

Supply Chain Analysis of Mango Fruit: Orchard to Processing & Export Markets Value Chain Management in Sindh Market

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Abstract:

Mango is one of the most demanded fruits of the world. Its worldwide trading is increasing, especially in the US and European markets who pay a high price but demand a better quality and higher standards. While the Pakistani mango production is increasing, the export stands at a negligible 4.5% and that too to the low paying markets of Gulf states specially Dubai. This paper explores why Pakistani mangoes fail to be exported to high paying markets. The focus of this research is the application of Michael Porter's Value Chain Model to analyze the value chain mechanism from the production to end consumption of mangoes. Out of the five value chain components, two components, Operations and Outbound logistics, have been analyzed through quantitative research techniques and the rest through qualitative. Action research methodology was adopted to develop this case study.

Results of this research show that the weak value chain mechanism that exists in Pakistan has hindered in meeting international mango demand. Recommendations have been made to improve the value chain mechanism that may assist Pakistani producers and marketers to meet the quality standards and play a more forceful role in the mango market in the US and Europe.

1. INTRODUCTION

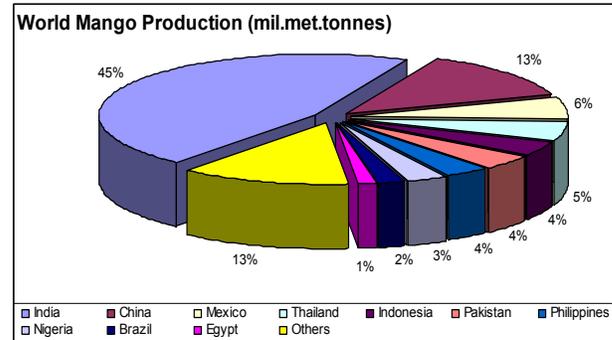
1.1 Economic Impact of Mangoes

Global production of mangoes is concentrated mainly in Asia and more precisely in India that produced about 11.5 million metric tonnes in year 2000-01. Mangoes are grown in 85 countries and 63 of them produce more than 1,000 metric tonnes a year. Total world production was 25.1 million metric tons in 2000-01 (FAOSTAT, 2001).

China, Mexico, Thailand, Pakistan, Philippines, Indonesia and Nigeria are a few eminent producers of the entire world mango production.

In recent years, mangoes have become popular both as fresh and processed products in the global market. Although, it's relative share in the world production has been gradually declining, India is still by far the major producer of mangoes. The increase in mango production in non-traditional mango-producing areas has been notable and includes parts of Asia, West Africa, Australia, South America and Mexico. International trade of mangoes is

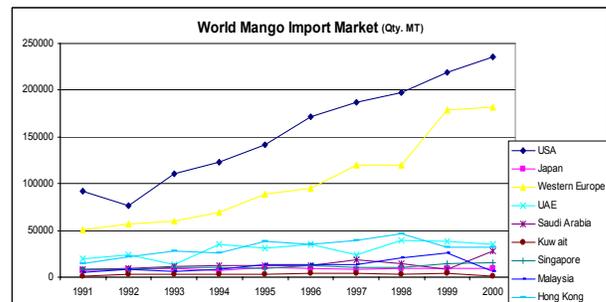
dominated by varieties like "Keitt" and "Tommy Atkins" (Emex, 2000).



Source: FAOSTAT2001

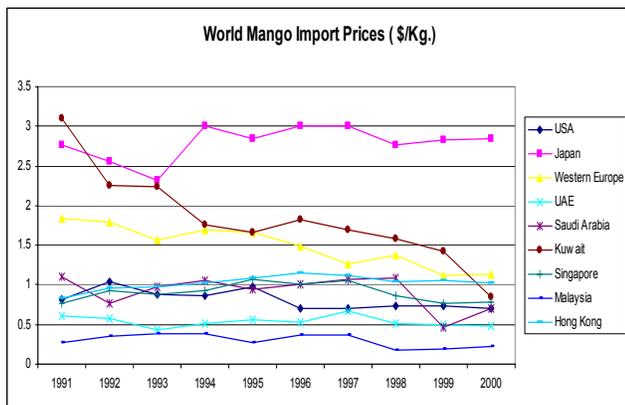
1.2 World Mango Market

The world mango imports have grown sizeable in the last decade. The over all growth is about 110.2% from 1991 to year 2000. Major importers of mango during the year 2000 were USA and Western European countries whose imports remained 235,080 and 181,585 metric tonnes respectively, followed by UAE (34800 MT.), Hong Kong (32375 MT.), Saudi Arabia (28325 MT.) and Singapore (15113 MT.).



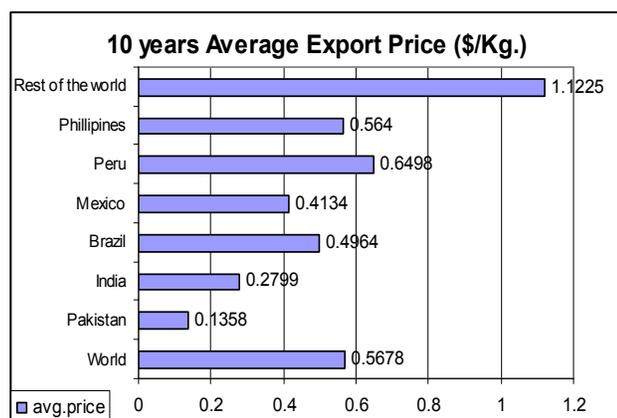
Source: FAOSTAT 2001

Japanese mango imports remained only 8,700 metric tonnes on average from 1991 to 2000 fetching a price of \$2.80 per kilogram (average).; followed by Kuwait (\$1.84/kg.), Western Europe (\$ 1.5/kg.), Hong Kong (\$1.027/kg.), Singapore (\$0.90/kg.) and Saudi Arabia (\$0.91/kg.).



Source: FAOSTAT2001

Peru's mango has fetched best export value per kg. on an average of 10 years, from 1991 to 2000; followed by the Philippines, Brazil, India and at last Pakistan.



Source: FAOSTAT2001

Based on this analysis it is surprising that the Pakistani mango, despite its rich taste, has been unable to fetch premium prices in the international market. For this purpose below is a summary of the Pakistani mango production, and the existing exports.

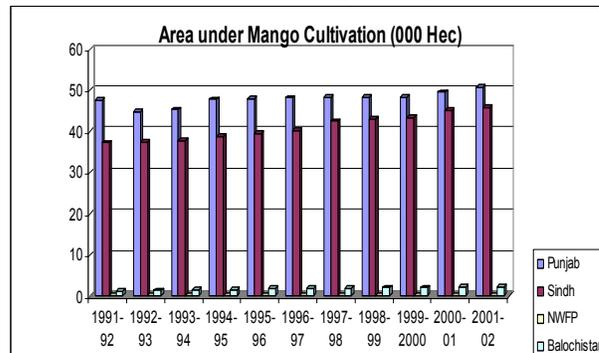
1.3 Pakistani Mango

Pakistan is blessed by nature. It is sanctified by fertile land along with the Indus basin, all types of weathers, traditional and hi-tech farming techniques, abundant manpower and strong and civilized culture. Around 48.4% of labor force earns its bread and butter from agriculture that contributes 24% to GDP (Economic Survey 2002-03) and 13.5% of exports belongs to this sector (WTO 2001).

Mango is one of the cash cows in agriculture sector. Its sweet taste differentiates it from other parts of the world's production. Mango is mainly produced in Punjab and

Sindh while Balochistan and NWFP also contribute a little in over all production.

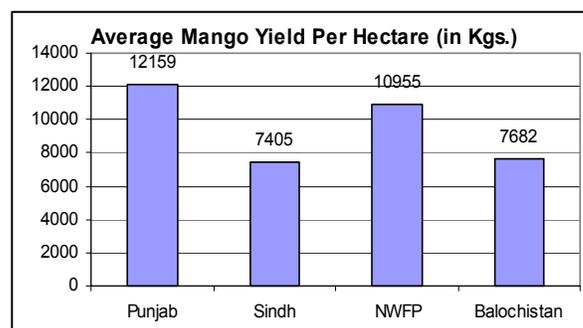
In terms of total area under cultivation, 51% was with Punjab while 46% in Sindh. Balochistan and NWFP's share was 2.32% and 0.20% respectively (Year 2001-02).



Source: Pakistan Statistical Year Book 2003, Fed. Bureau of Stats, GOP

Mango production-wise Punjab provided over 62% while Sindh, Balochistan and NWFP contributed 35.8%, 1.23% and 0.24% respectively in the years 2001 and 2002. Statistics show that average yield per hectare during last 11 years in Punjab is the highest, which yielded 12,159 kgs. per hectare and Sindh on the other hand yields the lowest among all 4 provinces at 7,405 kgs. per hectare.

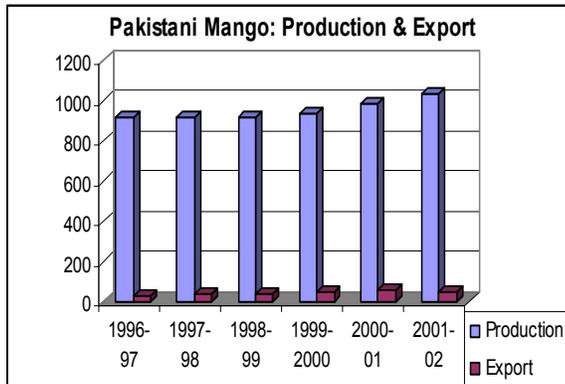
Though Sindh's yield is gradually and consistently increasing during past decade but growth in Punjab has remained better.



Source: Pakistan Statistical Year Book 2003, Fed. Bureau of Stats, GOP

1.4 Mango Exports from Pakistan

Pakistani mango exports are increasing in the world market. Pakistan exported about 4.57% of its production in year 2001-02; but some how, failed to fetch a good price. An analysis is provided below on the direction of exports and markets that are catered by the Pakistani exporters.



Source: Export Promotion Bureau 2003

Major chunk of mango export goes to Dubai, Saudi Arabia, Oman, Qatar and UK; but compared to the western markets the price per kg. is very low in the Middle East. Pakistani mango fetched the best price in the Japanese market (up to \$1.56 per kg. in 1996-97) that later declined to \$0.5 per kg and has remained so in the year 2000-01. The second best price was fetched from the Belgian market in the year 1996-97 at \$1.33 per kg but that also nose dived and dropped to \$0.39 per kg. Overall the Pakistani mango has been successful in fetching better prices in Japan, Europe as compared to Middle East. On the other hand, Yet Pakistan exports 90% of its production to Middle East and only 10% to the rest of the world countries.

This review leads to the research questions posed for the study:

- Why Pakistani mango is declining in value while the overall world mango market is growing?
- How can the existing value chain be improved to minimize inefficiencies and tap new attractive markets?

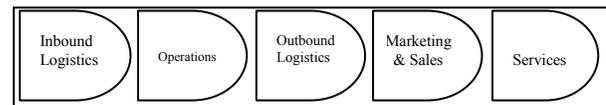
2. THE SUPPLY CHAIN MODEL

Supply chain management simply refers to the management of the entire set of production, distribution and marketing processes by which a consumer is supplied with a desired product. However, while the consumers may determine the market size and preference, they do not play an active role in the management of the chain. In practice, for the competitive performance of the chain to improve one or more of the suppliers/ members of the chain must take the initiative.

2.1 The Value Chain Model by Michael Porter

To analyze the specific activities through which firms can create a competitive advantage, it is useful to model the firm as a chain of value-creating activities. Michael Porter identified a set of interrelated generic activities common to

a wide range of firms. The resulting model is known as the value chain and is depicted below:



2.1.1 Primary Activities

The goal of these activities is to create value that exceeds the cost of providing the product or service, thus generating a profit margin.

- **Inbound logistics** include the receiving, warehousing, and inventory control of input materials.
- **Operations** are the value-creating activities that transform the inputs into the final product.
- **Outbound logistics** are the activities required to get the finished product to the customer, including warehousing, order fulfillment, etc.
- **Marketing & Sales** are those activities associated with getting buyers to purchase the product, including channel selection, advertising, pricing, etc.
- **Service** activities are those that maintain and enhance the product's value including customer support, repair services, etc.

Any or all of these primary activities may be vital in developing a competitive advantage. Each generic activity includes specific activities that vary by industry.

2.1.2 Support Activities

The primary value chain activities described above are facilitated by support activities. Porter identified four generic categories of support activities, the details of which are industry-specific.

- **Procurement** - the function of purchasing the raw materials and other inputs used in the value-creating activities.
- **Technology Development** - includes research and development, process automation, and other technology development used to support the value-chain activities.
- **Human Resource Management** - the activities associated with recruiting, development, and compensation of employees.
- **Firm Infrastructure** - includes activities such as finance, legal, quality management, etc.

Support activities often are viewed as "overhead", but some firms successfully have used them to develop a competitive advantage.

Based on focus group discussions with mango growers/farmers, it was found that these farmers belonged to two different schools of thought. There was one who still believes in traditional farming techniques and others who

are more progressive in their approach and believe in modern techniques that they have used in their farms to provide better yields per hectare. Data has been collected from both of these groups of farmers to support the value chain model for mango farms in Pakistan.

The following table gives a comparison of the activities that are utilized by these farmers.

Activity	Traditional Farm	Modern Farm
Distance b/w trees	No proper distance Maintained	40' b/w 2 trees
Urea	Natural Urea, no proper measurement	Urea treated thru EM/BM technique
Mulching	No proper computations	Dry leaf or paddy husk mulch upto 8 cm
Pruning	With axe	With blades, sunlight
Cutting	Cut w/o stem, drop at soil	Cut with stem, no dropping, catch
Storage	Normal temperature	Normal temperature (need to have reefer storage)
Supplied to	Local Market	Local Market and Exporter
Transportation	Trucks w/o reefer containers	Trucks w/o reefer containers

3. RESEARCH METHODOLOGY

3.1 Action Research

The research on the value chain mechanism on mango farms has been conducted through action research. Rory O'Brien, Faculty of Information Studies, University of Toronto, described Action research as "learning by doing" - a group of people identifies a problem, does something to resolve it, sees how successful their efforts were, and, if not satisfied, tries again. It is also known by many other names, including participatory research, collaborative inquiry, emancipatory research, action learning, and contextual action research.

Action research is used in real situations, rather than in contrived, experimental studies, since its primary focus is on solving real problems. It can, however, be used by social scientists for preliminary or pilot research, especially when the situation is too ambiguous to frame a precise research question. Mostly, though, in accordance with its principles, it is chosen when circumstances require flexibility, the involvement of the people in the research, or change must take place quickly or holistically.

3.2 Data Collection: Approach and Method

The secondary data has been used to identify the research problem and in literature review.

The primary data has been used to check value chain performance at orchard and processor levels by comparing modern and traditional methods. Primary data is collected through questionnaire and interview guides.

3.3 Empirical Statistical Tests

Following tests were conducted to check significance of data:

- ANOVA test; conducted within farm level and between farms
- Pearson's Correlation; to check the bindings of the variables, and
- Cluster testing; divide the farms in clusters between modern technology users and traditional farmers to differentiate their performance.

4. RESULTS

As mentioned earlier about two types of farmers, following hypothesis were formed and tested:

4.1 Hypothesis for Orchards (Operations)

- **H₀**: Orchards using new technology experience better yields than those that do not use modern technology
- **H₁**: Orchards using new technology do not experience better yields than those that do not use modern technology

4.1.1 Sub-hypothesis

- Orchards using new technology experience better yields than those that do not use modern technology with respect to Yield per acre.
- Orchards using new technology experience better yields than those that do not use modern technology with respect to Cost per Kilograms.
- Orchards using new technology experience better yields than those that do not use modern technology with respect to Sale Price per kilograms.

4.1.2 Data Variables

The following data variables have been used: Farm [F], Years [Yr], Total area under cultivation [TAC], Average number of trees per acre [ANT], Average distance between the trees [ADT], workers per acre [W], Export percentage [E], Quantity of urea used [QU], Wastage in percentage [Wp]

ANOVA between Traditional and Modern Farms/orchards

	F	Yr	TAC	ANC	ADT	Y	W	C	S	E	QU	Wp
H₀	★		★	★	★	★		★	★		★	★
H₁		★								★		
Yield	★		★	★	★					★		
Cost/Kg.	★		★	★	★						★	★
Sale P/Kg.	★		★	★	★						★	★

★ Accepted

Pearson's Correlation

Independent Variable	Weak Correlation (0-0.4)	Moderate Correlation (.41-0.69)	Strong Correlation (0.7-1.0)
F	-ANT;ADT;E	Y	TAC;C;S;QU;Wp
Yr	ALL VARIABLES	NONE	NONE
TAC	Yr;-S;E	-ANT;ADT;QU;-Wp	F;Y;-C
ANT	-F;-Yr;-Y;-S;-QU	-TAC;C;-E	-ADT;Wp
ADT	F;Yr-C;S;E;-QU	TAC;Y	-ANT;-Wp
Y	S;QU;-ANT	F;Y;ADT;E	-C
C	-Yr;-E	ANT;S;-QU	-F;-TAC;-Y;-QU;-Wp
S	Yr;E;ANT;ADT;Y	-TAC;C	-F;-QU;-Wp
E	ALL VARIABLES	NONE	NONE
QU	-Yr;ANC;-ADT;Y;-E	TAC;-C	F;-S;Wp
Wp	-Yr;-E	-TAC;-Y	F;ANT;-ADT;C;-S;QU

Cluster Testing

Cluster	Initial Iteration		Final Iteration		
	Traditional	Modern	Cluster	Traditional	Modern
Yield/acre in Kg.	1200 Kg.	5304 Kg.	Yield/acre in Kg.	2179 Kg.	4075 kg.
Cost / Kg.	PKR.6.60	PKR.2.20	Cost / Kg.	PKR.4.52	PKR.2.71
Sale Price / Kg.	PKR.12.5	PKR.11.66	Sale Price / Kg.	PKR. 10.12	PKR.9.23

4.2 Hypothesis for Processors (Outbound Logistics)

- **H₀:** Processors using new supply chain mechanisms experience better price than those that do not use them.
- **H₁:** Processors using new supply chain mechanisms do not experience better price than those that do not use them.

4.2.1 Sub-hypothesis

Processors using new supply chain mechanism experience better price than those that do not use them with respect to the following variables.

Storage / Cold storage Cost per Kg., Packing Cost per Kg., Shipping Cost per Kg., Sale Price per Kg., Processing Cost per Kg., Transport Expense [farm to market], Cost per Kg., Percentage of wastage.

ANOVA at Processor level

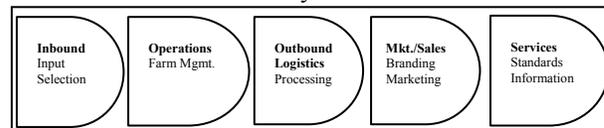
	Strg.	Pckg	Shpg	SP / Kg	PrcC /kg.	Trnsp	C/kg	%Wst
H₀	☆	☆	☆	☆	☆	☆	☆	☆
H₁								

☆accepted

4.3 Implication of Value Chain Model on Mango Value Chain Mechanism in Sindh:

This section relates to Sindh's farmers' mango value chain, as gathered through interviews of these farmers.

Primary Activities



4.3.1 Input Selection (Inbound Logistics)

This component of value chain is properly considered by farmers of Sindh. They carefully select area for orchard which has better climate, appropriate soil quality, accessibility to market, water availability, gene selection etc.

4.3.2 Farm Management (Operations)

In this value chain component it is proved that orchards using modern techniques experience better yields than those who use traditional methods, as described in results above, verified by ANOVA, Pearson's Correlation and Cluster tests.

4.3.3 Processing (Outbound Logistics)

As referred by processors' analysis tested in results section, it is proved that there is a significant difference between modern value chain mechanism user processors and traditional processors. Modern value chain processors get better prices in export market although they are not fully automated, and still lack in reefer storage transport and packing facilities of international standard.

4.3.4 Marketing and Branding (Marketing and Sales)

Few farmers like Kachhelo, Jatoi and Nizamani, and processors like Iftikhar Ahmed & Co. (IAC), and Sarah Fruits are exporting mango with their brand, and market the product in different parts of the world. But they do face certain issues like inconsistent quality, lack of reliable supply, inconsistent grading etc. which kept them away from adopting proper strategy to capitalize on their rich taste fruit.

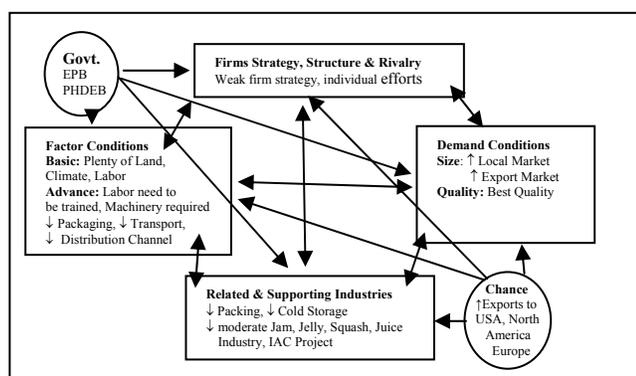
4.3.5 Standards and Information (Services)

Mango is in demand all over the world but due to lack of awareness of required standards by value chain members, Pakistani mango product cannot be exported to US, Europe and Japanese markets. Such information of export standards and requirements can only be made available to

individuals and not all value chain members. Government should take the responsibility to create awareness at all value chain members to fetch a better export price. Though Pakistan Horticulture Development Export Board (PHDEB) was established three years ago, but its outcome is yet to be awaited. To summarize, we can say that Governments approach is reactive instead of proactive.

4.4 Implication of Porter's Diamond Model on Support Activities of Value Chain Model:

The Value Chain Model is supplemented below with Porter's Diamond Model, which analyzes the support activities that can ultimately contribute towards success of mango export industry, explained as follow:



4.4.1 Factor Conditions

Basic: Pakistan has 22 million hectares cultivable land with low skilled labor available. Pakistan enjoys all four seasons and in every season has good yield of agricultural products especially fruits, which cater to local demand as well as certain quantity exported to several countries. Pakistan is also very rich demographically with a population of about 160 million. 65% of the total population lives in rural areas and mainly relies on agriculture production. Pakistan is also rich in water reserves drained from Himalayas to Karachi providing enough water necessary for cultivation.

Advanced: Pakistan lacks skilled labor, advanced packing machinery and reefer plants and transport facilities. Such infrastructure requires development.

4.4.2 Demand Conditions

As mentioned throughout the paper, the international demand of mango is on the rise. The Pakistani mango because of its quality has huge potential of export.

4.4.3 Related and Support Activities

There is a lot of potential for related industries, which can complement mango production. At present, moderate level of complimentary industry like, jam, juice, *chutni* etc already exist. There is a need to establish modern packing, improve reefer storage, and better transportation which can increase the shelf life of the product.

4.4.4 Firm Strategy, Structure and Rivalry

Unfortunately a very weak firm structure exists where all important decision are made by individuals who are land owners. There is no clear strategy adopted to differentiate and position their product. A handful of associations and cooperatives exist who do not have enough power to collectively negotiate with government and/or other stakeholder.

4.4.5 Government

Institutions like Chamber of Commerce, Export Promotion Bureau, and Pakistan Horticulture Development Export Board (PHDEB) established to create awareness to value chain members and facilitate exports. Unfortunately, they have not yet produced remarkable results, due to disorganized information dissemination. Information is mostly provided to interested individuals only.

4.4.6 Chance

Pakistan being non-nato ally of USA and Europe in war against terror can increase trade with these countries. Mango can also be exported in these markets as they offer better prices as compared to Gulf States, where about 90% of product is exported.

5. CONCLUSION

Based on research findings, the following can be concluded:

- Very weak value chain exists
- No coordination b/w VC members
- Poor cooperative performance, no negotiating power by value chain members
- Only first 3 components Inbound, Operations and Outbound logistics exist but in weak shape
- Fourth and fifth component of value chain i.e. Marketing and Services are almost non-existent
- VC members are not aware of standards
- Government cannot reach at individual value chain members
- No proper accounting process exists to compute performance

6. RECOMMENDATIONS

The following recommendations are provided to improve the value chain mechanism for the Sindh mango farmers:

- Establishment of efficient cooperatives network
- Strengthening of PHDEB by the government
- Improved coordination between EPB and PHDEB
- Informative literature should be printed in local languages and made available to all value chain members
- Encourage the private sector/ industrialists to invest in reefer storage chain and processing units

7. FUTURE RESEARCH AREAS

Future research in the following areas have been recommended which may support the agriculture industry overall in Pakistan.

- Further research can be done on all five VC components focusing individual component.
- Development of Entity Relationship Model (ERM) by removing gaps and creating linkages between VC components.
- Establishment of Cooperative Farming Associations and its efficient operations.
- Post January 2005, WTO suggests all fruits for export should meet Phyto-sanitary standards throughout value chain. Research should be conducted on vapor heat treatment plant and its feasibility to check its significance.
- A research can help to develop strategy to strengthen & make effective Pakistan Horticulture Development Export Board (PHDEB) to provide proper information to all VC members
- Initially, Agriculture Accounting Procedures can be devised in local language according to Generally Accepted Accounting Principles (GAAP), which can be automated further to facilitate future researches.

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