
  - damage from insects (thrips and fruit fly)
  - disease in the fruit (bacterial spot and postharvest rot development).
- Poor fertiliser and irrigation practices leading to poor fruit development and fruit unsuitable for long term storage.

#### **4.2.2 Contractors**

The role of contractors is to 'buy' the crop and manage it (irrigation and pest management) after fruit set, harvest the crop and pack it, from which point it will be delivered to commission agents. Contractors buy crops by estimating the yield once fruit has set and negotiating with the grower on a price per *maund* (40kg) for each variety. Contractors are guided, financed and given information by commission agents to whom they are effectively financially bound. One contractor can manage up to 400 hectares, but the average medium sized contractor manages 20 to 40 hectares. Contractors employ

about one labourer per hectare and larger contractors employ field supervisors at a rate of about one supervisor per 20-30 labourers.

#### **Contractor practices and activities that can affect mango quality**

- Poor tree management practices up to harvest
- Poor harvesting techniques – fruit is often dropped from the tree by either cutting or hitting with a pole, causing severe bruising.
- Trees are once-over harvested, ensuring that a portion of fruit will be immature.
- After harvest fruit is often placed in piles until removed from the orchard. This can cause bruising, heating (accelerating ripening), disease infection (*Aspergillus*) and sap burn.
- Little or no desapping is practised, resulting in major sap burn.
- Poor grading and packing – this is usually carried out in the field or sometimes in open sheds with earth floors. Fruit is sorted in piles then usually packed in roughly nailed wooden crates lined with newspaper.
- Wooden crates are packed until they bulge and the lid is nailed on (called 'belly' packing). Damage occurs from bruising and punctures by nails in the crates.
- No cool chain practices are adopted as no facilities are available, causing short shelf life as mangoes are harvested at up to 50°C air temperature.

#### **4.2.3 Commission agents and wholesalers**

Commission agents are the linchpin in the supply chain. They finance the operations of the contractors, and through them, the operations of growers, especially smaller growers. A small grower is paid in advance for his crop at fruit set. He lives off this advance until next season, but many run out of cash before the next season starts. At this point the commission agent again finances them in advance for the purchase of crop inputs, effectively binding them to the agent for another season. One large commission agent reported that he has outlaid more than USD6 million to growers before each season's harvest begins. Rates charged by commission agents for their services were reported as ranging from 6 to 10 per cent, although the total margin captured by them was reported as between 20 and 30 per cent. Commission agents control the product and the information in the supply chain more than any other participant. Commission agents usually operate from wholesale markets, where their product is auctioned to wholesalers, who may then sort and regrade fruit before selling it (in the wholesale market) to buyers, especially street vendors.

#### **Commission agent practices and activities that can affect mango quality**

- Commission agents are the powerbrokers in the chains, requiring growers to overpack crates which should weigh 10kg, but typically weigh 12-15kg.
- They also request overloading of trucks so they minimise the cost of transport and market levies (charged on a per truck basis).

#### **4.2.4 Retailers**

Domestic retail is dominated by street vendors who compete on price, have no capacity to cool store fruit and manage their daily-acquired inventory by

price discounting. Specialist higher quality retail outlets are very rare, but the arrival of multinational supermarkets in Pakistan in the near future is expected to introduce new standards to domestic fruit retailing. Retailers try to maintain fruit quality by purchasing only one day's supply at a time, keeping fruit shaded, and regrading fruit to customer requirements. The last fruit to be sold each day may achieve prices as low as Rs5-10/kg.

#### **4.2.5 Exporters (see also 3.2.6)**

Less than 10 per cent of total production is exported and almost none of the crop is grown specifically for export. Most fruit for export is sourced from commission agents, and most is graded and packed by hand with no other postharvest treatment. Many exporters are also commission agents and many commission agents are also exporters. Most exports are of low value product to Middle Eastern markets, notably Dubai. Many importers are Pakistanis living abroad.

#### **Exporter practices and activities that can affect mango quality include:**

- Poorly developed knowledge and implementation of postharvest practices such as heat treatment, disease control and storage
- Poor inventory management because of poorly developed market information systems
- Limited knowledge of markets and their individual requirements

#### **4.2.6 Domestic transporters**

Domestic transporters play an important role in getting fruit from farm to agent, and agent to destination market. Commission agents order and control transport, most of which is on high-sided body trucks with a nominal load capacity of around 7 tonnes. Overloading by up to 100 per cent is a feature of the system, supposedly to reduce transport costs per unit, and market levies which are on a per truck basis.

#### **Transport practices and activities that can affect mango quality**

- Overloading of trucks – often pack 1,000 crates on a truck instead of 500 (truck capacity) causing crushing of lower crates.
- Long times taken for loading and unloading – takes around two hours and one and a half hours respectively, leading to shorter shelf life.
- 60% of roads in Pakistan (particularly in rural areas) are unsealed and in poor repair. Trucks have basic suspension systems leading to impact injury of fruit.
- Loads are unrefrigerated and often uncovered, leading to shorter shelf life as top layer boxes easily overheat.

Export transport issues are discussed in section 3.2.2.

#### **4.2.7 Processors**

There is a minor but growing processing industry producing mango pulp and value-added products such as mango drinks and ice cream. The quality of processing systems investigated varied from basic unfiltered puree kept in drums in cold storage to aseptically packaged, bag-in-drum, UHT treated, super-filtered pulp. No data are available on the mango processing industry in

Pakistan, but it seems that less than 3 per cent of the crop is processed annually.

#### **4.2.8 Importers (see also section 3.2)**

Many importers are Pakistanis living abroad, and most exports are of cheap low quality fruit targeted at local expatriate Pakistani communities. Importers in Singapore indicated that they would pay higher prices for better quality fruit from Pakistan because of its inherent attractiveness (size and sweetness) to local Chinese and Malay consumers.

#### **4.2.9 Consumers**

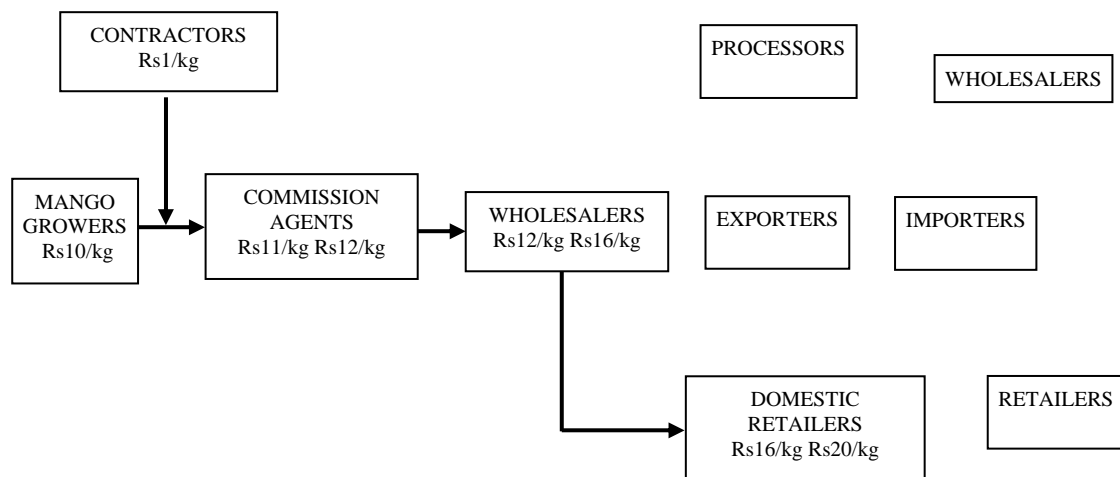
Mangoes are a very important fruit to domestic consumers, who were reported as being discerning about quality, aware of varietal differences, yet very price sensitive. Expatriate consumers in export markets such as the Middle East and the UK are likely to behave similarly to domestic consumers. If the industry were able to produce reliable supplies of higher quality mangoes, there may be opportunities to target European and other Asian consumers.

#### **4.2.10 Government agencies**

The mango industry is supported by activities of the Pakistan Horticulture Development and Export Board (PHDEB), a government agency set up in recognition that there was no “single ministry or institution responsible for development at all levels of the horticulture value chain” (PHDEB). As tariffs on imports are phased out by the WTO, export market development activities of the PHDEB will take on added significance. The Pakistan government has a policy to invest in infrastructure such as better roads and port facilities.

### **4.3 The domestic retail supply chain**

As with most horticultural products, there are numerous generic supply chains associated with the marketing of Pakistan mangoes. The most important of these in terms of volume is the supply chain that delivers to the mass domestic market for mangoes serviced by the street vendors and small retailers throughout the country (Figure 4.1). The values (Rs/kg) in this figure show the typical values of the fruit as it moves along this chain. Note that these are gross values, out of which each participant pays their operating costs. Wholesale and retail values in Figure 4.1 are from secondary sources, ie. not verified by the participants themselves.



**Figure 4.1 Typical domestic mango supply chain through street vendors**

This chain is characterised by a production base dominated by small and medium sized farmers who make up 90 per cent of the mango growers and whose product is sold in the wholesale markets of Lahore, Islamabad, Multan and Karachi. These growers rely on contractors to harvest, sort and pack fruit on the farm and arrange transport to wholesale markets. Commission agents are responsible for conducting the sale of the fruit to wholesalers via an auction system. The chain's activities are controlled by the Commission Agents who provide finance to the contractors and determine the scheduling of the flow of fruit from the contractor to the wholesale market.

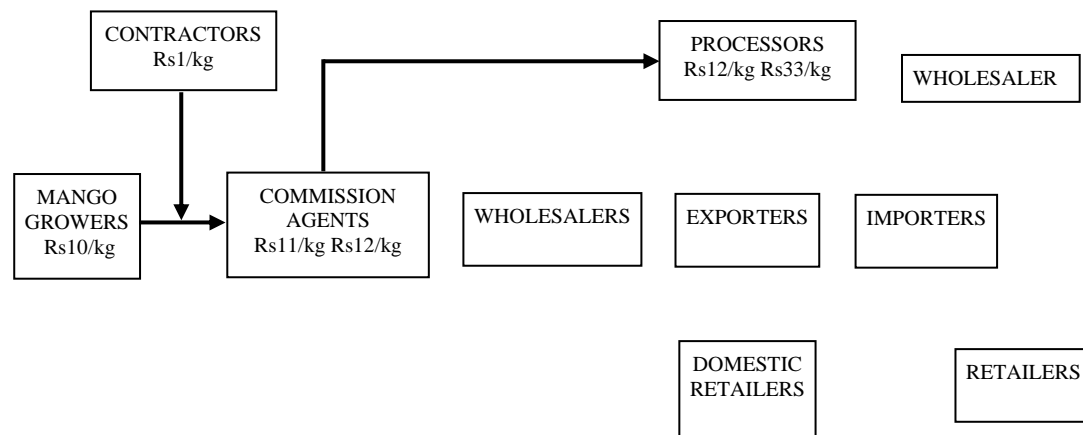
While interviews were conducted with growers, contractors and commission agents to clarify their individual roles in the chain and to identify their real or perceived impediments to the efficient operation of their supply chain, it was not possible to conduct similar interviews with representatives of street vendors and small retailers in the time available.

### **The major impediments in this supply chain**

- The product subsystem: the poor quality of the product that reaches the final consumer is the result of poor production systems coupled with inadequate harvest and postharvest handling, storage and transport systems.
- The communication subsystem: the absence of effective information flows within the chain inhibits any feedback from the market apart from average price information which is available for each of the major wholesale markets.
- The value subsystem: there is a wide variation in the prices quoted at the farm, market and retail level. There is no apparent system that rewards quality, mainly because there are no systems in place to monitor or control quality. Figure 4.1 is indicative only, showing average prices quoted during interviews.
- The governance subsystem: the dominant role of the commission agents may result in vested interests preserving the status quo.

#### 4.4 The domestic processed product supply chain

Processing of mangoes is limited and focused on the production on mango pulp for use in manufacturing drinks and ice cream.



**Figure 4.2 Typical domestic mango pulp processing supply chain**

In general, processors source their raw material through the wholesale markets where the prices paid for processing mangoes were the same as for fruit destined for the retail market. It seems not to be possible for processors to forward order fruit of a particular quality delivered to a particular supply schedule. The values (Rs/kg) in this figure show the value stream of the fruit as it moves along the chain. Note that these are gross values, out of which each participant pays their operating costs. The processor return of Rs33/kg is the value of pulp, which at a 60% recovery rate of pulp from fruit, represents a fruit equivalent value of Rs20/kg.

#### The major impediments in this supply chain

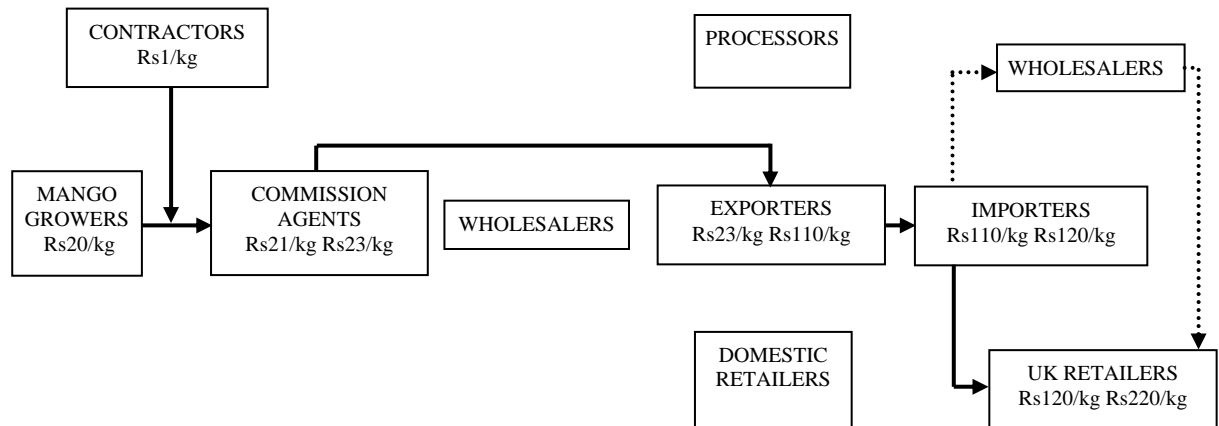
- The product subsystem: the processors reported difficulty in sourcing product that meets their specifications of quality (mature but unripened) or quantity via the wholesale markets.
- The communication subsystem: there was very little effective flow of information within the chain.
- The value subsystem: there appeared to be little understanding on the part of the processors of their market or what they needed to do to develop it; the processors claimed that demand for their product exceeded supply yet their plant utilization rates appeared to be very low (20-25 per cent of capacity).
- The governance subsystem: the dependence on the wholesale markets to source product was a weakness because of the relative unimportance of the processors to commission agents.

#### 4.5 The export supply chain

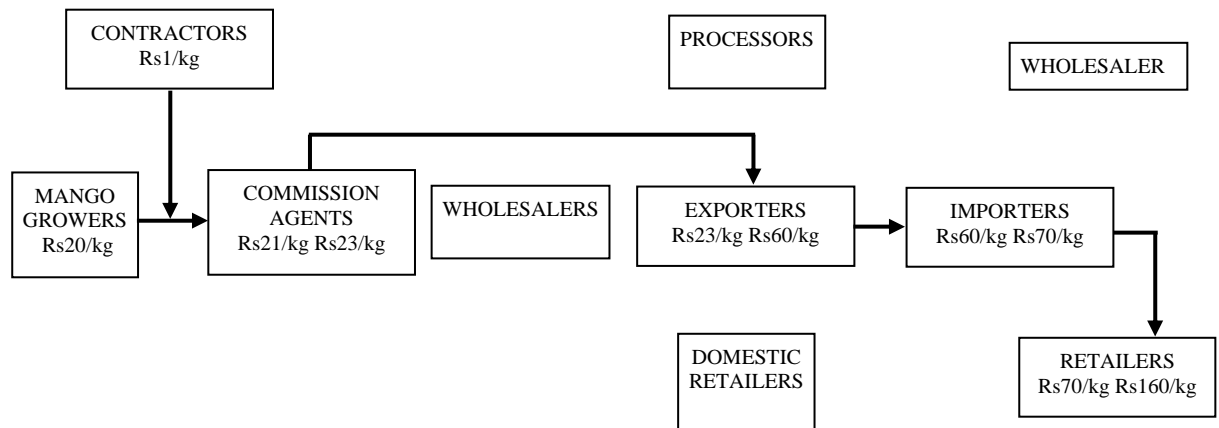
The major export destinations for Pakistani mangoes are the Middle East, the UK and Europe, with smaller quantities going to markets such as Singapore. Most exports are consumed by expatriate Pakistanis and others from south Asian communities living abroad. Figures 4.3 and 4.4 show typical supply chains for mangoes air freighted to the UK, and sea freighted to Singapore,



respectively. The average value of the product as it passes from one chain member to the next is shown in Rs/kg.



**Figure 4.3 Typical Pakistan -UK export supply chain for air freighted mangoes**



**Figure 4.4 Typical Pakistan - Singapore export supply chain for sea freighted mangoes**

Approximately 80 per cent of mangoes for export are sourced from commission agents in wholesale markets, with the remainder directly purchased from the larger farms through their agents. The values (Rs/kg) in figures 4.3 and 4.4 show the value of the fruit as it moves along the chain. Note that these are gross values, out of which each participant pays their operating costs. All values were verified by participants. In the UK, importer and wholesaler functions are often combined in the one firm.

### The major impediments in export supply chains

- The product subsystem: there was no effective quality management or trace-back system available for product sourced from the wholesale markets; there is a lack of documentation concerning appropriate handling and transport systems.
- The communication subsystem: there was an absence of effective information flows within the chain; and an absence of any market research on existing or potential export markets.
- The value subsystem: while the eating qualities of Pakistani mangoes were widely recognized, market development and profitability were

being undermined by the perception of low quality, short shelf life and inconsistent supply.

- The governance subsystem: there was a perception that exporters were opportunistic and not really interested in long term market development partnerships with importers.

## **5. Addressing Objective 3: Identify options to build better commercial linkages between all components of the supply chain**

### **5.1 Introduction**

The analysis of supply chain components and impediments in the previous section demonstrated that there is considerable potential to improve the performance of Pakistani mango supply chains. This section builds on that analysis by examining each level of the supply chain from grower to retailer, and each sub-system of the supply chain, to identify a range of approaches to improving supply chain performance. The purpose of this stage of the scoping study is to inform the content and execution of a research and development program whose aim is to improve the low competitiveness of Pakistan's mango supply chains.

In discussing these options, an assumption is made that the best practice models of supply chain management in horticultural industries, most of which reflect business strategies of western developed economies, can help to improve the Pakistani mango industry. It is acknowledged that being able to accommodate the distinct cultural, economic and social settings of Pakistan will be a critical factor in determining what value can be gained from adapting traditional supply chain management models to this country's specific situation.

Options to build better supply chain linkages may be identified for each type of participant in the chain and for each sub-system of the chain.

### **5.2 Options for supply chain participants**

#### **5.2.1 Growers**

The analysis of impediments has shown that all growers, whether large or small, need better access to information, specific skills training and more incentive to take responsibility for the quality of mangoes they produce. Growers are relatively disempowered in the supply chain and would benefit from two different types of alliances.

Firstly, alliances among growers could provide a platform for learning and skills development, achieving efficiencies in sourcing inputs and aggregating production into larger lots. Secondly, better linkages with other supply chain participants such as contractors, agents and exporters would provide a vehicle for feedback that is essential to improving their performance.

#### **5.2.2 Contractors**

The performance of contractors was rated as low in terms of its impact on product quality. Their operations are guided and financed by commission

agents, to the extent that contractors may have little power to voluntarily change their present practices. It is clear that improving the commercial linkages between contractors and other chain members would require the support and encouragement of commission agents.

Group meetings and one-on-one interviews with commission agents and contractors in Multan, Karachi and Hyderabad identified a need to improve the performance of contractors. Activities such as training programs, the registration of contractors and the formation of a contractor reference panel to determine training needs were suggested and supported by commission agents as well as contractors. These activities would be a first step in improving the linkages between contractors and mango supply chains because their aim would be to create more value in the chain by improving fruit quality.

### **5.2.3 Commission agents**

Commission agents hold most of the power in the supply chain, and any chain improvement strategy would depend on their support and involvement. Interviews with agents identified some who would be willing to become involved in projects that address the issues of low fruit quality and high losses in the supply chain. Working with them to improve overall supply chain performance would involve addressing the amount of power they have in present chains as well as the share of value they capture (see section 5.3.2 below). This will be a significant challenge.

### **5.2.4 Processors**

Three specialist processors were interviewed, between them producing 1 000 to 5 000 tonnes of mango pulp per year. Two of them expressed concern that processors were seen as a dumping ground for lowest quality fruit when in fact their requirement was for sound, fully mature mangoes. A third interviewee had integrated their processing operations with a large scale commission agent/export business and was able to access an adequate supply of fruit for processing.

Improving commercial linkages with processors will involve education of suppliers about processors' needs and their ability to pay for fruit that meets those needs.

### **5.2.5 Exporters**

Exporters expressed a wide range of concerns over fruit quality and the performance of the supply chain. Some of their practices, for example shipping mangoes at 4 degrees C, and hot water dipping for less than 5 minutes expecting to control fruit fly, had no scientific basis. A very wide range of practices was in use, each exporter doing what they thought to be 'the right things'.

Not surprisingly, exporters were eager to learn how to extend mango shelf life and how to access new markets. Most expressed support for supply chain building projects that involved all participants and some said that they would be prepared to share any value created by such projects with other chain

participants. There is a clear need for technical information to improve exporters' practices.

### **5.3 Options for improving mango supply chain sub-systems**

Modern supply chain management involves the management of four sub-systems within the supply chain with the aim of improving the competitiveness of the firms with the chain by improving the competitiveness of the chain as a whole. Competitiveness may be seen as an emergent property of the supply chain as a complex, dynamic system. Thus the interactions among the sub-systems are as important in determining competitiveness as the features of the sub-systems themselves. The four sub-systems revolve around product quality, value creation and appropriation, information, and governance.

#### **5.3.1 Product quality systems**

Improving product quality and reducing quality-related losses in the chain has been identified as the highest order priority. Achieving such an improvement will require a multi-faceted strategy focused on the determinants of product quality at each stage of the chain from grower to retailer. A critical element will be the resolution of a range of pre-harvest crop management issues that affect fruit yield and quality. This is the subject of a separate scoping study (SRA HORT-2005-154) whose results integrate with those of this study.

It will be impossible to improve commercial linkages in the chain without improving fruit quality. Results of this scoping study clearly indicate that fruit quality improvement must be the starting point before issues of value creation, information management and governance can be tackled. It is anticipated that achieving 'early wins' in improving fruit quality will be possible, and that these will provide strong motivation for involvement in subsequent activities by supply chain members, and may help to ease tensions that exist among growers, contractors and commission agents in relation to tree and crop management.

#### **5.3.2 Value creation and appropriation**

In general, Pakistani mango supply chains are very low on value creation, and this value is appropriated unevenly (see supply chain maps above). Low value results from low fruit quality, low ability to pay on most domestic markets, underdevelopment of higher value export markets, and relatively low value added by the processing sector. The asymmetric appropriation of value is a reflection of the asymmetry of power in the supply chain, ie. the relatively powerful positions taken by commission agents and exporters.

Options to improve the value stream need to ensure that value is coupled with quality, with a view to creating more value and sharing it more equitably. An equitable share of value provides the motivation for members of the supply chain to remain committed to making the changes necessary to improve overall performance.

#### **5.3.3 Information systems**

Results show that information flow mirrors value appropriation. Wherever critical information is able to be withheld from other members of a chain, value

is appropriated that might otherwise flow to those other parts of the chain. Options for improving information systems vary from industry-wide approaches, to specific strategies for individual chains.

### 5.3.4 Governance

Coupled with asymmetric value appropriation and information flows, there is a distinct concentration of power in almost every type of supply chain examined in this study. Based on preliminary evidence, this power is generally used to ensure the continuation of the present system. That is, those with the most power continue to use it to ensure that they appropriate as much of the value created as possible, aided by their ability to manage information flows. Somewhat ironically, this also explains why information about the need to improve fruit quality does not flow to where it is can be acted upon, in the process reducing the overall value created by the chain.

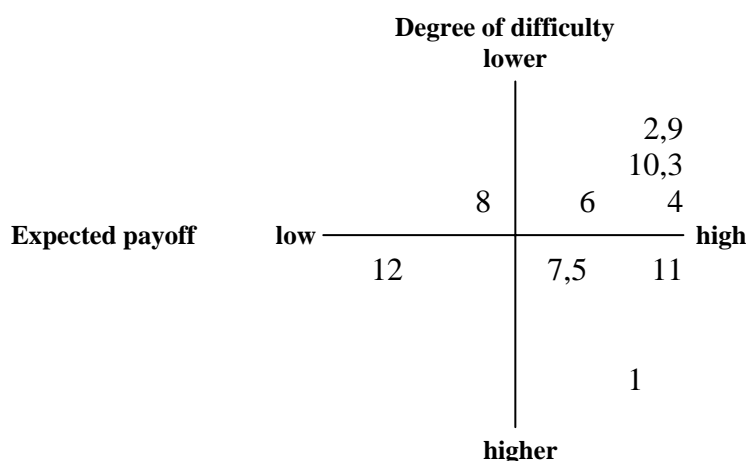
### 5.4 Possible approaches

Approaches to improving supply chain linkages and performance can be applied at the industry-wide level, at the level of participants in one part of the chain such as growers, contractors, transport operators, etc., or at the level of a specific chain with a specific market in mind. Activities that improve performance include training, research, demonstrations and capacity building for supporting agencies such as universities, extension services, promotion boards and commercial providers. The overall benefits from any approach to supply chain improvement can be rated as a function of the payoff from that approach combined with the degree of difficulty of executing the approach.

Table 5.1 summarises the expected benefits from 12 possible approaches to supply chain improvement. The rating in each cell is a combination of the degree of difficulty of that approach and its expected payoff, as identified in Figure 5.1. The number in each cell is used to identify that approach in Figure 5.1.

**Table 5.1: Expected benefits from approaches to supply chain improvement**

<b>Level/type of approach</b>	<b>Training</b>	<b>Research</b>	<b>Demonstration</b>	<b>Capacity building</b>
<b>Industry-wide</b>	Low 1	High 4	Medium 7	High 10
<b>Specific level in the chain</b>	High 2	Medium 5	Medium 8	Medium/High 11
<b>Specific to a particular chain</b>	High 3	Medium 6	High 9	Low 12



**Figure 5.1: Payoff and degree of difficulty of twelve approaches to supply chain improvement**

These results of this analysis show that:

1. a combination of approaches applied in a combination of ways is most likely to provide the greatest overall benefit;
2. a high value attaches to approaches that are specific to particular supply chains; and
3. there are significant benefits from industry-wide approaches to
  - a) research, and
  - b) capacity building among supporting agencies.

These outcomes were used in formulating the R&D strategies outlined below.

## **6. Addressing Objective 4: Recommendations for an R&D project**

The results of the workshop in Multan, along with subsequent scoping study findings, were used to identify research and development priorities.

### **6.1 Workshop outcomes**

At the Multan workshop, possible R&D activities were identified by working groups. These were broadly divided into activities in the areas of postharvest systems and supply chain management in addition to the areas of production research which are the subject of the companion SRA (HORT/2005/154 - *Assessment of mango diseases, pest and production problems in Pakistan*). From the lists of possible activities, those that were judged by participants to be most researchable and having the highest payoffs were identified, then combined into two broad R&D objective areas as indicated below. It is proposed that these will form the basis of project development under (PLIA/2005/157 *Optimising mango supply chains for more profitable horticultural agri-enterprises in Pakistan*).

Possible postharvest and quality management activities (those judged most researchable are shown in bold)

- **Cool chain management**
- **Handling systems**
- Disinfestation
- **Disease and disorder management**
- Traceability and certification
- Packaging
- Quality protocols
- Value addition
- **Training in postharvest systems**
- Economic performance

**R & D Outcome 1 Recommendations for quality improvement and maintenance in Pakistan mangoes**  
***Cool chain management; handling systems; disease and disorder management***

Possible supply chain management activities (those judged most researchable are shown in bold)

- More value added mango products
- **Create examples of modern supply chain management**
- How to comply with standards
- Improving the marketing intelligence system
- **Identify costs and inefficiencies in the chain**
- Supply chain infrastructure needs
- **Creation of farmer alliances**
- Empowerment of the PHDEB
- Export processing zones
- **Develop a domestic marketing strategy**
- Survey of present mango processing activities
- **Identify different supply chain management systems**
- **Case studies of successful exporting countries, eg. Mexico**
- **Market research – consumer needs**
- Create database
- **Identify new markets**

This process created two key R&D outcomes.

**R & D Outcome 2 A market development strategy for Pakistan mangoes**

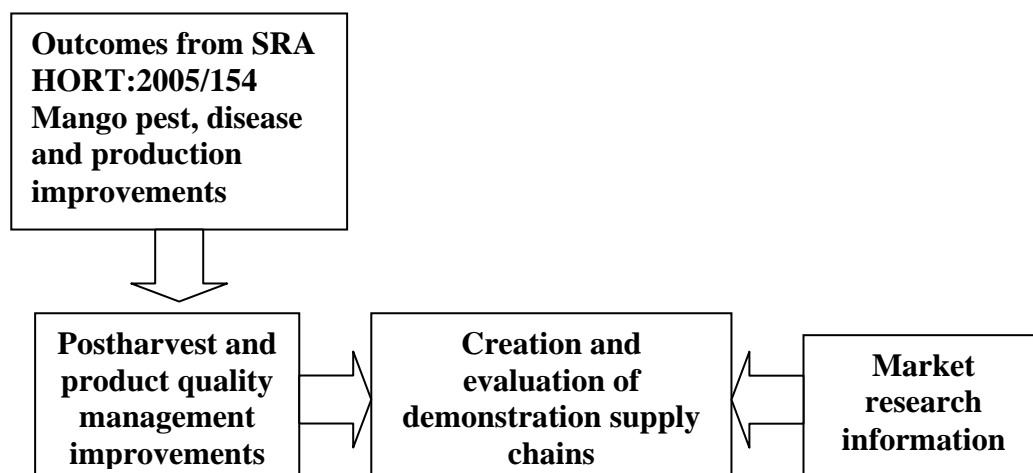
*Evaluating present domestic and export marketing performance; identifying consumer needs; examining potential new markets; case studies of successful exporting countries.*

**R & D Outcome 3 A demonstration supply chain for Pakistan mangoes**

*Reflecting modern supply chain management approaches; based on the development and implementation of appropriate postharvest and product quality management practices; based on market research; domestic and export focused*

These will be underpinned by and complement the R&D activities that will be developed as outcomes of the parallel SRA: HORT/2005/154 - *Assessment of mango diseases, pest and production problems in Pakistan*, as shown in Figure 6.1.

A schematic representation of the relationships among project elements outlined above is shown in figure 6.1.



**Figure 6.1: Relationships between project outcomes**

**6.2 Post-workshop scoping study outcomes**

After the workshop, the objective of scoping study activities was to validate potential R & D outcomes defined from the workshop with stakeholders from all parts of the mango industry. In a general sense, findings were consistent with workshop outcomes. No major changes were suggested, and the validity of working on the three R&D outcome areas identified in section 6.1 was confirmed.

**6.3 The R&D proposal**

Three objectives for PLIA/2005/157 *Optimising mango supply chains for more profitable horticultural agri-enterprises in Pakistan* are proposed. They are

1. Mango quality improvement and maintenance
2. Market research
3. Developing demonstration supply chains



A fourth objective relating to the need for capacity building will be addressed through each of the other three. Thus each objective will encompass R&D, capacity building, training and demonstration activities.

### **6.3.1 Objective 1: Mango quality improvement and maintenance**

Aim	To develop recommendations and technical capacity to improve and maintain mango quality
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Relevant ASLP Scoping Study Objective: *To identify present market needs and likely future opportunities for Pakistan mangoes, using this information to inform the analysis of existing supply chains and the development of improved supply chain management systems and practices.*

#### **1. R&D activities**

The desired outcomes from these activities are:

1. To enhance and maintain mango quality in the supply chain
2. To understand the basic physiological attributes of cultivars Sindhri and Chaunsa
3. To improve on current post harvest practices with Sindhri and Chaunsa, increasing their shelf life and marketability

#### **Activities**

##### Activity 1

The initial activity is to undertake a hands-on working case study of an Australian export mango supply chain, eg. Australia to Singapore. Members of this case study group will be the members of the demonstration supply chains plus key R&D contributors from supporting agencies such as PHDEB and UAF.

##### Activity 2

Documentation and evaluation of present postharvest practices, to guide demonstration supply chain improvement practices in the first year.

##### Activity 3

Storage trials to determine optimal conditions for each of the two main varieties; combined with trials to establish the impact of hot water treatments on storage life

##### Activity 4

Trials to establish ripening protocols for Pakistan mangoes.

##### Activity 5

Develop indicators and a method to determine optimum harvest maturity

##### Activity 6

Identification and quantification of postharvest diseases, and the use of this information to guide trials using hot water treatment and other disease control approaches.

### Activity 7

Hot water treatment trials for disinfestation (depending on market access evaluations)

### Activity 8

Topworking of a small block of trees to a new cultivar, identified by market research (this must link to the Production Team's activities)

## **2. Capacity building and training activities**

### Activity 1

As noted above, the initial activity is to undertake a hands-on working case study of an Australian export mango supply chain, eg. Australia to Singapore. Members of this case study group will be the members of the demonstration supply chains plus key R&D contributors from supporting agencies such as PHDEB and UAF. This is both an R&D and capacity building activity.

### Activity 2

Capacity building of the UAF postharvest lab and associated staff.

### Activity 3

Training of extension workers will take place by their on-going involvement in project action learning activities, supported by specialist workshops where necessary.

### Activity 4

Technical training of participants in demonstration supply chains will be on-going, involving action learning approaches.

### Activity 5

Results will be made available to the wider industry and government agencies through a regular project newsletter

### Activity 6

The preference is that two scholarships be sought, probably M Phil, one for storage and one for disease-related R&D. Alternatively, graduate research assistants may be employed who can at the same time enrol in a postgraduate course at UAF.

### 6.3.2 Objective 2: Market research

Aim	To assess market prospects and formulate a development strategy for export and domestic marketing of mangoes.
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Relevant ASLP Scoping Study Objective (Objective 2): *To identify present market needs and likely future opportunities for Pakistan mangoes, using this information to inform the analysis of existing supply chains and the development of improved supply chain management systems and practices.*

#### 1. R&D activities

The desired outcomes from these activities are:

1. To identify and evaluate the present domestic market performance of Pakistan mangoes
2. To identify and evaluate the present export market performance of Pakistan fresh mangoes
3. To identify and evaluate future export market performance of Pakistan fresh and processed mangoes

#### Activities

##### Activity 1

The first activity is to undertake research in existing domestic and export (Dubai, UK, Singapore) markets to document present performance levels against ideal standards identified by a range of participants in those markets, including consumers.

##### Activity 2

The second activity is to carry out desktop research to identify a list of potential markets or market segments not presently targeted. In-market research will be carried out in highest potential markets for fresh and for processed product. If results are positive, market entry strategies will be proposed.

##### Activity 3

This activity will involve a case study of a market which the Pakistan mango industry could use as a successful model of market-focused development, eg. Mexico, Peru or Thailand.

#### 2. Capacity building and training activities

##### Activity 1

As noted above, the initial activity is to undertake a hands-on working case study of an Australian export mango supply chain, eg. Australia to Singapore. Members of this case study group will be the members of the demonstration supply chains plus key R&D contributors from supporting agencies such as PHDEB and UAF. This is both an R&D and capacity building activity.

##### Activity 2

It is proposed that two scholarships be sought (probably M Phil), one for fresh product market research and one for processed product marketing research, co-supervised between UAF and UQ. Alternatively, these two could be collapsed into one, supported by a research assistant.

#### Activity 3

Training of extension workers will take place by their on-going involvement in project action learning activities, supported by specialist workshops where necessary

#### Activity 4

Marketing training of participants in demonstration supply chains will be on-going, involving action learning approaches

#### Activity 5

Results will be made available to the wider industry and government agencies through a regular project newsletter

### **6.3.3 Objective 3: Developing demonstration supply chains**

Aim	To develop model supply chains for domestic and export marketing of mangoes
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Relevant ASLP Scoping Study Objective (Objective 3): *To work with selected mango supply chains so that they can demonstrate to the rest of the industry the impact of improved supply chain management on competitiveness, with a particular focus on the economic well-being of smallholder producers.*

#### **1. R&D activities**

The desired outcomes from these activities are:

1. To identify factors unique to the Pakistan situation that will influence the adaptation of supply chain management approaches to local conditions
2. To develop three demonstration supply chains as vehicles for improved supply chain management systems and practices

#### **Activities**

##### Activity 1

The initial R&D activity will focus on determining the specific political, social, economic or environmental factors that may impact on the application of supply chain management principles in the Pakistani mango industry.

##### Activity 2

The main R&D activity will revolve round the initiation and development of three demonstration chains. The first stage in this process will involve potential members of these chains, plus personnel from supporting agencies, 'walking an Australian mango chain' from consumers and retailers in Singapore back to on-farm harvesting in Australia. The purpose of this activity is to raise the level of understanding among participants of the issues

associated with being involved in a more closely aligned and integrated chain structure that is market focused. This is both an R&D and capacity building activity. The second stage of the chain development process will involve detailed activities associated with each of the three chains that are designed to promote better alignment and cooperation among chain partners. These activities will be guided by results from the market research and quality improvement objectives.

### Activity 3

The final element of this project is a comparative study of the three case study mango chains initiated under the ASLP. Research may also include a case study of a successful mango exporting country such as Mexico or Peru. This activity would be undertaken by a PhD scholar. The outcomes would be applicable to similar projects being undertaken in other agricultural sectors such as citrus and dairy. In addition this research would add to the understanding of processes involved in the application of supply chain management principles in the agribusiness sectors of developing countries.

## **2. Capacity building and training activities**

### Activity 1

As noted above, the initial activity is to undertake a hands-on working case study of an Australian export mango supply chain, eg. Australia to Singapore. Members of this case study group will be the members of the demonstration supply chains plus key R&D contributors from supporting agencies such as PHDEB and UAF. This is both an R&D and capacity building activity.

### Activity 2

It is proposed that a PhD scholarship be offered to study the supply chain formation and performance improvement process, jointly supervised by UQ and UAF.

### Activity 3

Capacity building of a UAF agribusiness staff member will take place by involvement in all activities of objective 3.

### Activity 4

Training of extension workers will take place by their on-going involvement in project action learning activities, supported by specialist workshops where necessary

### Activity 5

Training of participants in demonstration supply chains will be on-going, involving action learning approaches

### Activity 6

Results will be made available to the wider industry and government agencies through a regular project newsletter

## **6.3.4 Cross-cutting project capacity building and training activities**

1. Project development officer (Pakistan)

Apart from specific activities associated with each of the three objectives, it is proposed to employ a full-time Project Development Officer in Pakistan. This would be a young graduate with a few years experience, whose role would be to ensure day to day management of project activities under the guidance of the research team, supported by appropriate training.

## 2. Project research officer (Australia)

To manage the complexity, heavy workload and time pressures associated with this project, it will be necessary to employ a full time research officer to support the team leader and team members in Australia, and the development officer in Pakistan. This person will be expected to spend extended periods in Pakistan; act as point of contact, mentor and support for the Pakistani project development officer; become involved in training and capacity building, especially for the demonstration supply chains; carry out day to day project administration in Australia, and undertake some of the research such as market research.

## **6. Addressing Objective 5: Institutional frameworks**

Although this objective has become the subject of a separate project, some preliminary observations about institutional frameworks and policy settings can be made.

In essence, the mango industry in Pakistan is a very lightly regulated industry. There are no mango-specific regulations other than those that apply to disinfestation treatments for export to specific countries, eg. China and Iran. Thus the industry operates in an open, competitive environment populated by a combination of entrepreneurs and traditional operators. Generally speaking, government regulation does not hinder the openly competitive activities of these operators.

Pakistan is actively seeking to expand and support its export development activities. Its Rapid Export Growth Strategy (REGS) is based on five pillars:

1. Improved market access
2. Focusing on neglected regions, eg. Africa, Latin America, Central Asia
3. Strengthening trade promotion infrastructure and trade offices abroad
4. Improving skill development and productivity through training
5. Provision of state of the art infrastructure

The mango industry is well placed to benefit from all of these strategies. In particular, the industry needs improved infrastructure and skills development so that it is better positioned to take advantage of improved market access and more aggressive market promotion.

At present, the Pakistan Horticulture Development and Export Board (PHDEB) is working very successfully as a semi-government agency to help develop the mango industry, especially its export performance. Like all such agencies, it is limited by its resources in tackling what is a very considerable challenge in developing Pakistan's horticultural sector. PHDEB would seem very capable of turning any additional government resources that it could attract under the REGS into economic benefits for the mango industry. During this scoping study, PHDEB's ability to build positive relationships across the

spectrum of R&D providers (government and academic) as well as the spectrum of the mango industry's commercial participants distinguished it from any other agency encountered. Engaging with PHDEB represents a unique opportunity under this R&D proposal to demonstrate how an effective public/private partnership can produce direct and lasting benefits to a developing industry.