CLUSTER DEVELOPMENT BASED AGRICULTURE TRANSFORMATION PLAN VISION-2025

Dates Cluster Feasibility and Transformation Study

Planning Commission of Pakistan, Ministry of Planning, Development & Special Initiatives

February 2020

FOREWORD

In many developed and developing countries, the cluster-based development approach has become the basis for the transformation of various sectors of the economy including the agriculture sector. This approach not only improves efficiency of development efforts by enhancing stakeholders' synergistic collaboration to resolve issues in the value chain in their local contexts, but also helps to gather resources from large number of small investors into the desirable size needed for the cluster development. I congratulate the Centre for Agriculture and Bioscience International (CABI) and its team to undertake this study on **Feasibility Analysis for Cluster Development Based Agriculture Transformation.** An important aspect of the study is the estimation of resources and infrastructure required to implement various interventions along the value chain for the development of clusters of large number of agriculture commodities. The methodology used in the study can also be applied as a guide in evaluating various investment options put forward to the Planning Commission of Pakistan for various sectors, especially where regional variation is important in the project design.

Muhammad Jehanzeb Khan,
Deputy Chairman
Planning Commission of Pakistan
Ministry of Planning Development and
Special Initiatives
Government of Pakistan.

FOREWORD

To improve enhance Pakistan's competitiveness in the agriculture sector in national and international markets, the need to evaluate the value chain of agricultural commodities in the regional contexts in which these are produced, marketed, processed and traded was long felt. The Planning Commission of Pakistan was pleased to sponsor this study on the **Feasibility Analysis for Cluster Development Based Agriculture Transformation** to fill this gap**.** The study aims to cover a large number of agriculture commodities spread in various clusters throughout the country.

I truly hope that the policies, strategies, and interventions suggested in this report will facilitate the federal and provincial governments to chalk out and implement plans for cluster-based transformation of the agriculture sector.

Zafar Hasan,
Secretary,
Ministry of Planning Development and Special Initiatives
Government of Pakistan

FOREWORD

This is part of the series of studies on 33 agriculture commodities undertaken for the purpose of preparing a cluster-based transformation plan based on the regional realities in the entire value chain including production, processing, value addition, and marketing. I congratulate the whole team of the project especially the Team Lead, Dr. Mubarik Ali to undertake and successfully complete this monumental study. We are thankful to all commodity specialists who have contributed to this assignment. The CABI Project officers Mr. Yasar Saleem Khan and Ms. Aqsa Yasin deserve appreciation. I truly believe that this study will serve as a basis to make and implement plans for cluster-based agriculture transformation. I hope you will enjoy reading the study and it can help you making your investment decisions along the value chain of various agriculture commodities.

Dr. Babar Ehsan Bajwa
Regional Director
CAB International

FOREWORD

This report is part of the series of studies on 33 agriculture commodities to prepare the agriculture transformation plan by incorporating regional realities at the cluster level. In the report, the clusters of various commodities are identified and characterized, and viable investment options along the value chain of each cluster are proposed. For this purpose, the study team has analyzed macro data, reviewed the literature, and made extensive consultation with stakeholders along the value chain. Foreign and local internationally reputed consultants, Dr. Derek Byerlee and Dr. Kijiro. Otsuka and national consultant Mr. Sohail Moghal were also engaged to understand the cluster-based development approach and conduct cluster-based feasibility analysis. An EXCEL-based Model was developed which was validated by our national consultants. Separate viabilities for individual technologies and products suggested in each commodity are also estimated. This humongous task would not have been possible to complete without the excellent cooperation and facilities provide by CABI, the hard work of commodity specialists and our research team especially Mr. Yasar Saleem Khan and Ms Aqsa Yasin. The true reward of our hard work is the implementation of the proposed policies, strategies and interventions to develop agriculture commodity clusters in the country.

Dr. Mubarik Ali
Team Leader
Cluster Development Based Agriculture
Transformation Plan-Vision 2020 Project
Planning Commission of Pakistan and
CAB International

ACKNOWLEDGEMENT

It is not possible to mention the names of all those who collaborated with us in completing this report, but my foremost gratitude goes to numerous stakeholders along the value chain who generously shared the information about barley production, marketing, trade and value chain. Without their support, this report would not have reached to the level of present quality.

My sincere thanks go to **Planning Commission of Pakistan** for this initiative and especially financial assistance to complete the project activities. Here I am especially thankful to **Dr. Muhammad Azeem Khan** (Ex-Member, Food Security and Climate Change, Planning Commission of Pakistan), **Dr. Aamir Arshad** (Chief Agriculture, Planning Commission of Pakistan), **Mr. Muhammad Akram Khan** (Project Director; CDBAT project) and other CDBAT project team member **Mr. Muhammad Arif** (Research Associate) and **Dr. Habib Gul** (Research Associate) for successful coordination and support for the project.

I am also grateful to **Centre for Agriculture and Bioscience International** (CABI) and its Regional Director for Central and West Asia, Dr. Babar Ehsan Bajwa and CABI team especially Mr. Yasar Saleem Khan for selecting me as commodity specialist for this task and offering outstanding cooperation, support and advice during all the stages of this project. However, the research team takes the responsibility of any shortcoming left in the report.

Dr. Muhammad Javed Tareen

Senior Author

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DISCLAIMER

This report is prepared by using the data from various published and unpublished sources and that obtained during the consultations with stakeholders. The research team took utmost care to arrive at the figures to be used, but is not responsible for any variation of the data in this report than those reported in other sources. Moreover, the views expressed in this report are purely of the authors and do not reflect the official views of the Planning Commission of Pakistan, Ministry of Planning Development and Special Initiatives or the Centre for Agriculture and Bioscience International (CABI).

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LIST OF ACRONYMS

CPEC	China Pakistan Economic Corridor
DRDI	Dates Research and Development Institute
FAO	Food and Agriculture Organization of the United Nations
GAP	Good Agricultural Practices
GB	Gilgit Baltistan
Ha	Hectare
IRR	Internal Rate of Return
Kg	Kilo gram
KP	Khyber Pakhtunkhwa
M.	Million(s)
MIS	Market Information System
NGO	Non-Governmental Organization
NPV	Net Present Value
PFVA	Pakistan Fruit & Vegetable Association
SWOT	Strengths Weaknesses Opportunities Threats
UAE	United Arab Emrat
USA	United States of America

EXECTIVE SUMMARY

According to last latest available statistics, global production of dates was 8.2 million tonnes from more than 1.3 million ha with an average yield of 6.1 tonnes per ha. Pakistan stands at 6th position among the largest dates producing countries in the world. In Pakistan dates are grown at 98 thousand ha, with 541 thousand tonnes of production and an average yield of 5.5 tonnes per ha. Globally, 1.25 million tonnes of dates worth of US$1.48 billion were exported during 2017. Currently, the top dates producing countries are Egypt, Iran, Algeria and Saudi Arabia, while Iran, UAE, Pakistan and Iraq are top dates exporting countries. On the other hand, India, UAE, Morocco and France are leading dates importing countries both in quantity and the value terms.

In Pakistan the yield per ha declined at the rate 2.1% per annum vis-à-vis international average yield improvement at 0.4% per annum. Pakistan's yield is now 13% lower than the world average yield. Trade in dates from Pakistan seems performed relatively well during the period because of the expansion in the export of dates and shrinking its imports, which has improved the trade balance of Pakistan both in terms of dates quantity and its value at quite a high rate of around 11%. The export of dates from Pakistan has reached to US$108 million in 2017. Such a high growth in the export of dates is not sustainable because of its declining per ha yield in the country. Moreover, Pakistani dates in international markets fetch only 60% of the world average export price indicating issues in its value chain resulting in poor quality dates. Expansion in export along with declining production has reduced the per capita consumption of dates in Pakistan by about 42%, although its high demand during the Ramadan time persists.

Based on the above background and the importance of dates production in marginal areas of Pakistan where it is cultivated by relatively small poor farmers and its declining competitiveness in international market, Planning Commission of Pakistan has initiated this study to analyse the entire value chain of dates including production, marketing, value addition, processing, and trade, identify the gaps and potential along the chain, and suggest economically viable policy, technological and institutional interventions to enhance the competitiveness of Pakistani dates in international market. This analysis is conducted on cluster basis to incorporate the regional variation in production, marketing and processing opportunities in each cluster while suggesting interventions along the value chain. To achieve the objectives of the study, large number of stakeholders along the dates were consulted, data related to dates production, marketing, trade etc. were analysed, and literature were reviewed. An EXL based model was also developed to estimate the economic feasibility of various interventions in each cluster.

Although dates are grown in all the four provinces of Pakistan, but its cultivation as a commercial crop is concentrated in few districts in each province which are largely marginal with low crop productivity. Based on the available district-level production data, three dates producing clusters i.e., Khairpur as Sindh Cluster, Turbat & Panjgur as Balochistan Cluster and Muzaffargarh as Punjab Cluster are identified for detailed analysis.

In consultation with stakeholders, several challenges of dates industry of Pakistan from production to harvesting and marketing are identified in this study. On production side, weak research and extension capacities, absence of the mechanism to replace old with new high-yielding varieties, lack of nurseries with certified mother-blocks, water scarcity especially in Baluchistan cluster, traditional methods of spathes selection and pollination, non-covering of fruit

bunches during rainy season (rather preferring to pick for making chohara or other low quality products), and bunch-pruning are the main challenges. On marketing side, lack of value chain segments including farm-level cold storage, improper packing and presentation are major constraints, which eventually lead the product in the low-end markets of the world. Gloomy prospects of traditional export to India are also a challenge. Dates drying under the open sky and lack of processing infrastructure at village level and capacity to operate these infrastructures are the main issues on processing side.

To overcome these constraints and keeping in view the cluster-specific environment, interventions are proposed at the respective focal point of each cluster for making the dates a competitive and export oriented commodity of Pakistan. These interventions include: a) restoration of existing orchards with plants of higher yielding, modern and exotic varieties; b) training farmers for adopting improved orchard management practices; c) controlling harvest and post-harvest losses by adopting better pollination strategies and fruit bunch management; d) shifting to solar tunnel dates drying; e) employment state-of-the-art packaging technologies and linking of stakeholders with markets. With these measures, the general quality and presentation of Pakistani dates in international high-end market shall improve.

In order to implement these interventions at the focal points, total project investments needed is US$108.144 million. Out of the total investment, about 28% are proposed to be borne by the federal and provincial governments and remaining 72% by the private sector. The federal government will bear 30% of the total cost, while the provincial governments will bear remaining 70% through their respective annual development plans.

As a result, after the successful implementation of the 5-years long proposed project, it is anticipated that during 10th year, more than 260 thousand additional dates will be produced from all the production enhancing interventions. In total, nearly 266 thousand tonnes very high quality dates (chohara and fresh dates) shall be available for processing through 214 pack houses. The dates so shall be produced, be able to get better price in both the domestic and international markets. This improvement in production will generate thousands of additional jobs in rural areas.

The proposed interventions as a package is economically viable in all the dates clusters, their total Net Present Values (NPVs) are estimated at US$ 145.56 Million. The overall Internal Rate of Return (IRR) for all the clusters is 34.27%. The cluster level economic analysis can be seen in the Summary Sheet given below. In addition to economic benefits, the cluster upgradation program shall also provide income and employment generating opportunities to local communities.

To make this initiative successful, it is imperative to adopt the integrated cluster approach by attempting to resolve the issues of whole value chain at local level. Strengthening the dates related research facilities, building capacities of all stakeholders along the value chain, organize Farmers' Entrepreneur Group (FEGs) and arrange loans so that stakeholders can fund the additional operational costs induced by the upgradation investments would be the key factors for the success of the Up-gradation Plan.

Summary Sheet of Dates clusters

Information	Punjab	Sindh	Balochistan	Overall
Area of cluster focal point (ha)	3,297	28,479	43,588	75,364
Production (Tonnes)	25,549	237,106	185,629	448,284
Yield of the cluster (tonnes/ha)	7.75	8.33	4.26	5.95
Area of the cluster (ha)	5,439	35,940	46,716	88,095
Production of the cluster (tonnes)	42,454	332,144	207,614	582,212
Annual yield growth without intervention (%)	0.63%	1.58%	-0.27%	0.65%
Percent area renovated in 5 years	20%	20%	20%	20.00%
Total orchards areas renovated in 5 years (ha)	659	5,696	8,718	15,073
Yield increase due to orchards renovated (%)	50%	35%	80%	55%
Added production-renovated of garden (5th year) (tonnes)	2,719	19,418	28,897	51,034
Added value - orchards renovattion (5th year 000 US$)	1208.6	8630.1	14983.6	24822.4
Added production –improved management practice (5th year (tonnes)	6,590	64,107	45,775	116,472
Additional value of production - improved practices (000US$)	2928.7	28492.2	23735.2	55156.1
Increased in production - reduced Ph losses in 5th year (tonnes)	5,476	36,092	51,056	92,623
Additional value – reduced Ph losses in 5th yr (000 US$)	2433.6	16040.9	26473.3	44947.8
Total Increase in production - all interventions in 5th year (tonnes)	14,785	119,617	125,728	260,129
Added income - enhanced processing in 5th year (000 US$)	2176.6	23545.1	38866.1	64587.8
Total dryer required (number)	137	1646	1977	3760
Total pack houses required (Number)	7	84	123	214
Number of nurseries required	4	30	46	80
Investments (000 US$)				
Investment on strengthening research infrastructure	200.0	1000.0	800.0	2000.0
Investment on capacity building of stakeholders	67.2	580.1	887.9	1535.2
Investments on orchard renovation	1564.7	13515.2	21296.9	36376.8
Investment on certified nursery establishment	161.5	1211.1	1857.0	3229.6
Investments on pack house	806.6	9679.3	14173.3	24659.2
Investment on solar dates dryers	1223.3	14697.0	17652.4	33572.6
Investments on Marketing/Export level interventions	37.0	37.0	37.0	74.1
Government loans on private investment	233.4	2803.3	3660.0	6696.7
Total investments	4293.6	43523.1	60364.5	108181.2
Public sector investment	1259.2	12211.3	16351.2	29821.7
Total private sector investment	3034.4	31311.7	44013.3	78359.5
Production level investments	1959.7	16016.4	24397.9	42374.0
Processing level investments	1490.3	17790.3	21756.3	41036.9
Investments for VC infrastructure	2029.9	24376.3	31825.7	58231.8
Economic Analysis (000 US$)				
Total production increase in 10th year (tonnes)	14,785	119,617	125,728	260,129
Gross revenue (undiscounted) in 10th year	10195.0	92365.9	129966.2	232527.0
Additional operation costs in 10th year	6131.4	54142.4	81702.3	141976.1
Net cash flow (undiscounted) in 10th year	4063.6	38223.5	48263.9	90550.9
NPV	4697.8	68525.5	72338.7	145532.1
Internal Rate of Return (%)	25.90%	37.26%	32.57%	34.26%

1. INTRODUCTION

1.1. Dates as a Fruit

Date palm or Dates (*Phoenix dactylifera L.*) --- is an oval shaped, reddish-yellow, highly delicious, sweet fruit grown on date palm tree - is a popular drupe fruit belonging to *Arecaceae* family. It is one of the oldest known fruit crop in the arid regions of the Arabian Peninsula, North Africa and the Middle East (Zohary and Hopf, 2000). Though the exact origin of dates cultivation is not known, the earliest record from Iraq (Mesopotamia) shows that dates culture was probably established as early as 3000 BCE (Wrigley, 1995) that spread throughout the Arabian Peninsula, North Africa and the Middle East. Dates culture has apparently spread into Egypt by the middle of the second millennium BCE. The spread of dates cultivation later accompanies of the spread of Islam and reach southern Spain and Pakistan. The Spanish were the first to introduce date palm outside the Arabian Peninsula, Norther Africa, the Middle East, South Asia and carrying them to America (Nixon, 1951). During the past three centuries, dates were also introduced to new production areas in Australia, India, Pakistan, Mexico, South Africa, South America, and the United States. Dates are the main source of income and staple food for local population in many countries in which they are cultivated and have played significant role in the economy, society and environment of those countries (Chao and Krueger, 2007).

Dates are considered to be one of the most important food for the human being, particularly those living in least developed regions and facing harsh climates like deserts. Nutritionally[1], it abundantly contains vitamins A, B, C, E & K and minerals like iron, calcium, magnesium, sodium and zinc. Dates are not only consumed fresh but also used for making different products like dry dates or *chohara*, pickles, juices, jam, cider etc. Due to its potential of replenishing energy and instantly revitalizing the body, in Muslim societies and Islamic countries, fresh dates are most consumed in the month of Ramadan for breaking the fast in the evening. In Pakistan, dry dates as *chohara* are commonly sold on shops at the shrines as a gift from the shrine, offered to the guests invited in wedding parties, while in Hindu communities, it is used in the religious rituals at the shrines, particularly at *Diwali*. Multiple types of dates are grown and consumed in the world. Some of the important ones are: Anbarah, Afandi, Berhi, Ajwah, Helya, Gharr, Baidh, Helwah, Barny, Jebaily, Menaify, Mushkouth, Zaewy, Wananah, Maktoomi (https://ecob.com.br/ top-10-date-producing-countries-in-the-world/).

Date palm tree has numerous uses and many useful products are produced from it (Chao and Krueger, 2007). For instance, its leaves are used for making roofs, mats, staple dishes, hand

[1] The fruit is rich in dietary fiber, which prevents LDL cholesterol absorption in the gut. Additionally, the fiber diet works as a bulk laxative. It, thus, helps protect the colon mucous membrane from cancer-causing chemicals binding to it in the colon. They contain health benefiting flavonoid polyphenolic antioxidants known as tannins. Tannins are known to possess anti-infective, anti-inflammatory, and anti-hemorrhagic (prevent easy bleeding tendencies) properties. They compose antioxidant flavonoids such as ß-carotene, lutein, and zeaxanthin. These antioxidants found to have the ability to protect cells and other structures in the body from harmful effects of oxygen-free radicals. Thus, eating dates found to offer some protection from colon, prostate, breast, endometrial, lung, and pancreatic cancers. date fruits are also rich in minerals like calcium, manganese, copper, and magnesium.

fans, baskets, packaging material, ropes and fences (PHEDB, 2008). Its trunk can be used in constructing houses and bridges and as packing material for local transportation of vegetables and fruits (Anwar, 2006). Its terminal buds and young leaves can be cooked as vegetables, while rachises are used for paper making (El Hadrami and Al Khayri, 2012; Khairi *et al*., 2011). Moreover, dates cultivation in orchards offer good employment opportunities for the local labor force during flowering, harvest and its marketing & processing (Jain, 2012).

Dates can grow well in very hot and dry climates, and are relatively tolerant of salty and alkaline soils. Date palms require a long, intensely hot summer with little rain and very low humidity during the period from pollination to harvest, but with abundant underground water near the surface or irrigation. One old saying describes the date palm as growing with "its feet in the water and its head in the fire". Such conditions are found in the oases and *wadis* of the date palm's center of origin in the Middle East. Date palms can grow from 12.7˚C to 27.5˚C average temperature, withstanding up to 50ºC and sustaining short periods of frost at temperatures as low as –5ºC. The ideal temperature for the growth of the date palm, during the period from pollination to fruit ripening, range from 21ºC to 27ºC average temperature. date palm likes warm climate for a relatively longer period, however, rains during flowering and fruit ripening stages are harmful for this fruit. dates are widely grown in the arid regions between 15ºN and 35ºN, from Morocco in the west to India in the east or location is at 100 - 200 meters above sea level (Zaid and de Wet, 2002a)

Date palm is dioecious in nature with separate male and female trees, where pollination mostly takes place by wind and insects. However, for good fruit production, 60–80 % of female flowers need to be manually pollinated (Nixon and Carpenter, 1978; Zaid and de Wet, 2002b). Pollen also has a metaxenia effect for getting good shape, fruit size, fruit development and its ripening time (Nixon 1934, 1936). Many dates varieties produce fruits even without pollination, but slender in size with imperfect seed (without embryo & endosperm) and ripen very late (Swingle, 1928).

Ecologically, the areas well suited to dates cultivation include those where: i) location is at 100 - 200 meters above sea level; ii) prevailing temperature ranges from 3ºC to 45ºC; iii) rainfall ranges from 200 mm to 250 mm; and, iv) the soils are sandy loam and clay loam. It can also be grown in the soils having high salts. Date palm likes warm climate for a relatively longer period, however, rains during flowering and fruit ripening stages are harmful for this fruit.

1.2. Dates Production in Pakistan

In Pakistan, in terms of area, dates is 6th most produced fruit in the country, although its rank goes to 6th in term of production (Table 1). Date palm is cultivated in a wide range of cropping and farming systems such as oases in the deserts, groves, home gardens, as a mono-crop and an intercrop (Abouziena *et al*., 21010; Bhansali, 2010). In Pakistan, date palm is cultivated in arid and semi-arid regions which are characterized by long and hot summers with no or at most low rainfall, and very low relative humidity level during the ripening period. Exceptional high temperatures (± 56 °C) are well endured by a date palm for several days under irrigation. More than 300 date varieties are known to exist in the country of which the twelve most commercially important cultivars are: Karbalaen, Aseel, Muzawati, Fasli, Begum Jhangi, Halawi, Dashtiari, Sabzo, Koharba, Jaan Swore, Rabai, and Dhakki (Ata, 2011). These cultivars possess unique aroma, colors, sizes, shapes and tastes. This diversity in dates of

Pakistan is yet to be exploited through research and exploring of neighboring international markets for export purpose.

Table 1: Top Produced Fruits in Pakistan, 2017-18

Countries	Area (000 ha)	Production (000 tonnes)	Share in area (%)	Yield (t/ha)
Citrus	183.8	2351.4	23.6	12.8
Mango	167.9	1735.0	21.5	10.3
Guava	64.9	586.1	8.3	9.0
Apple	88.6	564.7	11.4	6.4
Melons	37.8	551.9	4.8	14.6
Dates	98.4	540.6	12.6	5.5
Apricot	22.7	141.7	2.9	6.2
Banana	30.0	140.4	3.9	4.7
Peach	14.4	72.5	1.8	5.1
Grapes	15.7	67.0	2.0	4.3
Total fruit area	779.9	7048.2		

Source: Government of Pakistan, 2019a

The total production of dates in Pakistan was 540.6 thousand tonnes from 98.4 ha in the year 2017-18 with an average yield of 5.5 t/ha. Balochistan is the major dates producing province in Pakistan followed by Sindh. The province of Balochistan produced 33.4% of total production of country with 3.4 tonnes per ha yield while the province of Sindh produced 57.3% of total production of the country with 8.0 tonnes per ha yield. Punjab and Khyber Pakhtunkhwa are 3rd and 4th most dates producing provinces of the country, but their average yield are much higher than their counterpart most-producing provinces of Balochistan (Table 2).

Table 2: Area and Production of Dates Across Provinces in Pakistan, 2017-18

Provinces	Area (Ha)	Production (Tonnes)	Yield (Tonnes/Ha)	Area Share (%)	Prod. Share (%)
Punjab	4,930	37,792	7.7	5.0	7.0
Sindh	38,481	309,696	8.0	39.1	57.3
K. Pakhtunkhwa	1,612	12,423	7.7	1.6	2.3
Balochistan	53,392	180,695	3.4	54.3	33.4
Total	98,415	540,606	5.5	100.0	100.0

Source: Government of Pakistan, 2019a

The dates production in Pakistan has decreased from 612.5 thousand tonnes in 2000-01 to 540.7 thousand tonnes in 2017-18, which produced a negative trend of 0.91% per annum. This decline in production came entirely due to the plummeting trend in yield per ha at a quite high rate of 2.36% per annum, while area under dates has expanded at a rate of 1.45% per annum during the period (Table 3).

The declining trends in per ha yield of dates are prominent in all provinces, except in KP where it increased at the rate of 1.85% per annum. The highest yield decline came from Balochistan and Sindh, where it plummeted at the rates of 2.89% and 2.75%, respectively, while decline in yield in Punjab was relatively small and insignificant at 0.22% per annum (Table 3).

On the other hand, area under dates expanded in all the provinces, except in Punjab where it declined at quite a high rate of 3.03% per annum. The highest increase in area came from Sindh followed by KP where it expanded at the rates of 2.87% and 2.34% per annum, respectively. The area under dates in Balochistan expanded at 1.27% per annum rate (Table 3).

As a result of the above two phenomena, the production of dates significantly increased only in KP at 3.43% per annum rate, while in Punjab and Balochistan it shrunk at the rates of 3.25% and 1.62% per annum, respectively. In Sindh, the production increased was only marginally at 0.12% per annum (Table 3).

Table 3: Provincial Trend in Dates Production From 2000-01 to 2017-18

Year	Punjab		Sindh		KP		Baluchistan		Pakistan	
	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.
	(000) ha	(000) tonnes	(000) ha	(000 tonnes)	(000) ha	(000) tonnes	(000) ha	(000) tonnes	(000) ha	(000) tonnes
2001	11.4	97.9	23.1	266.0	1.0	6.6	43.1	242.0	78.6	612.5
2002	11.4	94.1	23.4	288.9	1.0	6.7	42.6	240.6	78.4	630.3
2003	8.5	62.1	25.3	317.1	1.2	8.1	42.9	237.7	77.9	625.0
2004	5.7	41.7	25.5	151.6	1.3	8.6	42.3	224.9	74.8	426.8
2005	5.8	42.7	26.4	318.2	1.4	9.3	48.1	252.2	81.7	622.4
2006	5.8	42.6	26.7	192.8	1.4	8.9	48.1	252.3	82.0	496.6
2007	5.9	43.2	29.3	201.0	1.4	10.0	48.2	172.1	84.8	426.3
2008	5.9	44.3	32.0	253.1	1.4	10.4	50.8	249.7	90.1	557.5
2009	6.0	44.6	32.4	262.0	1.4	11.3	50.9	248.6	90.7	566.5
2010	6.0	44.7	32.6	265.3	1.4	11.3	50.6	209.9	90.6	531.2
2011	5.8	42.5	32.7	268.6	1.5	6.8	50.1	204.3	90.1	522.2
2012	5.8	44.2	35.7	299.8	1.5	11.0	50.1	202.3	93.1	557.3
2013	5.8	43.6	32.4	268.9	1.5	11.0	49.9	201.1	89.6	524.6
2014	5.8	43.9	32.5	270.5	1.5	12.4	49.7	200.0	89.5	526.8
2015	5.8	44.0	34.0	280.8	1.6	13.0	50.1	200.0	91.5	537.8
2016	5.8	42.9	36.5	201.2	1.6	12.3	53.2	211.3	97.1	467.7
2017	5.8	43.6	37.1	202.3	1.6	12.4	53.3	180.8	97.4	439.1
2018	4.9	37.8	38.5	309.7	1.6	12.4	53.3	180.8	98.3	540.7
Annual growth (%)	-3.03	-3.25	2.87	0.12	2.34	3.43	1.27	-1.62	1.45	-0.91

Note: The growth in per ha yield in a respective region can be estimated from the difference in the growth rates in production and area; T=Tonnes and ha=Hectare.
Source: Government of Pakistan, 2019b

The high susceptibility of dates fruits to pests and diseases is one of its most limiting factors, which causes major losses. The postharvest losses are high and these losses begin from pre-harvest due to selection of wrong variety. Furthermore, these fruits are subject to further deterioration right at the time of harvest at the hands of unskilled labor. After harvest, mishandling of the fruit during transportation and marketing processes is very common.

1.3. Dates Trade of Pakistan

Pakistan's trade balance in dates is improving over time. In term of value, it has been increasing at an annual rate of 11% per annum from US$17.3 million in 2001 to US$98.5 million in 2017. The trade balance in terms of quantity also has similar trends (Table 4).

The improved trade balance in dates is both because of expanding exports and shrinking imports (Table 4). During 2001-17, while exports quantities and values have improved at the rate of 6% and 11% per annum, respectively, the imports have reduced with the rates of 15% and 3% per annum. It is worth noting that progress in dates trade in Pakistan have been achieved despite the reduction in its production in the country as noted above.

Table 4: Trade and Trade Balance of Dates in Pakistan during 2001-17

Year	Export		Import		Trade balance	
	Quantity (000 tonne)	Value (million US$)	Quantity (000 tonne)	Value (million US$)	Quantity (000 tonne)	Value (million US$)
2001	69.4	23.2	37.8	5.9	31.6	17.3
2002	77.5	28.4	38.1	6.2	39.3	22.2
2003	71.1	25.4	18.3	3.2	52.8	22.2
2004	65.4	22.5	51.1	9.5	14.3	13.0
2005	84.1	29.6	14.9	2.9	69.1	26.7
2006	89.3	32.2	37.8	6.5	51.6	25.7
2007	104.1	38.3	19.8	5.3	84.3	33.0
2008	93.1	32.5	10.2	2.0	82.9	30.5
2009	111.7	42.7	9.9	3.5	101.8	39.3
2010	121.7	48.7	2.3	1.1	119.4	47.6
2011	113.4	64.1	13.2	7.0	100.2	57.1
2012	164.0	80.7	6.2	3.5	157.8	77.2
2013	169.2	85.8	3.3	1.9	165.8	84.0
2014	118.0	80.0	4.7	2.7	113.3	77.3
2015	131.2	83.2	8.0	4.7	123.2	78.5
2016	163.2	102.6	5.6	6.7	157.6	95.8
2017	175.1	107.5	6.8	9.0	168.3	98.5
Growth rate (%)	5.9	10.7	-15.0	-3.0	11.3	12.3

Source: FAOSTAT, Trade, Crops and Livestock Products http://www.fao.org/faostat/en/#data/TP

1.4. Dates in Global Perspectives

Among the most produced fruits in the world, dates is 17th most produced on the globe[2] (http://www.statista.com/statistics/264001/worldwide-production-of-fruit-by-variety/). Pakistan stands at 6th position among the largest dates producing countries in the world (Table 7).

The global production of dates in 2017 was 8.2 million tonnes from 1.33 million has with an average global yield of dates at 6.14 tonnes per ha. The yield of dates in Pakistan is about 12% lower than the world average. Pakistan contributes 7.4% of the word area under dates, but 6.4% in world production because of its lower per ha yield (Table 5). Pakistan contribution in world export is significantly higher than those in dates area and production. The world export 15% of its production, but Pakistan sells 33% of its dates production abroad. The farm gate prices of dates in Pakistan is lower than the world average suggesting the compatibility of Pakistani dates at the farm level. However, world export price of Pakistani dates is lower than the world average, suggesting improvement in dates value chain will be required to get the world average dates prices.

Table 5: Comparison of World vs. Pakistan in Dates Production Sector in 2017

Parameter	World	Pakistan	Share (%)
Area (000 ha)	1330	98.0	7.37
Production (000 tonne)	8166	524.0	6.42
Value of production (Million US$)	9815	392.1	3.99
Yield (tonne/ha)	6.14	5.3	87.07
Farm gate price (US$/tonne)	1202	748	62.25
Quantity of international trade (000 tonne)	1253	175.1	13.98
Value of international trade (Million US$)	1477	107.5	7.28
Export quantity as % of production	15%	33%	-
Export value as % of production value	15%	27%	-
Average export prices (US$/tonne)	1042	629	60.33

Source: FAOSTAT, Production, Crops http://www.fao.org/faostat/en/#data/QC
Source: FAOSTAT, Trade, Crops and Livestock Products http://www.fao.org/faostat/en/#data/TP

[2] Global fruit production in 2017 by variety in decreasing order of their quantities was: watermelon (118.41 million tonnes), banana (113.92 million tonnes), apple (83.14 million tonnes), grapes (74.28 million tonnes), oranges (73.31 million tonnes), mangoes (50.64 million tonnes), plantain & others (39.24 million tonnes), tangerines (33.41 million tonnes), pineapples (27.40 million tonnes), peaches & nectarines (24.67 million tonnes), pears (24.17 million tonnes), lemons/lime (17.21 million tonnes), papaya (13.02 million tonnes), plums & sloes (11.76 million tonnes), strawberry (9.22 million tonnes), grapefruits (9.06 million tonnes), dates (8.17 million tonnes), avocadoes (5.92 million tonnes), persimmons (5.75 million tonnes), apricots (4.26 million tonnes) and kiwi fruit (4.04 million tonnes).

1.5. Global Production and Trade

Dates production globally has increased from 6.7 million tonnes in 2001 to 8.2 million tonnes in 2017 with at an annual rate of 1.3% per annum during the period (Table 6), which is higher than the population growth of 1.19% implying that per capita consumption of dates is increasing globally. The increase in production during the period is contributed by the improvement in dates yield with a growth rate of 0.4% per annum, while the area under dates cultivation has been increasing at a rate of 0.9% per annum. This is opposite to what happened in Pakistan where area increase contributed in production enhancement while per ha yield of dates have declined over the period.

Table 6: Trend in the Global Dates Production and Export During 2001-16

Years	World Dates Production			World Dates Export	
	Area (000 Ha)	Production (000 t)	Yield (t/ha)	Quantity (000 tonnes)	Value (Million $)
2001	1058	6660	6.29	547	252.7
2002	1086	6721	6.19	585	275.5
2003	1095	6749	6.16	583	322.7
2004	1068	6626	6.20	381	304.0
2005	1079	6551	6.07	790	437.4
2006	1145	6770	5.91	469	434.9
2007	1181	6963	5.90	871	622.0
2008	1181	7018	5.94	943	691.2
2009	1200	7183	5.99	659	606.5
2010	1282	7526	5.87	667	776.0
2011	1126	7262	6.45	710	902.2
2012	1114	7429	6.67	765	875.6
2013	1157	7517	6.50	825	993.1
2014	1158	7497	6.47	1183	1185.7
2015	1202	7911	6.58	1172	1193.6
2016	1285	8062	6.27	1164	1212.7
2017	1330	8166	6.14	1253	1477.0
Annual Growth (%)	0.88	1.29	0.41	5.26	11.08

Source: FAOSTAT, Production, Crops http://www.fao.org/faostat/en/#data/QC

More interestingly is the fact that dates are becoming an international commodity as its export quantity and value have increased at the rate of 5% and 11% per annum, respectively (Table 6). The world export of dates has reached to US$1.5 billion in 2017. Pakistan's export quantities have increased at the rate of 6% while growth in the export values is similar to the world average at 11% (Table 4), implying that while dates export quantity expanded at relatively a higher rate than the world rates, but could not get corresponding fetch the higher export price. This produces an opportunity for Pakistan to improve its share in international dates market (especially export value) if it can develop sophisticated value chain for dates required to export the produce.

Dates production is recorded in over 90 countries of the world. The top dates producing countries are Egypt, Iran, and Algeria (Table 7). The highest area under dates cultivation is in Iraq, but because its per ha yield is very low, therefore, in production it is at the 5th position. Egypt also gets significantly higher yield at 32 tonnes than any other country of the world

(Table 7). Oman and Sudan remotely follow Egypt in terms of yield. The Dates in Pakistan is only 5.3 tonnes per ha which is only 16% of the yield in Egypt. Therefore, Pakistan has a lot to learn from Egypt, Oman, and Sudan to improve its dates yield.

Table 7: Top Ten Dates Producing Countries of the World, 2017

Countries	Area (ha)	Production (tonnes)	Yield (t/ha)
Egypt	49.5	1590.4	32.1
Iran (Islamic Republic of)	169.8	1185.2	7.0
Algeria	167.7	1058.6	6.3
Saudi Arabia	108.1	754.8	7.0
Iraq	365.9	618.8	1.7
Pakistan	98.0	524.0	5.3
United Arab Emirates	65.0	475.3	7.3
Sudan	37.1	439.4	11.8
Oman	24.6	360.9	14.7
Tunisia	64.4	260.0	4.0

Source: FAOSTAT, Production, Crops http://www.fao.org/faostat/en/#data/QC

In quantity terms, the top exporting countries of the world are Iran, UAE, Pakistan and Iraq. In terms of total value of dates exported, the top ten exporting countries are Iran, Tunisia, Israel, UAE, and Pakistan. The countries like Egypt which is among top 10 dates producing country in the world is at 11th position in dates export quantity (Table 8). It should be noted that Tunisia and Israel make higher export earnings despite they have relatively lower export quantities, suggesting that their export prices are higher than other countries.

Table 8: Top Dates Exporting Countries of the World, 2017

Rank	Countries	Quantity (000 tonnes)	Country	Value (Million US$)	Export price Share in value (%)
1	Iran	253.5	Iran	250.5	17.0
2	UAE	218.0	Tunisia	230.0	15.6
3	Pakistan	175.1	Israel	181.2	12.3
4	Iraq	151.2	UAE	167.5	11.3
5	Israel	137.0	Pakistan	107.5	7.3
6	Tunisia	104.4	Saudi Arabia	91.5	6.2
7	Saudi Arabia	63.2	Iraq	60.9	4.1
8	Algeria	46.8	USA	58.3	3.9
9	France	13.2	Algeria	52.3	3.5
10	Oman	11.8	France	40.9	2.8
11	Egypt	9.6	Netherlands	39.0	2.6

Source: FAOSTAT, Trade, Crops and Livestock Products http://www.fao.org/faostat/en/#data/TP

India, UAE, Morocco, and France are leading dates importing countries of the world both in terms of quantity and the value (Table 9). France, Malaysia, and Morocco pay relatively higher price for their imported dates. Malaysia may be good market for Pakistan to explore to expand its exports.

Table 9: Major Dates Importing Countries of the World in 2017

Rank	Countries	Quantity (000 tonnes)	Country	Value (Million US$)
1	India	373.5	India	242.6
2	UAE	163.8	UAE	152.8
3	Morocco	70.1	Morocco	117.0
4	France	37.4	France	88.8
5	Indonesia	34.8	Germany	60.8
6	Turkey	34.2	United Kingdom	58.1
7	USA	34.0	Malaysia	54.1
8	Malaysia	26.3	Indonesia	53.4
9	Kazakhstan	25.6	Turkey	51.3

Source: FAOSTAT, Trade, Crops and Livestock Products http://www.fao.org/faostat/en/#data/TP

1.6. Dates Consumption

Dry or soft dates are used directly or with fillings of dates, walnuts, candied orange and lemon peel. They are used in Arab breads, cakes and other dessert items. Recent innovations include chocolate-covered dates and products like sparkling dates juice, used in some Islamic countries, for special and religious occasions such as Ramadan.

The world average per capita annual dates availability for consumption during 2013 (the latest year when data is available) is 0.93 kg, which is about 11% higher than that in 2001 (Table 10). The availability of dates for consumption in Pakistan during the corresponding years are 2.3 kg and 3.9 kg, indicating about 42% reduction in the period.

Table 10: Change in Per Capita Consumption of Dates During 2001-13

Country	Consumption (Kg/capita/annum)		Change (%)
	2001	2013	
Oman	94.13	67.55	-28.2
Saudi Arabia	37.23	34.25	-8.0
Algeria	12.91	20.93	62.1
Egypt	14.9	14.33	-3.8
Iran	10.0	12.15	21.5
Pakistan	3.94	2.28	-42.1
World	0.84	0.93	10.7

FAOSTAT, Balance Sheet, Food Supply - Crops Primary Equivalent; http://www.fao.org/faostat/en/#data/CC (Go to Foos Supply Quantity (Kg/capita/year)

The highest dates consumption is in Oman and Saudi Arabia. Overtime the availabilities of dates for consumption in Oman, Saudi Arabia, and Egypt have declined while it has increased in other major Dates consuming countries like Algeria and Iran (Table 10). As Iran, Oman and Saudi Arabia are among the major Dates exporting countries, reduction in consumption in these countries may create more competition for Pakistan in international market.

1.7. Need for the Study

Summarizing the macro analysis, we conclude that dates production in Pakistan is in crisis during 2000s because of its declining production trend while per ha yield has depressed quite significantly at 2.1% per annum rate. On the other hand, world average dates yield is improving at the rate of 0.4% per annum. Once at par with the average world yield, Pakistani yield is now 13% lower than the world average. Trade in dates from Pakistan, however, has performed relatively well during the period because of the expansion in the export dates and shrink in its imports, which has improved the trade balance of Pakistan both in terms of dates quantity and its value at quite a high rate of 11% and 12%, respectively.

However, such a high growth in the export of dates is not sustainable because of the declining per ha yield in the country. Expansion in export along with declining production has reduced the per capita consumption of dates in Pakistan by about 42%, which cannot be continued unabated as Pakistani people do like to consume dates especially in the month of Ramadan and during marriage ceremonies. Moreover, Pakistani dates in international markets fetch lower price which is now only 60% of the world average.

Based on the importance of dates production in marginal areas cultivated by relatively small poor farmers and its declining competitiveness in international market, Planning Commission of Pakistan has initiated this study to analyze the whole value chain of Dates including production, marketing, value addition, processing, and trade, identify the gaps and potential along the chain, and suggest economically viable policy, technological, and institutional interventions to enhance the competitiveness of Pakistani dates in international market. This analysis is conducted on cluster basis to incorporate the regional variation in production, marketing, and processing opportunities while suggesting interventions along the value chain.

2. OBJECTIVES

This study has been conducted to contribute in the Cluster Development Based Agriculture Transformation Plan Vision-2025. The following objectives of the study are given as under:

a) To identify major dates production clusters in Pakistan based on their production.

b) To characterize and conduct SWOT analysis of each dates cluster.

c) To identify infrastructure, institutional, technological, and policy issures of each cluster.

d) To evaluate the real potential of dates value chain.

e) To recommend infrastructure, institutional, technological and policy interventions to harness the cluster potentials.

f) To conduct economic and social feasibility of the suggested interventions and recommend policy measures.

3. METHODOLOGY

The presented data, field and other related information regarding characteristics, gaps, potentials and required interventions for development of dates cluster were gathered from following sources:

1. The primary data was gathered from field visits of farmers, meetings with farmers, stakeholders, researchers, extension agents, exporters, office bearers of farmer's associations, NGOs and higher authorities. and internet search engines. For the sake of in-depth discussion and information group discussions were also organized besides several meetings with farmers and other stakeholders (see Annexure 1 for the list of stakeholders consulted).

2. To collect detailed information, a questionnaire was developed and information was gathered thereof.

3. Macro data related to dates were also analyzed to see the trends in dates production, trade, consumption, etc. at the national and international level. The data in this analysis were mainly used from FAO and Agricultural Statistics of Pakistan.

4. Literature was extensively reviewed for consultation and references (See Annexure 2 for the list of literature reviewed in this study).

Moreover, the following generic parameters and indicators were used while collecting the data:

- World dates industry perspective.
- The dates industry analysis and its potentials.
- Dates cost of production, harvesting, postharvest and processing of dates data was collected from farmers and other stakeholders.
- Data was also collected from government directorates of Economics & Marketing, Postharvest & Food Technology, Wholesalers, Retailers and processers.
- Production constraints, harvesting, transportation of dates, marketing issues, trading export failures, and processing data was obtained from all the stakeholders.
- The recommendations have been made on the basis of local and national indices and international parameters.

4. REVIEW OF LITERATURE

The bilateral trade between China and Pakistan is quite imbalance and fully in favor of China. That is why Pakistan has asked China to encourage its agricultural products into Chinese market which will enhance one-sided contracted volume of trade from Pakistan side. In this respect China-Pakistan Economic Corridor (CPEC) is potential platform for both countries to benefit from therefore, China and Pakistan have principally agreed to widen agro based cooperation and adoption to fast-track trade in agricultural products (The News, 18th October, 2018). But to meet the export targets, Pakistan has to apply the protocols under International Plant Protection Convention (IPPC), which is a major requirement for the export of agricultural products (FAO, 2009).

Major portion of dates is not subjected to any processing operation except pressing and this still holds truth. Around 40% postharvest losses occur in dates. Dates are classified as climacteric fruit (Serrano *et al*., 2001), which requires special treatments after harvesting for longer shelf life. Furthermore, micronutrients are not applied to dates whereas these significantly increase fruit production, fruit size and quality (Khayyat *et al*., 2007).

There a trade war situation is prevailing between the two world economic giants and one of them is a very close neighboring friend to Pakistan and likely to be in need of Pakistani products especially agricultural products. The CPEC is one of the potential opportunities for the destination of Pakistani products especially fruits, vegetables and dairy and poultry products.

According to All Pakistan Fruit & Vegetable (Exporters & Importers) Association (PFVA), Balochistan can export US$ 1 billion worth of fruits and vegetables annually. Therefore, PFVA in the start of this year visited Balochistan and held a series of meetings with the stakeholders for paving the way for the agricultural products of Balochistan including dates to be marketed in international markets.

During our consultation process the farmers of dates expressed their concerns that besides water scarcity. Major pests of this crop are also posing great threat. Dubas Bug, Lesser Date Moth, red palm weevil, Rhinoceros beetles and Scale insects have been reported as major dates pests in Balochistan (Khan, *et. al*., 2018). The severity of these insect attacks sometimes cause sprays on this precious crop. Thanks to dry climate of most of dates growing areas, no major disease has been mentioned by the farmers of dates. About more than one decade ago Dubas bug entered in Balochistan through Iran in the bordering area of Panjgur and devastated the dates crop by infesting them severely. This bug has spread from Iraq and entered in Pakistan through Iran. The Balochistan Agriculture Research Institute, Quetta, took the preventive measures and confined the pest within same area but for total control still more is needed to be done. Furthermore, for sustainable preventive measures, research capacity, extension capabilities and farmers' agriculture literacy is needed to be enhanced for good agriculture practices and food security.

5. CLUSTER IDENTIFICATION AND ITS CHARACTERISTICS

5.1. Identification of Dates Clusters

As stated earlier, Balochistan is contributing 33.4% of dates of Pakistan while the rest of 67% dates are produced in Sindh (57.3%), Punjab (7.0%) and Khyber Pakhtunkhwa (2.3%). Main dates growing districts in the order of area concentration are Turbat, Khairpur, Panjgur, Muzaffergarh, Sukkur, Awaran, Gwadar, Dera Ismail Khan, Jhang, and Bhakkar (Table 11). Most of these districts are on or in close proximity to CPEC routes meaning thereby that the dates of Pakistan would have access to world's biggest population's market of China in the near future.

Based on the district level data on dates, following three clusters are identified in Figure-1 and Table 9:

1. **Baluchistan cluster** includes Turbat, Panjgur, Awaran and Gwadar districts with Turbat and Panjgur as its focal points. Around 86% of dates area in Balochistan is concentrated in this cluster while 45% of dates area of the province lies in Turbat. This cluster is on the western route of CPEC.

2. **Sindh cluster** includes Khairpur and Sukkur with Khairpur as its focal point. About 98% of dates area in the province is concentrated in this cluster, while 89% is coming from Khairpur. The district is in close proximity to the Western CPEC route.

3. **Punjab and KP** cluster includes Muzaffargarh, Jhang, Layyah and D.I. Khan with Muzaffargarh as its focal point. About 72% of the provincial area (or 6% of the country area) of dates comes from this cluster while 44% comes just from Muzaffargarh. D.I. Khan is also in close proximity of CPEC route. The cluster has the highest per ha yield of dates among all the clusters.

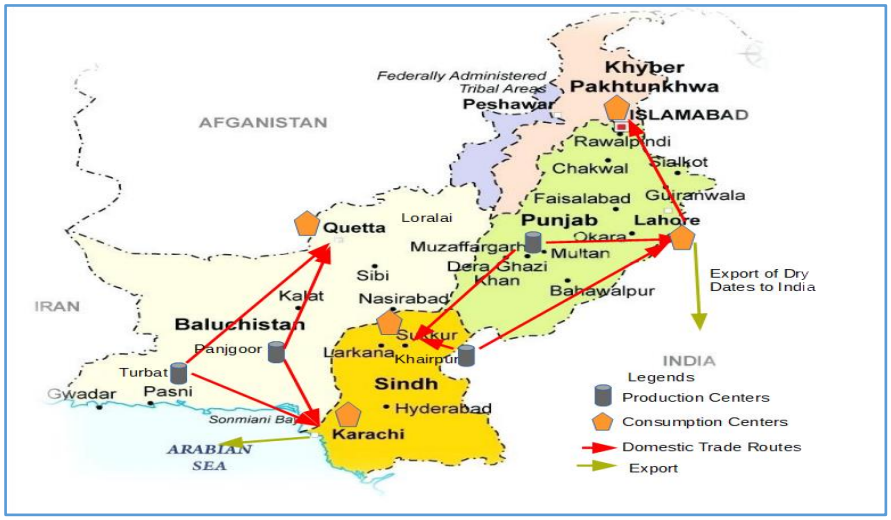

Figure 1: Map of Pakistan showing dates production & marketing areas

Table 11: District wise Area, production of Yield of Dates in Pakistan, 2015-16

Sr. #	District	Area (Ha)	Production (tonnes)	Area (% of total in the province)	Production (% of total in the province)	Yield (kg/ha)
Baluchistan Cluster						
	Turbat	23,776	102,522	44.7	48.5	4312
	Panjgoor	17,489	83,107	32.9	39.3	4752
	Awaran	2,775	10,065	5.2	4.8	3627
	Gwadar	1,699	8,376	3.2	4.0	4930
Total Balochistan cluster		45,739	204,070	86.0	96.6	4462
Total Balochistan		53,181	211,340	100.0	100.0	3974
Sindh Cluster						
	KhairPur	32,450	177,951	88.8	88.5	5484
	Sukkur	3,490	17,752	9.6	8.8	5087
Total Sindh Cluster		35,940	195,703	98.4	97.3	5445
Total Sindh		36,524	201,165	100.0	100.0	5508
Punjab-KP Cluster						
	Muzaffargarh	3,298	26,161	44.4	46.8	7932.4
	D.I. Khan	928	8,121	12.5	14.5	8751.1
	Jhang	646	4,828	8.7	8.6	7473.7
	Layyah	455	3,170	6.1	5.7	6967.0
Total Punjab-KP Cluster		5,327	42,280	71.8	75.6	7936.9
Total Punjab-KP		7,420	55,941	100.0	100.0	7539.2

5.2. Comparison of the Dates Clusters

The development of clusters is to make the dates industry more profitable and export oriented. The Sindh Cluster has the advantage of access to Karachi market and its port for export to international markets. The proposed Balochistan Cluster is lying on the CPEC rout and is just 160 km away from Gwadar. This cluster has the advantage of good road network which provides access to dates produce to Karachi and other parts of the country. Therefore, the dates can be dispatched to any part of the country. The Punjab and KP cluster can become exportable via Karachi and Gwadar. The big cities and population of Punjab province itself is a major market. The following presents an overall comparison of key characteristics in these all three clusters.

In all dates clusters, harvesting of dates starts from first week of June to Mid-September. It is matter of satisfaction that dates farmers of Pakistan expressed their satisfaction over existence of major road network for access to their produce to the main markets of the country. However, roads from farm-gate to main roads are quite in poor condition. Furthermore, the mode and condition of transport is not good which cause bruises/damage to closely packed dates fruit due to abrasion. This is also one of the factors which is responsible for reduced storability and quality of fruit and postharvest losses to fruit.

The per ha yield of dates is highest in Punjab-KP cluster followed by in Sindh cluster, while it is lowest in Baluchistan where most of the dates area is concentrated (Table 12). Therefore, Balochistan cluster needs the most urgent attention for improvement. One of the reasons for

low yield in Balochistan is that orchards are not properly laid out. In Punjab and KP cluster, farmers in the early stage of the garden, intercrop dates fields with wheat and vegetables.

The cultivation method in all the three clusters, especially in Balochistan is still conventional. The grower still plants old varieties which are prevailing in the cluster for more than 50 years. Despite the existence of high efficiency irrigation systems, irrigation methods have not changed, still flooding method is applied. The farmers of the cluster do not test their soil and water, and in Balochistan cluster no such facility exists in the area. Fertilizers are used injudiciously and the quality of fertilizer is also compromised. On the other hand, farmers spray their orchards as preemptive measures without pest scouting which results in loss of money without much benefit. The research and extension wings do work in the cluster but they are working with very meager funds and capacity to address farmers' issues.

Table 12: Characteristic and Comparison of Dates Clusters

Salient Features	Sindh Cluster	Baloch. Cluster	Punjab-KP Cluster
Districts	Khairpur and Sukkur	Turbat, Panjgur, Awaran and Gwadar	Muzaffargarh, D.I. Khan,Jhang, Bhakkar
Focal point district/Tehsil/ Mouza	Khairpur	Turbat	Muzaffargarh
Focal point area (ha)	32,450	23,776	3,298
Focal point production (tonnes)	177,951	102,522	26,161
Area of the cluster (ha)	36,524	46,716	5,439
Production of the cluster (tonnes)	201,165	207,614	42,454
Av. yield of the cluster (t/ha)	5.51	4.44	7.80
Percentage of the crop area that lies in the cluster (dates area of the cluster/dates area in the country)	37.01%	48.10%	5.60%
% of the total cropped area under dates in the cluster	10.94%	44.62%	0.17%
Geographical and Environmental Factors	• Calcareous river alluvium, clay silt soil.	• Alluvial, silt clay and light sandy soil	• Loam and sandy loam
	• Plains.	• Mountainous and plains.	• Plains
	• Climate of these two dates growing areas is very hot/tropical in summer and pleasant in winter.	• The climate of these four areas is quite similar and arid to hyper arid. These areas receive mostly winter rains with hot to very hot summers/ tropical.	• The climate these four areas are almost similar and very hot/tropical.
	• Mostly areas of dates orchards are irrigated with ground water.	• Irrigation is dependent on ground water table level. For irrigation, the ground water is pumped by tube wells in addition to	• Most of the dates growing areas are abundant with river water and some receive glacier water.

		trational Karez system.	
	• Precious ground water is pumped and the water used is fit for irrigation.	• Precious groundwater & high costs of pumping from very low depths in most of areas.	• Quality surface water is available.
	• Average rainfall 90-110 mm. Most of the rain occur in winter.	• Average rainfall 50–170 mm per year.	• Average rainfall 150 and 250 mm per annum in Muzaffargarh and D.I. Khan respectively.
	• Temperature rises up to 40-45°C during summer but drops to 7°C during winter. Dry hot and cool nights are typical in summer.	• Temperatures frequently rises > 43°C during Mid-May and Mid-August. In winters, temperature goes drops to 10°C, particularly during nights.	• Temperature frequently rises 42°C in summer and drops 5°C in winter normally.
	• No dust storm occurs.	• Strong winds and dust storms may occur in winter.	• Dust storms occur in Bhakkar & Muzaffargarh and sand dunes are also formed.
	• Mostly dry during the fruiting season of June-August	• Dry and hot weather during May through July and very rarely receive monsoon rainfall.	• Most of the areas remain dry during summer, while Muzaffargarh receives most of the rainfall in the July and August.
Dates Growers	• A good majority of marginal and small sized farming households (See Annexure-3)	• A notably good proportion of farming households belong to marginal and smalled groups (See Annexure-3)	• Majority of the farming households belong to marginal and small size groups (See Annexure-3)
	• No dates specific growers association however, Farmer's Association do exist with name of Sind Abadgar Board.	• Turbat Dates Growers Association.	• No formal Dates Growers Associations.
	• Availability of abundant labor for dates production practices, especially at the time of harvesting.	• Availability of abundant labor for dates production practices, especially at the time of harvesting.	• Labor is provided by households themselves, however, in some areas where big orchards exist

			hired labor is engaged.
Product Features	• Mature Fruit: brown or deep brown in color. Some yellow colored dates varieties are also grown.	• Mature Fruit: brown or deep brown in color. Some yellow colored dates varieties are also grown.	• Mature Fruit: brown or deep brown in color. Some yellow colored dates varieties are also grown.
Variety Feature	• Around 50 dates varieties are available in the country out of which five to six varieties have become main commercial varieties. • Name of some dates varieties cultivated in this cluster are Aseel, Hussaini, Karbalain, Dhakki, Fasli and Begum Jhangi.	• Around 50 dates varieties are available in the country out of which five to six varieties have become main commercial varieties. • Name of some dates varieties cultivated in this region are Mozawati, Begum Jhangi, Haleny, Shakar, Hussaini, Kungu, and Jadgali.	• There around 50 dates varieties are available in the country out of which five to six varieties have become main commercial varieties. • Name of some dates varieties cultivated in this cluster are Dhakki, Haleni, *Chohara*, Alipur, Mochi Wali, Dora Kaheeri, Aseel, Sufaida, Kupra.
	• Average yield of dates per tree is 100-120 kg.	• Average yield of dates per tree is 90-100 kg	• Average yield of dates per tree is 120-200 kg
Nursery and Planting	• Some dates farmers raise their own nursery plants. • Dates saplings are also available from private as well as government nurseries.	• Some dates farmers raise their own nursery plants. • Dates saplings are also available from private as well as government nurseries.	• Some dates farmers raise their own nursery plants. • Dates saplings are also available from private as well as research institute's nurseries.
	• During the early dates orchards wheat and vegetables are grown. • Normally orchards are properly laid out.	• Mostly farmers do not plant Dates tree with proper layout rather they plant dates trees on the sides of their land and in the center vegetables are grown. However, nowadays, some farmers are planting dates trees according to proper orchard layout.	• Proper dates orchards are established.
	• Average number of plants is 100-110 per acre.	• Average number of plants is 90 per acre. This is	• Average number of plants is 108 per acre.

		because in this cluster, date plam plants are not planted systematically i.e., in square, rectangular, triangular, hexagonal, quincunx or contour systems.	
Inputs/Management Practices	• Fertilizers are used. Fresh cow dung is used as FYM which is very harmful for trees.	• Very little fertilizers are used and mostly in vegetables fertilizers are applied.	• Fertilizers are used.
	• Mostly pesticides are used against insects while rarely used against diseases.	• Mostly no pesticides are used while, very rarely used against diseases.	• Mostly pesticides are used against insects while rarely used against diseases.
	• Micronutrients are applied in dates orchards.	• No micronutrients are applied in dates orchards.	• Micronutrients are applied in dates orchards.
	• Normally in one season on average, 8 irrigations are applied at intervals of 20-25 days.	• Normally in one season, on average, irrigations are applied at intervals of 12-15 days. While, in peak summer, irrigations are applied 8-10 days intervals.	• Normally in one season on average, 8 irrigations are applied at intervals of 12-15 days.
	• Mainly orchards are flood-irrigated.	• Mainly orchards are flood-irrigated.	• Mainly orchards are flood-irrigated.
	• Intercropping with vegetables, fodder, cereal crops (such as alfalfa, wheat etc.) and vegetables is a normal practice.	• Intercropping with other fruit plants and fodder, cereal crops (such as alfalfa, wheat etc.) and vegetables is a normal practice.	• Intercropping with other fruit plants and fodder, cereal crops (such as alfalfa, wheat etc.) and vegetables is a normal practice.
	• Weeding is done manually, no weedicides are used	• Weeding is done manually and as such no weedicides are used	• Weeding is done manually, no weedicides are used
Pollination/Harvesting	• Dates fruit is harvested manually. No mechanized harvesting.	• Dates fruit is harvested manually. No mechanized harvesting.	• Dates fruit is harvested manually. No mechanized harvesting.
	• Post-harvest losses are 30-40%	• Post-harvest losses are 30-40%	• Post-harvest losses are 30-35%

	• No exact know how about proper stage of maturity of dates fruit for its harvesting. Farmers do not use any scientific maturity index.	• No exact know how about proper stage of maturity of dates fruit for its harvesting. Farmers do not use any scientific maturity index.	• No exact know how about proper stage of maturity of dates fruit for its harvesting. Farmers do not use any scientific maturity index.
	• Few farmers do pollination manually in the month of May.	• Few farmers do pollination manually in the month of May.	• Few farmers do pollination manually in the month of May.
Making dry dates or *Chohara*	• Some of the portion of dates production is dried for making *Chohara*. This process is done when fruit is at *Doka* stage (50% ripe). This process is done by boiling dates fruit for 15-20 minutes in a big pane and after this sun dried. One small solar dryer unit has been installed at a farmers facility by the PARC.	• Some of the portion of dates production is dried for making *Chohara*. This process is done when fruit is at *Doka* stage (50% ripe). This process is done by boiling dates fruit for 15-20 minutes in a big pane and after this sun dried.	• Most of the Dhakki variety of D.I. Khan is dried for making *Chohara*. This process is done when fruit is at *Doka* stage (50% ripe). This process is done by boiling dates fruit for 15-20 minutes in a big pane and after this sun-dried.
Packaging/Transportation	• After harvesting fruit is left under the sun for drying for six days then packed at a shady place in the orchard and transported in small vans, pickups and through trucks by big farmers.	• After harvesting fruit is left under the sun for drying for six days then packed at a shady place in the orchard and transported in small vans, pickups and through trucks by big farmers.	• After harvesting fruit is left under the sun for drying for six days then packed at a shady place in the orchard and transported in small vans, pickups and through trucks by big farmers.
Wholesaler/Retailer	• Contractors or wholesalers buy the product from farmers. The price is offered to the farmer based on the size and variety of fruit.	• Contractors or wholesalers buy the product from farmers. The price is offered to the farmer based on the size and variety of fruit.	• Contractors or wholesalers buy the product from farmers. The price is offered to the farmer based on the size and variety.
	• The auction in the wholesale market is generally based on the variety and weight, but grading standards are not followed.	• The auction in the wholesale market is generally based on the variety and weight, but grading standards are not followed.	• The auction in the wholesale market is generally based on the variety and weight, but grading standards are not followed.

	• As per market demand re-grading is done by commission agents, retailers and exporters. The average price of dates is PKR 80-140/kg.	• As per market demand re-grading is done by commission agents, retailers and exporters. The average price of dates is PKR 80-140/kg.	• As per market demand re-grading is done by commission agents, retailers and exporters. The average price of dates is PKR 80-140/kg.
	• The prices remain high in start of the season and after that remain unstable until the end of the season.	• The prices remain high in start of the season and after that remain unstable until the end of the season.	• The prices remain high in start of the season and after that remain unstable until the end of the season.
	• Mostly sold as fresh in local and national markets and some quantity is exported. A considerable quantity is dried (*chohara*).	• Mostly sold as fresh in local and national markets and some quantity is dried (*chohara*). While, locally dates syrup is also prepared.	• Mostly sold as fresh in local and national markets. While, from *Dhakki* variety mostly *Chohara* is made.
New Technologies/ Infrastructure	• No warehouse or cold storage facility is available in the cluster. In Khairpur and Sukkar for production of quality dates saplings, a Tissue Culture laboratory building has been completed while, purchase of laboratory equipment is under process. This project is being implemented by the Agriculture Research Department of Sindh.	• At present no warehouse facility is available while, cold storage facility is available only at Turbat which is not enough to accommodate the considerable volume of dates produced in the area. At Turbat a project entitled Construction/Establishment of Cold Storage and Date Processing Plant District Turbat is being implemented and under which a dates processing plant, cold storage, a market square and refrigerated trucks will be provided. This project is being implemented by the Agriculture Extension Department of Balochistan.	•

	• No value addition, preservation, mechanical drying, and prominent industrial processing is done with surplus dates.	• No value addition, preservation, mechanical drying, and prominent industrial processing is done with surplus dates.	• No value addition, preservation, mechanical drying, and prominent industrial processing is done with surplus dates.
Export/ domestic marketing	• Dates are mostly marketed in Karachi, Sukkur, Lahore, Multan, Islamabad, Hyderabad and Faisalabad markets.	• Dates are mostly marketed in Karachi, Sukkur, Hyderabad, and Quetta markets.	• Dates are mostly marketed in Karachi, Lahore, Islamabad, Peshawar, Multan, and Faisalabad markets.
	• Although most of the dates are destined to various export markets and other provinces but still export potential in the commodity exists	• Most of the fresh dates produced are consumed locally but still their marketing to other markets and export potential exist but very little quantity is exported.	• Although most of the dates are destined to domestic markets and almost zero quantities are exported.
Supply Chain	• Due to variation in quality and mixed varieties no sustainability in prices. There is uneven price spread throughout the chain.	• There is uneven price spread throughout the chain. Due to variation in quality and mixed varieties no sustainability in prices.	• This cluster is spread in two provinces (KP and Punjab) and less integrated; • Price spread is uneven
	• Lack of cold chain (no cold storage, refrigerated containers (transportation), proper cold storage at markets). • Complex procedures for shipment of dates limit its export export.	• Lack of cold chain (no cold storage, refrigerated containers (transportation), proper cold storage at markets). • Complex procedures for shipment of dates limit its export.	• Lack of cold chain (no cold storage, refrigerated containers (transportation), proper cold storage at markets). • Complex procedures for shipment of dates limit its export.
	• Majority of farmers and traders do not follow the commodity handling precautions and protocols (HACCP and Euro-Gap).	• Majority of farmers and traders do not follow the commodity handling precautions and protocols	• Majority of farmers and traders do not follow the commodity handling precautions and protocols (HACCP and Euro-Gap).

		((HACCP and Euro-Gap)).	
Certifications	• SPS, Food safety standards and traceability standards such as HACCP, EurepGAP, Global Gap, IFS are not followed which cause major obstacle to enter into high end markets.	• SPS, Food safety standards and traceability standards such as HACCP, EurepGAP, Global Gap, IFS are not followed which cause major obstacle to enter into high end markets.	• SPS, Food safety standards and traceability standards such as HACCP, EurepGAP, Global Gap, IFS are not followed which cause major obstacle to enter into high end markets.
	• Organic food certification is costly and not affordable by majority of the farmers.	• Organic food certification is costly and not affordable by majority of the farmers (most of the produce is organic).	• Organic food certification is costly and not affordable by majority of the farmers.
Processing	• Several dates processing plants are in Khairpur and Karachi. These plants are equipped with modern technology and fully automatic metal detection scanning machines. The processing plants are ISO certified and HACCP procedure is implemented.	• A project titled Construction/Establishment of Cold Storage and Dates Processing Unit in District Turbat is under process with the cost of Rs 500 million.	
Socioeconomic networking/Gender involvement	• Women role in dates industry is low (potential is there for women).	• Women role in dates industry is low (potential is there for women).	• Women role in dates industry is low (potential is there for women).
	• A typical orchard owner earns more than Rs.1.5 million.	• A typical orchard owner earns more than Rs.1.5 million.	• A typical orchard owner earns more than Rs.1 million
	• Community mobilization needs to be fostered for greater awareness about the importance of modern production technology of dates.	• Community mobilization needs to be fostered for greater awareness about the importance of modern production technology of dates	• Community mobilization needs to be fostered for greater awareness about the importance of modern production technology of dates.
Subsidies/Incentives/Facilities	• Balochistan Agriculture Department,	• Balochistan Agriculture Department,	• Different Agriculture Departments,

	Agriculture Research, Extension, BARDC, FAO and other Non-Governmental Organizations are working on horticulture production inclusive of dates crop through different projects and interventions but still a lot needed to be done.	Agriculture Research, Extension, BARDC, FAO and other Non-Governmental Organizations are working on horticulture production inclusive of dates crop through different projects and interventions but still a lot needed to be done.	Agriculture Research, Extension, PARC, AKRSP and other Non-Governmental Organizations are working on horticulture production inclusive of dates crop through different projects and interventions but still a lot needed to be done.
Socioeconomic Networks	• The role of FAO, and NRSP is important in improving dates husbandry in this cluster. These organizations can involve every walk of life for promotion of dates industry in the cluster.	• The role of FAO, BRSP and NRSP is important in improving dates husbandry in this cluster. These organizations can involve every walk of life for promotion of dates industry in the cluster.	• The role of FAO, KRSP and NRSP is important in improving dates husbandry in this cluster. These organizations can involve every walk of life for promotion of dates industry in the cluster.
	• Several projects on different aspects of horticulture has been implemented inclusive of dates crop. A Public Private Partnership project (Rs.3,200 M) titled Khairpur Khajoor Mandi is in progress. Another project is also being implemented by US$A through Winrock for installation of cold storage facilities.	•	• Several projects on different aspects of horticulture has been implemented inclusive of dates crop. Presently a project titled as Diversification of High Value Cropping through Promotion of Horticulture (Rs.780 M). While, a project titled as Improvement in Yield and Quality of Guava, Pomegranate and Date Palm (Rs.22.124 M) has been completed.

Source: visits of dates growing areas, feedback from different stakeholders, data from secondary sources, and the literature review.

5.2.1. Sindh Dates Clusters

The dates crop was introduced in Sindh Cluster during the time unmemorable. Despite such long history this crop has not been given due attention. The climatic conditions of the dates

growing areas of Sindh suit best to dates crop and that is why dates varieties thrived well and became cultivars but potential yield has yet not been achieved. However, at present this crop has become an industry which has engaged thousands of farmers, laborers, traders and relevant allied services providers. The Balochistan cluster produce quality dates and most of harvested crop is marketed in other parts of the country and exported as well. It has also been learnt that the quality dates of Balochistan are also brought in Sukkur market and then after sorting and proper packaging exported to USA.

The paid visits to the clusters provided an opportunity for in-depth observations of loopholes of existing industry. During the said visits, meetings with growers and other stakeholders provided insight about the dates industry of the area. This crop is main source of living to people engaged in it but the farmers still do not receive the due return from this important crop. They were not happy with the existing value chain of the crop and marketing facilities. They were also complaining about unfair marketing system.

For diversification in dates crop it is essential to introduce new cultivars. For export purpose it is very important to cultivate those varieties which are the demand of targeted international markets. However, existing cultivars have also potential export commodities but production technology and value chain is poor. In the Sindh Cluster a large number of small farmers are engaged in dates cultivation and they produce considerable volume of dates while, their marketing cost is very high. There no Farmer Enterprise exist to manage inputs in bulk like pesticides, fertilizers, packaging materials, branding, transportation and marketing of their small volume produce. The Sindh dates cluster is the most important cluster in terms of both production and area but no considerable attention has yet been given to this crop. A considerable volume of dates of both Balochistan and Sindh clusters are exported mainly from Karachi port. But the current exported volume is relatively small compared to its production.

There are certain limits to increase existing dates production using current technologies but both horizontal and vertical increase in dates production is possible by adopting modern production technology and besides this, improvement in product quality and marketing diversification is also possible. Small presently export of dates to several countries which include both fresh and dried dates can be enhanced. There is potential for value addition in dates through improved production, processing, product development and good marketing practices. Farmers have moderate levels of skills in orchard management with no or less appropriate technology for harvesting.

5.2.2. Balochistan Dates Clusters

Turbat (focal point of the cluster) after Khairpur produces dates fruit from single largest area of the country, however, per unit area yield very low. This crop has been grown for more than 200 years. The prominent dates varieties are Muzawti, Begum Jhangi, Karaba, Hussaini, Gogna, Haleni, and Shaker. With Turbat, as a focal point some other promising areas of dates growing have also been clustered with this cluster i.e., Punjgur, Awaran and Gwadar. The main dates cultivar is ‘Begum Jhangi’ which is of small size but possess good taste and keeping quality. This cultivar is used for industrial purpose and is being exported to the United States of America from Karachi and Sukkur. If similar industry is established in this cluster the dates farmers will definitely benefit from this intervention which will ultimately boost this crop.

There is also enough potential for production enhancement and quality of dates by improving production technologies and value chain which can increase per unit area yield and improve quality. Presently most of the harvested crop (in some cases postharvest losses exceed even 50%) is wasted due to absence of value chain and proper marketing of dates. Another reason is lack of processing of dates that is why it is estimated that 50% of dates fruit is wasted during the different segments of value chain. At present there a processing unit is being established at Turbat by the Agriculture & Cooperatives Extension Wing, Balochistan which will indeed decrease the postharvest losses and increase marketing opportunities.

For quality dates production the climatic conditions of this cluster areas are suited best and that is why several varieties thrived well and became cultivars. Now, this crop has become an industry which has engaged thousands of farmers, laborers, traders and relevant allied services and service providers. The paid visits to this cluster and other clusters provided an opportunity for in-depth observations of loopholes of this important industry. During the said visits, meetings with growers and public and private stakeholders provided insight and more know how about the crop. This crop is main source of living for the people engaged in it but for last few persistent drought years caused a looming fear over farmers of Turbat and Panjgur and other areas of Balochistan.

Despite persistent drought and other miseries, the cultivation of dates is increasing in some areas but the cultivation methods are still conventional which are needed to be changed with modern cultivation technologies. Even the irrigation methods are not changed i.e., still flooding method is applied, and farmers have no soil testing ideas nor do they have such any facility in the area. Fertilizers are used injudiciously and the quality of fertilizer is also compromised. It is also a fact that fresh cow dung is used in date palm orchards to make soil pulverize but instead of any benefit from this practice tree roots get polluted and an enemy insect emerges that destroys the roots of the trees which results in loss of young bearing trees. It has been observed that in this cluster mostly date trees are not planted with proper layout rather they are planted on the border of fodder or other field crops meaning thereby that their main crop is sown in the center while dates tree are planted as a secondary crop. It is also fact that the farmers rarely apply FYM or fertilizers to the dates trees.

It is pertinent to mention that the growers still plant old varieties which are prevailing in the cluster for more than last 50-60 years. For diversification in dates crop it is essential to introduce new varieties. For export purpose it is very important to cultivate those varieties which are the demand of targeted international markets. In all clusters a large number of small farmers are engaged in dates cultivation and they produce considerable volume of dates while, their marketing cost is very high and even there no any platform (enterprise) is available for collection of their fruit in bulk and presented or marketed these small volumes in better form and large quantity. It is also a fact that there no such intervention exist that manage inputs in bulk like pesticides, fertilizers, packing and packaging materials, branding, transportation and marketing. This is also a fact that small growers work hard in their small orchards for best quality production which can be an advantage. The above mentioned clusters of dates are very important in terms of both production and area but no considerable attention has yet been given to their development.

5.2.3. Punjab and KP Dates Clusters

The other important dates areas are Muzaffargarh (focal point, D.I. Khan which is administratively a territory of KP), Jhang and Bhakkar has highest per unit area yield as compared to above mentioned clusters but far lower than other important dates producing countries. It is matter of satisfaction that dates grown in Punjab and D.I. Khan's yield very high than rest of the country but this can be further improved by introduction of modern production technologies and new improved local and exotic varieties.

Dates have been grown in this cluster for more than 100 years. The climatic conditions of this cluster areas suit best to dates crop but very few varieties prevail. In D.I. Khan the '*Dhakki*' cultivar is very promising and popular for its larger size and pleasant taste. The yellowish color of this variety is very attractive and most of the fruit is dried (called *Chohara*) and exported (The dried dates of *Dhakki*, 2015).

Despite widespread cultivation of dates in this cluster for last several decades but the cultivation methods are still conventional which is needed to be changed with modern cultivation technologies. The irrigation methods are not changed i.e., still flooding method is prevailing, normally farmers do not get their soil tested from soil laboratories. However, in Punjab, farmers do have access to soil testing laboratories set up by the Agriculture Department Research Wing. The application of fertilizers is not done judiciously and the quality of fertilizer is also compromised.

In spite of these production level deficiencies, the dates have become an industry which has engaged thousands of farmers, laborers, traders and relevant allied services and service providers. The harvested quality of dates is marketed in other parts of the country particularly in Islamabad, Karachi, Peshawar, and Lahore. The dates growers of this area have the leverage to dispatch their produce to main cities of Punjab like Lahore, Rawalpindi and Faisalabad. The paid visits to this cluster and other clusters provided an opportunity for in-depth observations of loopholes of existing industry. During the said visits, meetings with growers and other stakeholders provided insight about dates crop. This crop is main source of living to people engaged in it but they do not receive due returns. The dates growing farmers of this cluster are naturally bestowed with abundant quality river water therefore, water is plenty and free of cost.

It is also matter of fact that growers of this cluster still plant old varieties which are prevailing in the cluster for last more than 40 years. For diversification in dates crop it is essential to introduce new cultivars and for the purpose certified nurseries are needed to be established in the private sector. While, some good businessmen are doing nursery business very diligently but need training and support from Agriculture Department and public sector. For export purpose it is very important to cultivate those varieties which are the demand of targeted markets. In Muzaffargarh Cluster (including D. I Khan) a large number of small farmers are engaged in dates cultivation and they produce considerable volume of dates but their marketing cost is very high while, there no any platform (enterprises) is available for collection of their produce for presentation or marketing of these small volumes. There no Enterprise for farmers exist to manage inputs in bulk like pesticides, fertilizers, packaging materials, branding, transportation of their produce, and marketing. This is fact that small growers work hard in their small orchards for best quality production which could be an advantage. The

Punjab cluster of dates is an important cluster in terms of both production and area of Pakistan but no considerable attention has yet been given to this important crop.

The Punjab cluster (including D.I. Khan) has many advantages like availability of plenty of water, favorable climate, and available vibrant markets favor this crop. Therefore, special attention is required to be paid to this crop for its vertical and horizontal production.

5.3. Dates Marketing and Value Chains[3]

Dates value chain begins from producers and ends when it came into the hands of the final consumers. The dates of Balochistan are marketed in Karachi and Sukkur markets while the dates of Sindh, Punjab, and Khyber Pakhtunkhwa are mostly marketed in Sukkur, Karachi, Islamabad, Lahore and Peshawar markets. The market of Sukkur receives quality dates supply from Khairpur, Turbat and Punjgur dates, after sorting and processing, are exported to United States of America where these are further processed.

The relative role of various stakeholders in the chain is given below.

5.3.1. Producers

Date palm cultivation is carried out by large number of producers geographically spread over all provinces of the country. Dates producers mainly belong to farming families. Majority of the dates farmers sell the harvesting rights of the dates to pre-harvest contractors at flowering stage. Very small proportion of producers directly market the produce by themselves.

5.3.2. Pre-harvest contractors

They play key role in marketing of dates in the country. These are mostly local people, to the farming community but engaged in trading business. They acquire marketing experience informally --- learning by doing. On the basis on their experience, they decide about where to sell the produce most profitably. He is also responsible for bearing harvest and post-harvest losses as well as other market risks.

5.3.3. Commission agents

Commission agents maintain contacts with interregional wholesale markets and possess comprehensive and accurate information. Commission agents are the principal agency around which all marketing activities revolve. They perform their activities on commission basis in the fruits & vegetables markets' premises and do not accept any type of goods, while selling the produce brought by producers or contractors. Besides dates, they also deal in other fruits and vegetables. They are well equipped with telephone, cell phone and other communication facilities. Though the hardware of commission agents' shop sized 10 × 12 meters, but consisted of simple table, a few chairs, a register showing daily transactions and a locker. However, they possess big stores, sometimes in the market but mostly outside the market.

[3] Major proportion of this section is taken from Khushk *et al*., 2009.

5.3.4. Wholesalers

They buy and sell large quantities of the farm produce. Usually they perform their business in wholesale and terminal markets. Besides dates, they deal in several other commodities such as fruits, vegetables and other agricultural produce within inter-regional markets. In some cases, they supply produce to processing industries, exporters and retailers. They maintain their business contracts with commission agents in wholesale markets (for buying purposes) and retailers of the area (for selling purposes). The buying is mostly done on credit basis, which is paid back after receiving payments from the retailers.

5.3.5. Retailers

They are the last functionary in the marketing channel of any produce in Pakistan. They gather small quantities of various produce from different wholesalers in the various markets and sell small quantities of various items according to the demand of the consumers in the area. They maintain direct contacts with the consumers and set prices of various commodities/products on the basis of quality and quantity/packing sizes. A small proportion of retailers are also street hawkers, who selling their produce by putting on wheel barrow or four-wheeled cart. Now-a-days, in big cities, some fruits and vegetables retailers also doing their retailing business on Suzuki carry (loaders) and try to cover large area (ranging from streets and squares in residential colonies to standing on roadsides.

5.3.6. Auction of Dates

As soon as the dates reaches the market, representative of the contacted commission agent approaches the truck, ask few questions about whose farm's the produce is brought and present it for auction in the market. One or few bags or cartonnes are randomly taken from the consignment and opened in front of the auctioning participants or the buyers who inspect its filling layers. Mostly the bag is teared longitudinally so that all the packing from top to bottom becomes visible, while in case of cartonne, it is either opened entirely or from the side --- for examining the quality of the material packed in different layers. After the visual (sometimes tasting the dates) satisfaction, the auction begins from the lowest offer and keep rising till no further higher offer is announced from the buyers. Then the commission agent (or his representative) asks the owner, whether he accepts the highest bid offered or not. If he agrees, then the commodity title is transferred to his name and some token money is paid on spot. In open auction, the participating buyers are wholesalers, retailers and shopkeepers. Clear price difference can be observed on the basis of variety, grading, packaging, location of the production point, the owner of the orchard, stage of the season and timing of the auction. Generally, early and late season dates as well as period close of Ramadan receive good price.

In secrete auction, the bids are placed in code words or pressing the fingers/rubbing the hands of the commission by the buyers in different ways. Sometimes the bidders cover his hand and the hand of the commission agent with a piece of cloth and indicate the offered price with rubbing the fingers. In secrete auction, producers and contractors do not know the actual price of their produce, but they must accept the price reported by the commission agent to him. Secrete auctioning is practiced in two scenarios: i) when the commission agent attempts to buy the produce by himself, but in the name of some fictitious buyers; ii) when the commission

agent wants to charge higher commission illicitly; iii) in some cases the contractors have borrowed some money in advance from the commission agent, i.e. at the time of contracting with the farmer. In this way, the commission agent is covertly charging the interest rate from the pre-harvest contractors. In other words, the secrete auction can be regarded as illegal trading.

5.3.7. Dates contracting system

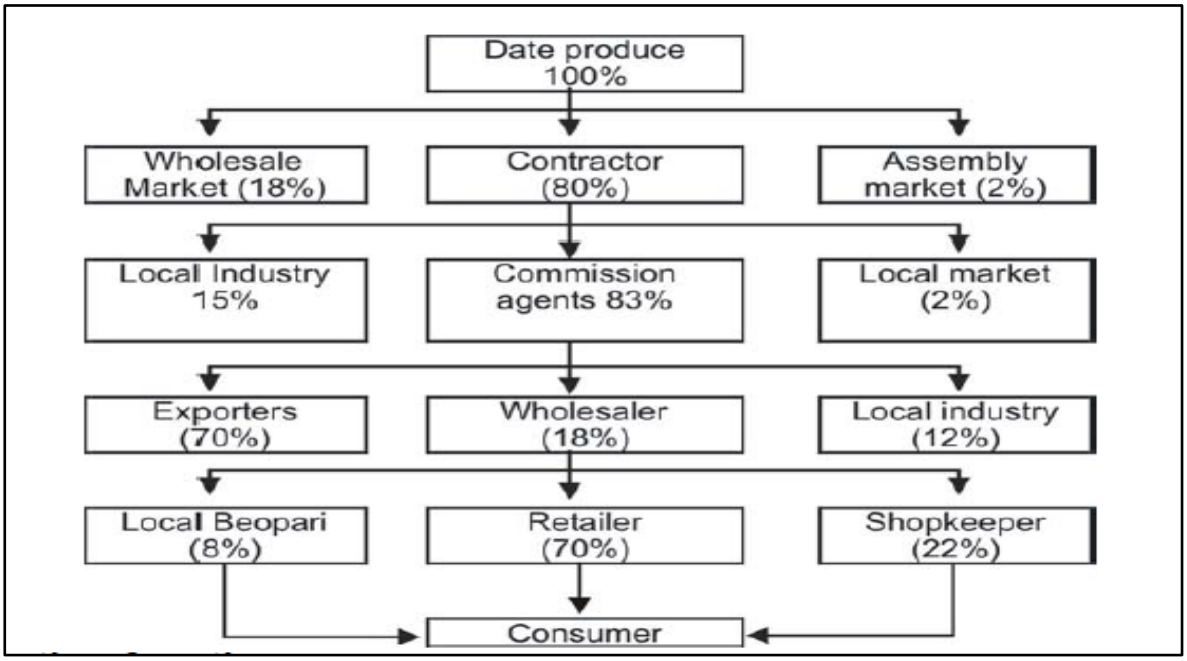

Figure 2: Domestic dates marketing System in Pakistan (Source: Khushk *et al*., 2009)

Contracting out orchards, including dates, is a common practice in fruits marketing systems in Pakistan. The owners of the fruit orchards generally do not prefer self-marketing because of the reasons like: i) little quantities of the fruits is channelized through local markets of the production points. Mostly it is directly siphoned off to various assembly or terminal markets from the production point. So, because of lack of price and other information in different markets of the country and arranging transport facilities and/or personally present at auctioning time is quite cumbersome for them; ii) fruit farmers generally avoid of taking risks of ups and downs in the market and effectively dealing with delaying payment tactics played by the commission agents; iii) farmers also have limited knowledge about candidate markets of different quality of produce available with them; iv) the dates farmers have little knowledge about grading of the produce; and, he also possess less labor for professional handling of the produce at harvesting and post-harvesting stage. All these also equally apply on dates.

5.4. SWOT Analysis

5.4.1. Overview

The SWOT analyses for each cluster have been conducted in consultative meetings in major dates producing areas. These stakeholders include dates farmers, different players in the

dates value chain, and all the stakeholders involved in the provision of inputs, production, storage, and marketing. For identifying strengths and opportunities, researchers who have been engaged in dates research have specifically consulted.

5.4.2. SWOT Analysis of Sindh Cluster

The Sindh cluster has many strengths and opportunities for the cultivation of variety of dates. The experience of growing of dates by the farmers of this cluster is one of the greatest strengths which is needed to be exploited by employing all modern production technologies of dates crop. This cluster lies in the south of the country. Major weaknesses are lack of planning, no familiarity with modern production technologies, post-harvest handling of dates is always undermined which spoils the investment and labor the farmer employ for. No or less investment in dates oriented research and development has been made. Indigenous technology development, breeding programs, extension work and marketing has always been neglected. The biggest threat is persistent drought followed by climate change, insect infestation, and this crop is further made worse by absence of cold chain, value addition, energy shortage and unfair trading practices. These all factors hinder the development of this very important crop which is livelihood and mainstay for the farmers and other stakeholders of this cluster.

Table 13: SWOT Analysis of Dates Cluster in Sindh

Parameters	Strengths	Weaknesses	Opportunities	Threats
Environment/ Climate Change	• Tropical and semi-dry climate makes the cluster ideal for cultivation of different dates varieties.	• Occasional rain at the time of fruit maturity and harvesting.	• Date fruit is ready for harvesting simultaneously in whole cluster and ends at same time as well.	• During ripening stage rainfall spoils the dates crop.
	• Favorable climatic conditions can be one of advantages for development of dates cluster.	• Local dates varieties are planted which do not withstand climate change.	• New and commercial varieties can be introduced in the region which are resilient to climate change and require quite less water than the local germplasm.	
Input Supplies	• As plantation area is expanding, demand for input supplies including fertilizers and pesticides is growing.	• Non-availability of quality fertilizers and micronutrients in local input market is one of the weaknesses.	• Conducive environment for private sector can fill the gap by providing input supplies to the growers.	• Lack of awareness regarding use of inputs, slow the offtake of inputs by the farmers resulting in low and inferior quality produce.
	• Increasing population is	• New germplasm is expensive and	• Well prepared compost can	

	increasing demand of high density and exotic varieties.	non-accessibility can hinder expansion.	improve the soil condition and water holding capacity.	
		• Non-availability or accessibility to financial assistance for small farmers cause less productivity.	• Government can establish mother nurseries (GPUs) to provide different varieties with consistency.	
Cluster interaction	• Agriculture is main sector of the cluster and dates is one of the major crops of most of the areas.	• Little interaction among farmers and researchers and no platform for interaction.	• Small and new farmers have opportunities for learning from progressive farmers in the cluster.	• There is lack of coordination and integration among dates value chain actors.
	• Existing dates value chain is fully functional in the cluster, producing high value dates crop from the existing available germplasm for dates trade.	• The dates growers have little information about the quality and quantity requirements in national and international markets.	• There is possibility of collective efforts for achieving the economies of scale.	
		• Little or no credit availability from formal institutes like Zarai Taraqiati Bank and other commercial banks for the small growers in the area even not for progressive farmers.		
Production Management practices	• Thousands of Farmers having conventional expertise in dates production which can be a tool for better production and quality enhancement by introducing modern production technology.	• Traditional/conventional orchard management practices are faulty. Presently most of the management practices are not increasing productivity and quality.	• There great potential for increase in both vertical and horizontal production exist for dates crop.	• Present production technology, existing poor irrigation system and outdated cultivars discourage.
	• Possibility of diversification due to improved varieties.	• Without any plantation system, unorganized and		

		mixed plantation in orchards.		
	• There is potential to handle the challenge of existing per unit area yield, which can increase production by many fold.	• Lack of concentration on soil health improvement and less than optimal dose of fertilizers.	• There are opportunities for private sector to provide extension services. Service Providers can also be an opportunity.	
		• Pre- and post-harvest losses due to lack of skills and infrastructure (storage facilities) cause wastage i.e., nearly 40% of total production		
Transportation	• The cluster has the strength to supply the produce to any part of the country. In future CPEC is also an opportunity.	• The conditions of existing access roads to main high ways are not good.	• Availability of paper boxes (corrugated) in the market already being used in other fruits and currently being used for packing the dates.	• Floods during monsoon season cause blockage of roads which hamper produce supply and destroy the produce as well.
		• No existence of cold chain system. No temperature, humidity and proper transportation system.		
		• High transportation cost and fluctuation in transportation fares.	• Quality dates are produced and presentation can be improved.	
		• The cluster is dates producing center but without any cold chain and cold storage.		
Marketing	• Existing marketing potentials are encouraging to fetch good prices for quality dates of the cluster.	• Dates growers sell their produce at throw away prices due to unawareness of high value market. No MIS.	• Contract system has the potential to manage quality produce flow in the market with the help of commission agents' financial support.	• Small farmers have reservations against high value markets.
		• No grading system exists and fruit is packed with A grade at top		

		while, very small size fruit is placed in the bottom.		• Small farmers cannot fulfil the big orders.
		• Non-transparent auctioning of dates and absence of on spot grading causes losses to growers.	• Sale of dates in big lots can be beneficial for Dates growers.	
		• No capacity building of farmers and traders cause no improvement in produce quality and presentation.	• The emerging super markets trend in Pakistan and abroad, a good opportunity for dates growers which is direct business mechanism with the farmers. And will narrow the trading gap.	
Trade/Export	• Most of the produce is traded within the country and very small quantity is exported.	• Quality dates have no food safety standards and traceability (HACCP, EuroGAP, Global Gap, IFS etc.) which are major obstacles to enter into high end international markets	• Growing urban population of the country is good opportunity for dates produce.	• High cost of quality standards and its continuity. And also high costs of certifications.
		• Lack of transportation, airport, and port facilities, no cargo flights, shortage of air cargo space and inadequate cargo handling limit the export.	• Better prices for higher quality dates products in domestic and national markets.	
Processing	• Mostly dates are consumed fresh while, many byproducts can be made and even industrial use and its potential does exist.	• Dates can be stored for longer period but storage facilities are not available or poor therefore, more postharvest losses occur.	• Huge demand for processed dates in national and international markets.	• Absence of local processing units cause great losses to the farming community earnings.
	• The absence of storage facilities therefore, development of processing	• Unavailability of modern processing units, technologies,	• There is tax holiday on import of agriculture machinery	

	industry is better option.	and equipment for preservation and processing.	including the cold storage equipment and processing machinery. This is a good opportunity for private sector.	
	• Dates have the potential for use in many bakery items and confectionary. Dried dates are one of the examples.	• Small stakeholders have no capacity and financial support to process the produce.		

5.4.3. SWOT Analysis of Balochistan Cluster

The Balochistan Cluster is famous for the production of dates and most of the dates producing districts of this cluster are adjacent to focal point of the cluster. This is top producing cluster of Pakistan in terms of production and area. But it is also a fact that the produced dates of this cluster have very low value due to several reasons. On the other hand, it has the potential both in its production and geo-strategic location due to in the vicinity of CPEC center i.e., Gwadar.

Table 14: SWOT Analysis of Dates Cluster in Balochistan

Parameters	Strengths	Weakness	Opportunities	Threat
Environment/ Climate Change	• Tropical and dry climate makes the cluster ideal for cultivation of different dates varieties. Occasional monsoon rains do occur.	• Persistent drought may affect quality and production.	• Due to close proximity, dates fruit is harvested simultaneously in whole cluster and harvesting ends at same time as well. Dry climate favors clean cultivation of dates.	• During rainy season less rains cause less production and small fruit size with less water content and thick skin.
	• Due to dry climate less chances of occurrence of diseases or with no severity.	• Mostly local dates varieties are planted which do not withstand climate change.	• New and commercial varieties can be introduced in the region which are resilient to adverse climate change and require quite less water than the local germplasm.	• Strong winds with dust storms occur in winter.
Input Supplies	• As plantation area is expanding, future demand for input supplies including fertilizers &	• Non-availability of quality fertilizers and micronutrients in local input markets is one of the weaknesses.	• Conducive environment for private sector can fill the gap by providing input supplies to the growers.	• Lack of awareness regarding use of inputs and conventional cultivation practices, slow the offtake of

	pesticides will be growing.			inputs by the farmers.
	• Demand of high density and exotic varieties is increasing.	• New germplasm is expensive and non- availability can hinder expansion.	• Both agriculture and city waste is available therefore, well rotten compost can improve the soil condition and water holding capacity.	
		• Limited availability of certified, quality, and true variety saplings.	• Government can establish mother nurseries to provide different varieties with consistency.	
Cluster interaction	• Agriculture is main sector and dates is one of the major crops of most of the areas of the cluster.	• Little interaction among farmers and researchers and no platform for interaction.	• Good opportunities for small & other farmers to learn from progressive farmers in the cluster.	• There is lack of coordination and integration among dates value chain actors.
	• Existing dates value chain is fully functional in the cluster, producing high value dates crop for the growers, traders and retailers.	• The dates growers have little information about the quality and quantity requirements of national and international markets.	• There is possibility of collective efforts for achieving the economies of scale.	
		• Little or no credit availability from formal institutes like Zarai Taraqiati Bank and other commercial banks for the small growers in the area.		
Production Management practices	• Thousands of Farmers having conventional dates cultivation expertise which can be used for production and quality enhancement.	• Traditional orchard management practices are faulty. Presently most of the management practices are not helping in productivity and quality.	• There great potential for both vertical and horizontal production exist for dates crop if modern production technology is adopted.	• Present production technology, existing poor irrigation system, insect attack and outdated cultivars.

	• Possibility of diversification in improved varieties.	• Dates are planted without any system or unorganized and mixed plantation in orchards.		
	• There is potential in coping up with the challenge of existing per unit area yield that increasing by many fold through modern production technology.	• Lack of soil health improvement or less than optimal dose of fertilizer.	• There are opportunities for private sector to provide extension services such as service Providers can also be an opportunity and other allied services.	
		• Pre- and post-harvest losses due to lack of skills and infrastructure (storage facilities); losses/wastages are nearly 40% of total production		
Transportation	• The cluster has the strength to supply the produce to any part of the country. In future CPEC is also an opportunity.	• Existing access roads to main high ways condition is not good.	• Availability of paper boxes (cartons) in the market already being used in some other fruits and currently being used for packing the dates in small scale.	• Floods during monsoon season cause blockage of roads which hamper produce supply and destroy the produce as well.
		• No existence of cold chain system. No maintenance/control of temperature, humidity and proper transportation system.		
		• High transportation cost and fluctuation in transportation fares.	• Quality dates are produced and presentation can be improved.	
		• The cluster is dates producing center but without any cold chain and almost no cold storage facility.		
Marketing	• Existing markets have potentials for better returns but improved practices and fair business environment can fetch good	• Dates growers sell their produce at throw away prices due to unawareness of high value market. No Market	• Contract system has the potential to manage quality produce flow in the market with the help of commission	• Small farmers have reservations against high value markets. • Their produce is always ignored.

	prices for quality dates of the cluster.	Information System.	agent's financial support. Contractors can also convert small volumes in bulk.	• Small farmers cannot fulfil the big orders in absence of Farmers' enterprise.
		• No grading system exist and fruit is packed with A grade at top while, very small size fruit is placed in the bottom.		
		• Non-transparent auctioning of dates and absence of on spot grading causes losses to growers. No market facilities also one of the reasons.	• Sale of dates in big lots can be beneficial for dates growers.	
		• Absence of capacity building of farmers, middlemen and traders hinder improvement in produce quality and presentation.	• The emerging super markets trend in Pakistan and abroad, is a good opportunity for dates growers for bypassing various intermediaries.	
Trade/Export	• Most of the produce is traded within the country and very small quantity is exported except dried dates.	• Quality dates have no food safety standards and traceability (HACCP, EuroGAP, Global Gap, IFS etc.) which are major obstacles to enter into high end international markets.	• Growing urban population of the country is good opportunity for dates produce.	• High cost of quality standards and its continuity. And also high costs of certifications.
		• Lack of transportation, airport/port facilities, no cargo flights, shortage of air cargo space and inadequate cargo handling limit the export.	• Better prices for better quality dates products in domestic and national markets.	
Processing	• Mostly dates are consumed fresh while, many byproducts can be made and even industrial	• Dates can be stored for longer period but storage facility is not available therefore, processing	• Huge demand for processed dates in national and international markets.	• Absence of local processing units cause great reduction in farmer earnings.

	use potential exist.	industry is one of the options.		
		• Unavailability of modern processing units, technologies, and equipment for preservation and processing.	• There is tax holiday on import of agriculture machinery including the cold storage equipment and processing machinery. This is a good opportunity for private sector.	
	• Dates have the potential for use in many bakery items and confectionary. Dried dates is one of the examples.	• Existing small stakeholders have no capacity and financial support to process the produce.		

5.4.4. SWOT Analysis of Punjab-KP Dates Cluster

The Punjab-KP Cluster is famous for the production of quality dates. Three dates producing districts of this cluster are lying in Punjab including focal point of the cluster while, one dates producing district i.e., D.I. Khan is lying in Khyber Pakhtunkhwa and this district is famous for production of quality dates particularly '*Dhakki*' variety of dates. But it is also a fact that the produced dates of this cluster have very low market value due to several reasons.

Table 15: SWOT Analysis of Punjab-KP Cluster in Punjab and Khyber Pakhtunkhwa

Parameters	Strengths	Weaknesses	Opportunities	Threat
Environment/ Climate Change	• Tropical and dry climate makes the cluster ideal for cultivation of different dates varieties.	• Climate change will be impeding quality and consistent production.	• Dates fruit is ready for harvest simultaneously in whole cluster and ends at same time as well.	• Climate change is a big threat. Monsoon rains at the time of fruit maturity and harvesting.
	• Less chances of occurrence of diseases or with no severity before and after rainy season.	• Most of the rainfall occurs during July and August which is harvesting time.	• New and commercial varieties can be introduced in the region which are resilient to adverse climate change and require quite less water than the local germplasm.	

Input Supplies	• As plantation area is expanding, demand for input supplies including fertilizers and pesticides is growing.	• Non-availability of quality fertilizers and micronutrients in local input market is one of the weaknesses.	• Conducive environment for private sector can fill the gap by providing input supplies to the growers.	• Lack of awareness regarding use of inputs, slow the offtake of inputs by the farmers.
	• Demand for exotic varieties is increasing.	• New germplasm is expensive and absence can hinder the pace of expansion.	• Well rotten compost can improve the soil condition and water holding capacity.	
		• Limited availability of certified, quality, and true to type variety saplings.	• Government can establish mother nurseries to provide different varieties with consistency.	
Cluster interaction	• Agriculture is main sector of the cluster and dates is one of the major crops of most of the areas.	• Little interaction among farmers and researchers and no platform for interaction.	• Small and new farmers have chance of learning from progressive farmers in the cluster.	• There is lack of coordination and integration among dates value chain actors.
	• Existing dates value chain is fully functional in the cluster, producing high value dates crop for the growers, traders and retailers.	• The dates growers have little information about the quality requirements in national and international markets.	• There is possibility of collective efforts for achieving the economies of scale.	
		• Little or no credit availability from formal institutes like Zarai Taraqiati Bank and other commercial banks for the small growers in the area.		
Production Management practices	• Thousands of Farmers having conventional expertise in dates production which can be used for production and quality enhancement. Per unit area yield is very high as compare to	• Traditional orchard management practices are faulty. Presently most of the management practices are not helping in productivity and quality as compare to other main dates	• There great potential for both vertical and horizontal production exists for dates crop.	• Present production technology, existing poor irrigation system and out dated cultivars.

	other clusters of the country.	producing countries.		
	• Possibility of diversification into improved varieties.	• Without any plantation system or unorganized and mixed plantation in orchards.		
	• There is potential of coping up with the challenge of existing per unit area yield increasing by many fold.	• Lack of soil health improvement or less than optimal dose of fertilizer.	• There are opportunities for private sector to provide extension services. Service Providers can also be an opportunity.	
		• Pre- and post-harvest losses due to lack of skills and infrastructure (i.e., storage facilities); losses/wastages are nearly 40% of total production		
Transportation	• The cluster has the strength to supply the produce to any part of the country. In future CPEC is also an opportunity.	• Existing access roads to main high ways condition is not good.	• Availability of paper boxes (carton) in the market already being used in some other fruits and currently being used for packing the dates.	• Floods during monsoon season cause blockage of roads which hamper produce supply and destroy the produce as well.
		• No existence of cold chain system. No temperature, humidity and proper transportation system.		
		• High transportation cost and fluctuation in transportation fares.	• Despite all production issues still quality dates are produced and presentation can be improved.	
		• The cluster is dates producing center but without any cold chain and cold storage.		
Marketing	• Better marketing environment can fetch good prices for quality dates of the cluster.	• Dates growers sell their produce at throw away prices due to unawareness of high value market. No	• Contract system has the potential to manage quality produce flow in the market with the help of	• Small farmers have reservations against high value markets. And also not satisfied with the

		Market Information System.	commission agents' financial support.	role of commission agents.
		• No grading system exist.		
		• Non-transparent auctioning of dates produce and absence of on spot grading causes losses to growers.	• Sale of dates in big lots can be beneficial for dates growers.	• Small farmers cannot fulfill the big orders.
		• Absence of capacity building of farmers and traders hinder improvement in produce quality and presentation.	• The emerging super markets trend in Pakistan and abroad is an opportunity for dates growers which is direct business with the farmers. And will narrow the trade gap.	
Trade/Export	• Most of the produce is traded within the country and very small quantity is exported.	• Quality dates have no food safety standards and traceability (HACCP, EuroGAP, Global Gap, IFS etc.) which are major obstacles to enter into high end international markets	• Growing urban population of the country is good opportunity for dates produce.	• High cost of quality standards and its continuity. And also high costs of certifications.
		• Lack of transportation, airport, and port facilities, no cargo flights, shortage of air cargo space and inadequate cargo handling limit the export.	• Better prices for higher quality dates products in domestic and national markets.	
Processing	• Mostly dates are consumed fresh while, many byproducts can be made and even industrial use potential exist.	• Dates can be stored for longer period but storage facility is not available therefore, processing industry is one of the options in absence of modern storage facilities.	• Huge demand for processed dates in national and international markets.	• At local level absence of processing units cause great losses to the farmers earnings and huge losses in dates fruit.

		• Unavailability of modern processing units, technologies, and equipment for preservation and processing.	• There is tax holiday on import of agriculture machinery including the cold storage equipment and processing machinery. This is a good opportunity for private sector.	
	• Dates have the potential for use in many bakery items and confectionary. Dried dates is one of the examples.	• Small stakeholders have no capacity and financial support to process the produce.		

6. CHALLENGES FACED BY THE CLUSTERS

6.1. Climate Change and Water Shortage

All the three dates clusters of Pakistan are identical in many ways while differences and varied modes of opportunities do also exist. The foremost similarity is the climate which suits to dates cultivation in most areas of these clusters. However, climate change is a near future threat and in this regard as scientists say that climate change related issues will further augment in future. On average most of the areas of these clusters are growing dates for more than a century. But after such a long time cultivation experience, these clusters still could not overcome the issues faced by the dates industry of these clusters. Both more or less rains cause drastic reduction in production of dates and this is due to climate change and it is estimated that in coming future Pakistan will receive more rains than past i.e., changes in rainfall patterns (Saifullah, 2017).

One common constraint faced by this crop in these clusters is imposed by nature i.e., water scarcity, flooding and limited land resource. The Punjab-KP Cluster is blessed with plenty of water mainly from canal system, but lifting of water from subsurface is beoming expensive. In Balochistan dates cluster, non-availability of surface irrigation water is major hindrance to enhance its production. In this cluster, the available of water is precious with no access to canal/Kareez water and limited ground water and its expensive extracted through wells and tube wells. Thus dates crop is dependent on seasonal rains. For revolutionary changes and development in dates industry it is imperative to introduce high efficiency irrigation systems, new varieties and solar system for water extraction. This fear is common in all the stakeholders in Balochistan that solar energy system will extract the whole remaining aquifer water. The reply to the said fear is, above mentioned interventions.

The orchards in Sindh dates cluster are irrigated with Rohri Right Bank Canal, which has relatively low cost. In addition to water shortage, dates clusters may face the challenge of new insects and diseases and shift in crop cycle in future due to climate change,.

6.2. Weak Research and Extension

In Punjab, Sindh, KP and Balochistan, a setup on dates research do exist generally under the provincial Agriculture Research Institutes.

1. Arid Zone Research Institute, Bhakkar, Punjab and Horticultural Research Institute at Bahawalpur, Punjab do conduct some research on Dates. This research institutes are working on development of new dates varieties and production technologies of existing varieties. At present a project is being implemented for introduction of new exotic varieties which will after adoptability these varieties will certainly contribute in future quality production of this crop. At Bahawalpur Research Institute about 40 varieties including 21 exotic ones are available.

2. The Khairpur and Sukkar areas of Sindh are main dates growing area. The Date Palm Research Institute at Khairpur is working on dates research. The Aseel vaierty of dates of this cluster is very popular for its size and taste.

3. The Directorates of Agriculture Research at Turbat, Panjgur and Kharan, in Balochistan. These directorates are involved in research on different aspects of dates crop. As there more than 60 different dates varieties are available at the farms of these directorates, and which require more research and investment on this crop for enhancement of quality production of dates. Especially, Mozawati and Begum Jhangi varieties have remarkable potentials which need to be given priority. These directorates are involved in dissemination of research outcomes to the dates growers of the respective areas. New exotic varieties are also being tested at the farms of these directorates.

4. The KP province has only one dates district i.e., Dera Ismail Khan which is famous for Dhakki variety of dates. This dates district is served by Agriculture Research Institute, Dera Ismail Khan. This institute is working on development of varieties and nursery raising technologies.

Among all the above institutes, the date palm research is relatively more advanced at Date Palm Research Institute, Khairpur, while at other institutes/stations, there is not much research on standardizing the improved dates management practices by variety especially on harvesting and input use. Moreover, research on dates value chain is almost completely missing. There is a need to develop protocols on harvesting, grading, packing, drying, transportation, storage, etc. This will certainly minimize the postharvest losses and better marketing of the commodity. But prior to these measures like modern production technologies for dates and both latest and conventional breeding programs are necessary. Moreover, protocols for tissue culture production of dates nursery need to be developed urgently. This is necessary to expand the area under dates. Capacity building of researchers will play key role in the development of dates industry/clusters.

In addition there is little capacity of the provincial extension system to guide farmers in quality dates production, and its handling along the value chain. It is also a fact that research institutes are not generating that much data and information on production technologies meant for transfer technology. Moreover, little support is available on how to set up and run the quality value chain infrastructure. As the economics and marketing system is maintained on extension side in some provinces so, MIS (market information system) is needed to be strengthened.

6.3. Constraints at the Production Level

Different provincial Agriculture Departments have introduced several new and exotic dates varieties in all three Dates clusters but only a few varieties prevail in farmers' orchard. With the passage of time, varieties loose or degrade their yielding and quality potentials. To replenish the orchards, high yielding germplasm is very essential while, currently dates industry lack such ability due to absence of any such mechanism of varietal replacement.

After the 18th amendment to the constitution of Pakistan, like many other departments, agriculture has also become a provincial subject. Therefore, the Agriculture Departments have

the responsibility and mandate to prioritize the research and development for the underdeveloped dates industry. Contrary to increased burden on the provincial research system, research institutes receive very little budget for operational purposes which has further dwindled after devolution. There are highly qualified researchers in these institutes but lack of funds make them idle. Hence, management practices for dates could not be standardized so far, although extension system is available moderately in every cluster.

There are a number of problems and limitations for the development of date palm industry ranging from production to harvesting, processing and packaging. However, the problems vary among the four provinces. Monsoon rains during the ripening of dates fruit are always the most serious risk and the largest challenge faced by Pakistani Dates growers. Irregular rainfall from the end of June to August can destroy the entire crop whether on the trees or cured on mats (Abul-Soad et al., 2015). In Punjab-KP cluster, in addition to monsoon rains, the humid climate of above 60% relative humidity and low temperature during fruit development and ripening stages, reduce fruit quality (Abul-Soad, 2013). The use of bunch covers is expensive. The non-availability of tissue-cultured date palm of local elite cultivars is another hindrance in dates production enhancement as farmers are using low quality suckers.

Table 16: Gaps and Constraints at Production Level

Sr. #	Parameters	Sindh Cluster	Balochistan Cluster	Punjab-KP Cluster
1	New germplasm	Difficult to access	Difficult to access	Difficult to access
2	Mother nurseries or GPUs	Very few	Very few	Very few
3	Orchard size/type	Large/standard	Large/small & irregular	Small/mixed crop
4	Certified plants	Commercial production	Limited availability	Limited availability
5	Standardization of management practices	Not done	Not Done	Not Done
6	Extension services	Moderate	Moderate	Good/weak
7	Commercial inputs	Moderate use	Moderate	Moderate/no use
8	Rain and humdidity	High risk of rain and humidity	Less risk	High rik fo rain and humidity
9	Low temperature at ripening stage	Medium risk	High risk	Medium risk
10	Labor input	Hired	Hired	Hired

6.4. Constraints at the Processing and value Addition Levels

Processing of dates not only refers to its processed products but also to basic treatments given for hygienic and quality control purposes, as well as stabilization for a longer shelf life. These basic and essential steps include fumigation, cleaning or washing, drying, sorting and grading, and packaging. In Punjab-KP cluster, about 80% of Dhakki cultivar of D.I. Khan

production is sun-dried (fruit is cured in boiling water for 15-20 minutes and then sun dried). In other clusters, considerable volume of dates is also dried mainly for export (same procedure for drying is used as mentioned above). But largely, fresh dates are packed in cartons and polythene packs and transported through open trucks for marketing in big cities of Pakistan without much value addition.

Modern equipment and mechanical lines of factories, limited number of high-quality local cultivars, hygiene and lack of cold storage facilities are major problems facing the dates processing sector in Pakistan (Abul-Soad et al., 2015). Bad presentation of the produce is the major constraints in further expanding export especially to high-quality markets. At present farmers just manually pack their dates in polythene or corrugated cartons while, most of the farmers and traders skip important processing, washing, drying, grading, packaging, transportation protocols and never use any labeling and trade mark. In the absence of these technologies it is not possible to maintain the quality and standards of dates crop.

Dates are required to be stored at 5-8°C and same temperature is also required during transportation. However, there is no cold chain process or farm-level cold storage in any cluster, except few in Balochistan Cluster that was established under a cold chain project on cost sharing basis which accommodate very little quantities of dates.

To meet the big orders or capture big or potential markets both in country and foreign, close collaboration among traders and farmers is imperative which is currently lacking.

6.5. Marketing and Trading Constraints

The postharvest handling and storage of dates is not according to HACCP conditions/standards. Very little quantities of this produce is stored in cold storage in Balochistan and Sindh Clusters, while in Punjab-KP Cluster the cold chain system is completely absent. In the Balochistan and Punjab-KP (Punjab area) clusters, formal regulated marketing system does exist where traders are bound to conduct their businesses under the licenses issued by the authorities. But in Sindh Cluster no such mechanism exists. For earlier two clusters there are opportunities for trading in dates under the regulated system established by the governments. In Balochistan, government is trying to establish fruit and vegetables markets at district level which will create healthy environment for dates marketing.

Naturally traders strive to earn the highest margins by buying at the lowest prices and selling at the highest prices. But very little attention is paid on product differentiation and quality aspects to achieve premium prices. For better marketing, modern and advanced communication technologies and internet services are easily accessible but no Marketing Information System (MIS) exist in Balochistan Cluster. Labor is available on permanent and seasonal basis, and financial services to traders are provided by both formal and informal banking institutions.

Table 17: Gaps and Constraints at Trading Level

Sr. #	Parameter	Sindh Cluster	Balochistan Cluster	Punjab-KP Cluster
1.	Marketing channels	Regulated	Traditional	Regulated
2.	Hygienic processing and value addition	Low to medium	Low to medium	Very low
3.	Internet services	Available	Not available	Available
4.	MIS Services	Limited	Available	Non-available
5.	E-commerce platforms	Not available	Not available	Not available
6.	Contract farming	Harvesting contract widely practiced	Less practiced	Most practiced
7.	Export readiness	Limited	Limited	No
8.	Certifications (phytosanitary)	No	No	No
9.	Branding	Limited	Limited to completely absent	Limited

Unavailability of electricity is a common and big obstacle for the processing of dates in all three clusters. For the development of processing segment, a diversification strategy is necessary to develop new products and markets. For in-country or export trade in higher-value markets, it will be necessary to develop facilities for packing, cold storage and refrigerated transport. The three dates clusters are hubs of temperate fruit in Pakistan, such infrastructure development will be vital and will be fully utilized to its capacity for serving not only dates but the entire horticulture sector.

7. CLUSTER DEVELOPMENT POTENTIAL

7.1. Overview

The strategic locations of all three clusters are very important and advantages should be taken from. Some of the areas are lying strategically on CPEC routes. The Balochistan, D.I. Khan and Sindh routes are close to Gwadar and CPEC routes, and these routes facilitate the export of dates to Middle East and Far East Asia, Afghanistan and Iran while, the Punjab Cluster is bordering with India. These opportunities provide an edge to dates crop for future competition both locally and internationally thus making Pakistan a hub for trade in dates and other commodities. The clusters lying in Balochistan has the capability to expand both vertically and horizontally due to availability of plenty of land along with favorable climatic conditions, existence of main high ways network, round the year availability of labor, clean and diseases free environment etc. The Punjab-KP cluster is lying in two different administrative setups but possess tremendous potentials for sustainable cultivation of dates due to availability of plenty of water, round the year labor availability, well experienced dates growers etc.

In this section it has been tried to evaluate the potentials of all the three clusters in terms of production, demand, quality and market side of dates value chain, export alignment of the crop, and processing possibilities. Both quantitative and qualitative analyses are presented to explain the nature of active, dormant and inactive segments of the dates value chains in the said clusters.

7.2. Potential of Expanding Production

As noted earlier, the current dates average yield of Pakistan is around 5.5 t/ha which is much lower than the world average yield of 6.1 t/ha. The yield is particularly very low in Balochistan. Although, Punjab and Sindh clusters get higher yield than the world average, but these yield levels, according to the stakeholders including farmers and researchers, are much lower than the potential yields and the yield obtained by other countries of the world having similar environment like Pakistan. For instance, per ha yield of dates in Egypt is more than 32 t/ha.

7.2.1. Improved Varieties and Management Practices

Both the provincial and federal Agricultural Research Institutes do exist in Balochistan, Sindh and Punjab and are working for setting the technologies aimed at increasing productivity of dates in the province. These activities generally under Provincial Horticulture Institutes are able to collect limited germplasm of dates. Many advanced production technologies, such as pollination, and good quality dates varieties such as Muzawati, Aseel, Begum Jhangi and Dhakki already exist which according to researchers can easily double the yield. Moreover, if management practices of dates are standardized and promoted, it can further enhance its per ha yield.

Date orchards need special care for almost round the year[4]. Date palms are dioecious (i.e. the male and female parts called spathes) are on separate plants. The selection and use of proper spathes[5] is very important. Dates growers traditionally harvest male spathes 1-2 days after their opening and place them in shade and moisture free-area for drying. Strands are then detached and stored till needed for the pollination of female inflorescences. Considerable scope exists in training the farmers in spathe selection, pollination. The pollination service provides or pollinators are also need to be trained from achieving quality dates production from the area. After pollination, dates fruit development progresses through five different stages that takes about 6-8 months from fruit setting till maturity, i.e. *Hababauk*[6], *Kimri*[7], *Khalal*[8]/*Bisr*/*Doka*, *Rutab* or *Dang*[9] and

Tamar[10] (Figure-4). The fruit become edible in the last three stages as a result of decrease in bitterness, increased sweetness and improved tenderness and succulence. These stages are sensitive to rainfall. Summer monsoon rains always cause problem for the date crop,

[4] Date palm requires a long intensely hot summer with little rain and very low humidity from pollination to harvest but sufficient wetting of root zone. The ideal temperature ranges from 21°C to 27°C. Commercially, few male trees are grown the dates gardens and pollens are collected for the artificial pollination - critical for the success of production. Artificial pollination can be done by the traditional method or by using some mecanized device. Fruit quality mainly depend on the quality of pollen used. Growers typically obtain male spathes at the beginning of the season from the market and they are mostly price conscious (Figure-3). Considerable scope, therefore, exists in training or capacity building of farming community and the pollinators in selection and storing the spathes. After pollination, bunches are often tied to the leaf stalks to support the weight of the fruit. Fruit thinning is also recommended to decrease alternate bearing, increase fruit size, improve fruit quality, advance fruit ripening and facilitate bunch management. Fruit thinning can be carried out three ways" removal of entire bunches, reduction in the number of strands per bunch and reduction in the number of fruit per strands (Chao and Krueger, 2007; Abul-Soad, 2015).

[5] The flower stalks of both male and female dates trees are produced inside a spathe. The spathe emerges from the axils of the leaves in early spring in mature date palms. The date palm flowers from within the long stout spathe which, on bursting exposes may thickly crowded floral branchlets inside.

[6] The *Hababauk* stage begins with the fruit appearance and continues for 4-5 week. The fruit is of round shape, whitish-cream colour with green strips.

[7] The *Kimri* stage ppears in the first 17 weeks after pollination. At this stage, the fruit is young, elongaged, greenish in colour, hard in texture and with about 85% moisture. Fruit weight increases significantly and the tannine concentration is high. Although the fruit is inedible for direct consumption at this stage, however, it can be sued for making chutney (sauce) or pickles.

[8] The *Khalal* or *Bisr* or *Doka* stage comes during next 6 weeks. At this stage, the date fruit gains maximum size and weight, color becomes a typical yellow, purplish-pink or red depending on the cutivar, with hard texture. The sugar contents increases slowly and becomes mainly sucrose. So, the fruit is physiologically mature, hard and crisp, yellowish in colour with moisture contents as 45% to 65%. This *Doka* stage fruit can be consumed as raw fresh fruit or they can be used for jam, butter, or dates syrup.

[9] In the next 4 weeks, *Rutab* or *Dang stage* develops. The dates lose water with half of the fruit becoming soft, sweeter and darker in colour (light brown), or less astringent. Sucrose converts to reducing sugars and protein, fat and ash percentage decreases. This stage is the start of ripening. So, the fruit is partially browned and softened, moisture contents reduced to 30% to 40%. Dates of many cultivars at *Rutab* stage are eaten as fresh and processed into jam, butter, date bars and date paste.

[10] The *Tamar*/*Tamr*/*Tamer* is the final stage which lasts for 2 weeks. At this stage, the fruit gains maximum total solids, highest sweetness, astringency, dark brown clor, soft texture and a typical wrinkled shape. There is a high concentration of glucose and fructose, with no or very low sucrose. The percentage of protein, fat and ash are less as compared to Rutab stage. Owing to low moisture and high sugar content, dates of this stage have good storage stability, i.e. about one year at room temperature, if properly packed/stored. Tamar dates are yellowish brown to dark brown, texture from sof flexible to compact and moisture contents are below 20%.

particularly during July-August, whether fruits are still on the tree or being cured under the sun or solar dryers.

Figure 3: Fresh spathe market at Khairpur as a source of pollen grains used

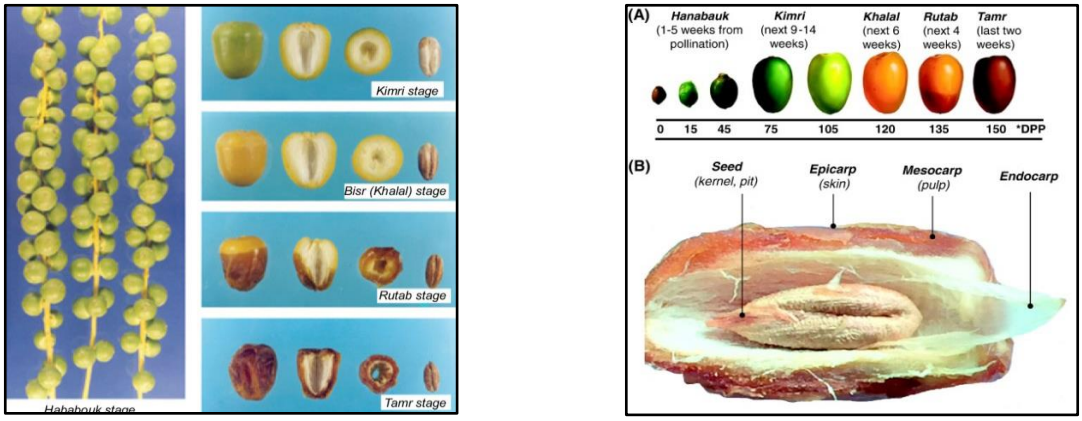

Figure 4: Stages of dates fruit development after pollination

Date palm harvesting season often coincides with the monsoon rains happening between July to September in dates growing clusters of Pakistan. In case of monsoon, it is very difficult to save dates, whether on the tree or on mats under sun drying[11]. A short spell of monsoon roain can destroy upto 90% of dates fruit. Bunch covering, not only practiced against rain damage, it also protects maturing fruit from birds and late season pests as well as prevent early ripening fruit from falling on the ground. Other benefits of bunch covering include accelerated fruit ripening, particularly when rains cause delayed ripening due to lowering the temperature and increased humidity (Barreveld, 1993). In Khairpur, if the bunches of Aseel variety are covered, they ripen one-week earlier than the uncovered ones (Abul-Soad, *et al*., 2010). In Balochistan, dates farmers use date palm leaflets made baskets to cover the bunches. This method is also quite effective particularly to protect fruit from very hot and dry winds bearing sand particles along with controlling falling fruits. Therefore, including bunch covering in the improved management practices package can notably improve quality dates production in Sindh and Balochistan clusters.

[11] Rains during fruit ripening causes the fruit to crack and ferment and mould development causing aflatoxin.

Figure 5: Protection of dates fruit bunces from monsoon rains by Tyvek bags in Pakistan

Source: Siddiq and Grieby, 2014; Abdul Soad *et al*., 2015

Researchers and farmers have no doubt that dates yield can easily be improved by 25% if proper varieties and management practices are promoted and farmers are trained for these practices. With the 25% increase in dates yield in the focal points of each cluster through concentrated efforts by promoting these technologies in the farmers' fields, it can generate millions of additional income to the farmers only in the focal points of the dates cluster during the fifth year of the project.

7.2.2. Renovation of Gardens

Furthermore, it is well established that by renovating the old gardens with new improved cultivars and facilitating the pollination on these newly established gardens, the dates yield can be increased many folds. The cost of renovation of old garden with high-density gardens is given in annexure 4. If we renovate only 20% of the garden and assume 35- 80% increase in yield, it will bring more additional incomes to the farmers only in the focal pints of dates clusters. In addition, it will generate thousands of additional jobs in each cluster.

7.3. Reduction in Post-Harvest Losses

Producing a good crop of high-quality dates requires time, skill and money. To gain full benefits from the crop, it is important to sustain the quality of the dates until they are reach to the consumers. Proper post-harvest handling can prolong the shelf life during which they remain consumable and marketable, thus reduces the post-harvest losses. In this regard, faster diffusion of using solar dates dryers or solar-cum-gas fired dates dryers can significantly control post-harvest losses in dates in Pakistan. The researchers believe that with the adoption of appropriate harvesting and post-harvest technique, the post-harvest losses can easily be reduced from 30% to 10%, which will save considerable quantity of dates and result in extra income to the farmers.

7.4. Demand Potential

As noted in the Introduction Section, per capita consumption of dates in the country has declined significantly by 42% during the 2000s because of the reduced production, increased export, and lower imports of dates in the country. This trend cannot be continued unabated because of the people's preferences for dates especially during the Ramadan month and on marriages. Therefore, expansion in production due to above interventions will be a great relief for the country to stop the declining trend in dates consumption.

Moreover, as we have noticed earlier that Pakistan's exports of dates since 2001 is increasing by 11% per annum rate, which is expected to continue because of the similar increase in international demand for dates during the period, if Pakistan is able to meet the quality requirements of the demand. To continue exporting with this rate, however, Pakistan needs to expand its production quite significantly.

Therefore, we believe that absorbing the expanded production by 40-50% during next five years through the introduction of new varieties, improved management practices, renovation of gardens, and reduced post-harvest losses will not be a problem as it can be used to stop the declining per capita consumption, feeding the burgeoning population, and continue exporting the dates at a fast rate.

7.5. Enhanced Processing and Value Addition

The date palm sector requires a paradigm shift towards varietal development, value addition and packaging to create more space in a competitive international market. Although some big factories of dates processing have been established in Karachi and Khairpur, but small scale value addition at the village level is missing in all the three clusters. Small scale dates processing technologies, like for example, dates solar drying and dates pack house which includes grading, sorting, washing, drying, and packaging are available. The fixed cost of dates pack house of capacity 540 tonnes per season (or 1.2 tonne per batch each batch last for 5 days assuming 150 days season) is about US$125000 with an operating cost for the whole season at around US$225000. Similarly, the dates solar drier with a capacity of 300kg per hour running for 12 hours a day and 150 days in a season with a total capacity of 36 tonnes per season will have fixed cost of around US$7500 with an operating cost for the whole season at around US$ 11000. The detailed feasibilities of the dates pack house is explained in Annexure 5, while the feasibility calculation for the dates drier is given with MS-EXCEL Model sheet.

The farmers of Pakistan are very poor and illiterate so adoption of these processing and value addition technologies is very difficult. Therefore, it is imperative to organize the farmers in groups and incentivize these technologies for their adoption. The public sector cannot do this alone so, it will be imperative that private sector and NGOs come forward with win-win solution by investing and developing infrastructure for introduction of processing and value addition technologies.

The promotion of processing industry within the cluster will minimize the postharvest losses considerably. By this new economic activity can be promoted and employment will also be generated for unemployed youth of the cluster.

7.6. Harnessing the Export Potential

Realizing the health benefits of dates, the worldwide demand of date has been on the rise since 2001. As noted earlier, Pakistan export significant amount of its dates production (35%) to the world market, but most of its export is to low-end market like India, Afghanistan and UAE where Pakistani exports earn 60% of the world average export price. This implies that considerable potential exists in fetching good price through improving the quality (through quality improvement and maintenance through improved production and postharvest technology adoption; value addition and processing).

Pakistan can easily expand its export by targeting the high-end markets like Malaysia and Indonesia. However, to penetrate in the expanding high-end dates market, Pakistan has to proactively adopt commercial strategies by linking its traders with international market, which are explained in the next section, and invest on improving its value chain as suggested above. Moreover, it has to improve its per ha yield and reduce production cost to become internationally competitive.

Our discussion with traders suggested that as first step, the emphasis should be laid on enhancing the quality of dry (Chohara) and fresh dates, rather than concentrating upon enhancing export-production ratio. Once our quality standards are established in high-end international markets, then it would be easy to expand export-production ratio. As a trickle down effect, the farmers' returns will also increase, which shall induce adoption of improved management practices and renovating their orchards with new dates varieties and better yielding plants.

8. CLUSTER DEVELOPMENT STRATEGIES

8.1. Plan

After discussion with stakeholders, following dates development plan with fixed targets to be achieved is specified (Table 18).

Table 18: Targets of dates cluster plan

S. No.	Targets for Dates Cluster Development
1.	Renovation of 20% old orchards and increasing the yield on these by 80% compared to the old orchards.
2.	Increasing the per ha yield of dates by at least 25% over a period of next five years on the old gardens through improved management practices.
3.	Reducing post-harvest losses from the current 30-40% level to 15-20% in various clusters.

8.2. Policies

It is imperative to set an agriculture policy that guide both the public and private sectors for investment in different fruit industries for its business regulation and infrastructure development. In dates following policy steps need to be take:

- Strengthening of agriculture research on dates is needed in each cluster, especially on collecting new germplasm, developing protocols for tissue culture nursery production, standardizing the farm management practices especially fertilizer, micronutrient and water application, protocols for harvesting, packaging, transportation, and storage for various dates varieties, etc.
- Building capacities of stakeholders along the value chain, especially farmers, pollination services providers, date drying technologies, traders, and processors to produce and handle quality dates fresh-produce and its products. For this purpose, capacities of extension department in each cluster will be enhanced by including experts on value chain development as extension experts in the department.
- Provision of Marketing Information System (MIS) on dates production, trade, and quality trends as well as emerging technologies.
- Provision of E-commerce facility
- Provision of special incentives for value chain infrastructure development.

8.3. Strengthening of Date palm Research

There in Pakistan several research institutes are working on dates varieties evolvement and development. Despite limited resources several dates varieties have been evolved and got registered by different research institutes. Research can play a leading role in the development of dates value chain development and performance of these varieties are remarkable both quantity and quality wise. But still a lot is needed to be done. Keeping in view the climate change and rise in demand of this important commodity, the evolvement of new varieties is imperative. Therefore, more attention and resources are required to be invested to boost research activities. Particularly, breeding and agronomic aspects are needed to be given more attention. It is also a dilemma that postharvest aspect of the commodity almost remained neglected and that's why more than 30% postharvest losses occur in this crop. It can generate new high-yielding technologies, standardize improved management practices in production, processing, and marketing, and it can also help in capacity building of stakeholders. Because Sindh is the major dates growing area in Pakistan, therefore, it is suggested to strengthen the Datepalm Research Institute in Khairpur into a Datepalm Research and Development Institute (DRDI). The Center should be made an autonomous body under the Board of Directors chaired by a pronounced business man and members taken from the private sector and dates growing provinces. The institute should collect and distribute dates germplasm of various characteristics to public and private sectors in other provinces especially in Balochistan, Punjab[12] and KP, undertake research on issues related to the whole value chain, generate information about dates marketing in domestic and international markets and new emerging technology trends. Target oriented research should be encouraged. The research on dates in Punjab and Balochistan need to be strengthened in the guidance of DRDI in Khairpur.

8.4. Organizing farmers' Entrepreneur Groups

Farmers Entrepreneur Groups (FEGs) can play important role in helping farmers to overcome the economies of scale issues, collect investments from small farmers for processing and value chain infrastructure, capacity building of farmers, and start contract farming by ensuring value chain. To establish the FEGs following are suggested:

- Farmers Entrepreneur Groups will be organized at the union council level in dates growing areas with the help of NGOs like NRSP who have main focus on social mobilization.
- Incentives through the FEGs will be provided to build basic dates value chain and processing infrastructure like dates pack-houses, dates solar driers, etc.
- Management of the processing infrastructure will be through a hired manager selected by the FEGs through consensus but initially trained and paid by the government.
- The members of the groups will be trained as demanded by the majority of FEGs. They can pick any or all of the training modules including good agricultural practices, IPM

[12] In Punjab, recently under an R&D project, tissue cultured plants of elite date varieties like Ajwa, Anbarah, Khalas, Barhi, Medijael and Ghanami shall be distributed to farmers

on pest, mechanical drying of dates, etc. These modules will be developed by the specially hired experts for this purpose.

- The groups will be encouraged to start quality- and fixed price-based contract with dates traders. The main responsibility of FEGs would be to ensure quality of dates.

8.5. Renovation of the Present Orchards

The existing date palm orchard are characterized with varieties with low yield potential and low market price. It is proposed to replace these with high priced cultivars by planting more productive trees of improved varieties which produce high priced dates. These cultivars will be established on high efficiency irrigation systems to increase the date area. It is assumed that an encouraging response to this intervention shall come from the farmers' side. The target is that 20% date palm area in every provincial clusters shall be renovated in 5 years' period. For the purpose, the following measures needs to be taken:

- Signing of Memorandum of Understanding with countries like USA, Spain and Australia for research and scientific collaboration and germplasm exchange particularly high density and more productive germplasm.
- Importing the date varieties characterized with different harvest times, higher yield from countries like Saudi Arabia, Iraq and Egypt.
- Establishing mother orchards at provincial agriculture research institutes and private nurseries having good business experience and reputation.
- Providing financial support to private nurseries for propagation of certified nursery plants of improved imported varieties for provision to the farmers.
- Providing financial support to the farmers in renovation of their orchards with high priced varieties plants on 50:50 cost sharing basis under project approach.

8.6. Capacity Building of Stakeholders

As noted earlier, farmers in each cluster generally are following decades old orchard and nursery management practices. The nurseries are not raised using appropriate protocol by farmers or nursery men to obtain helathy and disease free nurseries. Similarly, traders and processors, as noted earlier, do not adopt appropriate practices to keep the dates quality intact until it reaches to consumer's table.

Capacities of all stakeholders along the value chain will be improved. To promote improved management practices, these will be standardized at the experiment station first, and then the impact of these practices will be demonstrated at farmers' field through FEGs, and member farmers will be trained to adopt these practices. Similarly, certified nurseries with true-to-type mother-block will be established at the experiment station and nursery men will be trained to supply true-to-type healthy dates nurseries. For this purpose, truth-in-labling system will be implemented and monitored by the extension department in each cluster. The traders and processors will be trained for also be trained on quality value chain managment system.

For this purpose, public agricultural extension department and the agricultural advisory services will be activated and private sector will be involved to promote these practices to farmers, and other value chain agents. It is anticipated that these efforts will improve 25% yield per ha of dates in 5 years' period in each cluster. For this, the following measures will be taken:

- Standardizing the improved management practices at the experiment station, especially about the use of appropriate farm manure, artificial pollination of dates trees, pesticide micronutrient, fertilizer use and harvesting methods. Broachers and movies will be prepared by the experts on improved management practices, and private sector will be engaged to demonstrate and train farmers in line with the developed literature by the experts. The public sector extension will pay the role in monitoring the training and demonstration activities by the private sector.
- Standardizing the nursery establishment with certified mother blocks at the experiment station, and trained the nursey men/women about modern nursery management practices with the maintenance of certified mother blocks. Possibility of tissue culture based nursery production will be explored, and if successful, private sector will be trained to established tissue culture-based nurseries.
- Training of traders, processors, and other stakeholders on quality value-chain management system, especially on appropriate grading, packaging, storing, and transportation protocols.
- Educating farmers for applying decomposed farm yard manure and recommended doses of fertilizers on regular basis for soil health.
- Organizing trainings of the farmers and service providers in facilitating pollination through artificial pollination in the date palm orchards.
- Applying sprays of recommended chemicals, when and wherever needed and biological control of some major pests.
- Developing schedule of drip irrigation based on the soil, climate, etc.

8.7. Controlling Post-Harvest Losses

Even the best post-harvest techniques can only maintain the quality, not improve it. Therefore, quality of fruit as harvested must be ensured at the harvesting stage to maintain it throughout the value chain. Selection of appropriate climate and harvesting at the correct time using appropriate harvesting techniques are essential to produce good quality dates.

At present, date is harvested manually by hand, which damages the tree and affects the fruit quality significantly. After harvesting, dates is normally transported and stored in bulk after filling in plastic sacks in the orchard. These bags are not resistant to moisture and insect attack. The dates should be packed after proper drying in open air to remove excessive moisture. All this results into the loss of a notably high proportion of fruit in the supply chain.

Under the improved post-harvest management practices, the harvesting labor will be trained in better harvesting methods by educating them about the signs of appropriately mature fruit. The payment method shall also be changed from quantitative to qualitative & graded-based.

Moreover, the fruit packaging method shall be changed from plastic sack to air tight and gas tight bags. Farmers will also be trained on improved grading (size and maturity based). It is assumed that market shall also positively respond to these practices by offering relatively higher prices for the better sorted, graded and packed dates than those packed in conventional plastic sacks. It is anticipated that the proposed intervention under consideration shall result in controlling post-harvest losses from 10% to 20% in each cluster.

In this regard, following specific measures will be taken:

- Organizing trainings of the dates harvesting labor to teach them about the appropriate stages at which the dates should be harvested.
- Providing financial support to use appropriate packing material at relatively cheaper rates.
- Providing financial support to service providers in transport and forked loading and unloading sectors.
- Encouraging farm-level storages with appropriate temperature control for dates storing.

8.8. Solar Drying of *Chohara* and Fresh Dates

Drying of food items is an ancient technique to preserve them for later use. Dates are harvested in monsoon season (July-August) which does not allow dates to be ripened on the tree due to high humidity in ambient air (*Tamar* stage). Mostly dates are harvested at 50-60% moisture contents (*Khalal* stage) and are sundried in open to attain 20-24% moisture contents (Markhand *et al*., 2015). In this method, dates are spread on palm leaf mates and are exposed to sun rays (Ibupoto *et al*., 2015). Open sun drying technique, the oldest technique being utilized for dehydration of agricultural produce in most of the developing countries, has many disadvantages like: product spoiled due to rain, wind, dust and moisture; animal and bird infestation; insect attack; direct radiation of sun may also cause hardening of upper layer of agricultural produce (Sharma *et al*., 2009). This method requires large surface area and causes drudgery. The open sun drying also results in high post-harvest losses.

The appropriate alternative to open sun drying is solar drying in closed chamber for dehydration of agricultural produce. Solar dryers are more efficient, requires less time for drying and protects the produce from abrupt weather changes. It also results in good quality dried dates (Srinivasan and Balusamy, 2015). Use of solar energy is encouraged as it is environment friendly, free of cost and abundantly available in most parts of the world. Pakistan has tremendous potential of solar energy, especially in southern Punjab, Sindh and Balochistan. Solar irradiation received by these areas has value over 2 MWh m-2 per annum; with 3000 clear sunny hours per year (Malik and Maqbool, 2013). The solar-cum-gas fired dates drying is a further development made by the Pakistan Agricultural Research Council, Islamabad (Akhtar, 2017). The potential markets for processed dates have been identified in the previous section. The following strategies are suggested to promote processing of dates as a cottage industry in rural areas:

- Fifty cottage level dates processing units will be established along with due gadgets (e.g. washer, grader, solar dehydrator etc.) for storing/dehydrating the dates. For this, 20% subsidy will be provided to FEGs, and remaining investment will come from the members of the FEGs on voluntary basis.
- Collection of dates processed in rural areas and its packaging will be encouraged at small scale industry in peri-urban areas who will collect the processed dates from many manufacturing points in rural areas. The established firms will market the processes dates and distribute it to various destinations of the country throughout the year and abroad under its own brands. For this interest free loans will be provided to the distributors.
- Training and certification of dates processing in food safety and quality management system so that SPS certified processed dates are available from the cottage industry in the date cluster areas.
- Introduction of GI (Geographical Identification) registration and certification in the date cluster areas.

8.9. Linking Traders with High-End Markets

The projection of Pakistani dates in international market shall be made through increasing participation in international exhibitions, providing information about international markets, and establishing e-commerce portals. It is expected that these measures along with the above measures for the purpose of improving dates quality for achieving better prices our dates. Following measures are suggested for this purpose:

- Establishing e-commerce portal where FEGs and traders can directly contact and trade with international buyers.
- Establishing information portals regarding trends in dates production, quality requirements, prices, emerging production technologies, production costs, etc. in major dates producing, Dates exporting and dates importing countries of the world.
- Providing due information like, variety, nutritional information, certifications about non-usage of harmful chemicals in production and processing, child labor, etc.
- Introduction of Pakistani brands of dates with attractive names and packaging in the international food exhibitions.
- Providing financial and policy support to the potential dates exporters for successful participation in international food exhibitions and sponsored trip to expanding markets.

9. FEASIBILITY ANALYSIS OF CLUSTER DEVELOPMENT

The section estimates feasibility of the package of proposed interventions for the upgradation of each cluster, which includes:

1. Increasing yield through innovation of orchards;
2. Increasing yield through good agriculture practices (GAP);
3. Reducing post-harvest losses by improving harvesting methods, improved packaging, and transportation;
4. Introducing solar drying of fresh dates,
5. Linking traders with markets, and
6. Value chain improvement costs.

The feasibility of dates pack-house is also estimated separately at Annexure 5.

9.1. Punjab-KP Cluster

9.1.1. Baseline Status or Prevailing Situation

The baseline status of the dates production in the cluster has been shown Table 19. At present, total dates orchard area in the cluster is about 3297 ha produced more than 25 thousand tonnes of dates in 2016-17. The mean dates yield falls at 7.75 tonnes/ha with an average annual growth rate as 0.63% per annum and farm gate price as US$444.44/tonne. The total value of output currently produced accounts US$11.355 Million. At current level of growth rates in yield, very minor increase in earnings from dates can be expected (Table 19).

Table 19: Yearly Baseline Status at the Muzaffargarh Focal Point of Punjab-KP Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Total dates areas in the cluster (ha)	3,297										
Total dates prod. in the cluster (tonnes)	25,549										
Baseline yield (t/ha)	7.75										
Annual yield growth in past 10 years (%)	0.63%										
Average farm gate price (US$/tonne)	285.71										
Av. yield growth w/o interventions (onnes/ha)		7.75	7.85	7.90	7.94	7.99	8.04	8.10	8.15	8.20	8.25
Annual expected prod w/o intervention (tonnes)		25,549	25,869	26,031	26,194	26,358	26,523	26,690	26,857	27,025	27,194

T. value of cluster output at farm gate (Million US$)		11.355	11.497	11.569	11.642	11.715	11.788	11.862	11.936	12.011	12.086

9.1.2. Interventions and their Benefits

9.1.2.1. Intervention-1: Orchards Renovation with High Density Plantation

The first intervention proposed is increasing dates productivity through renovating the current orchard with high valued and higher yield dates varieties plantation in the cluster. The renovated gardens will also adopt best management practices. It is assumed that in coming 5 years, 20% of the total orchard area of the cluster shall be renovated and the mean dates yield from these orchards shall increase by 50%. In this way, 132 ha of dates orchards shall be renovated annually. As the gestation period of dates is 5 years, the new inserted plants shall start fruiting in 6th year. The total value of additional dates produced from renovated orchards at farm gate price shall be US$0.236 Million, US$0.475 million and US$1.209 Million in 6th, 7th and 10th year of the project, respectively (Table 20).

Table 20: Yearly Returns from Orchards Renovation with High Density Plantation of Modern Varieties in Muzaffargarh District Dates Cluster in Punjab

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
% area renovated with high density plantation in 5 years	20%										
% area annually renovated with high density plantation	4.00	4.00	8.00	12.00	16.00	20.00	20.00	20.00	20.00	20.00	20.00
Orchard area that would be renovated (ha)		132	264	396	528	659	659	659	659	659	659
Assumed yield increase from renovated orchards (t/ha)	50.0										
Additional production due to yield from renovated orchards (tonnes)							530	1,068	1,611	2,162	2,719
Value of added prod. from renovated orchards (Million US$)							0.236	0.475	0.716	0.961	1.209

9.1.2.2. Intervention-2: Raising Productivity by Better Management Practices

On the remaining 80% of the orchards, varieties will not be changed but only improved management practices shall be introduced. For this purpose, the farmers shall be educated through demonstrations and organizing farmers' field days in the area. The farmers' coaching on improved management practices shall be consisted of weeds control, balanced application

of fertilizer, pruning, selection and storage of male spathes, pollinators' training, thinning of fruit bunches and methods of bunch covering during the rains. Based on the results of such experiments on farmers' fields, it is anticipated that the mean dates yield in the areas shall improve by 25% during 5 years of project period with an average yield increase of 0.49 tonnes per ha every year and total increase of 2 tonnes per ha in five years. Its benefits are expected to be started and realized by the farming community in 2nd year of the project period. The additional production achieved from adoption of improved management practices resulting additional revenue to the farming community shall be to the tune of US$2.929 Million during 5th year of the project period (Table 21).

Table 21: Yearly Returns from Better Orchard Management in Muzaffargarh District Dates Cluster in Punjab

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
% yield increase over five years	25.00	6.25	12.50	18.75	25.00	25.00	25.00	25.00	25.00	25.00
Increase in yield after intervention (onnest/ha)		0.49	0.99	1.49	2.00	2.00	2.00	2.00	2.00	2.00
Additional production got from enhanced yield (tonnes)		1,617	3,254	4,911	6,590	6,590	6,590	6,590	6,590	6,590
Value of additional prod. from better management practices (Million $)		0.719	1.446	2.183	2.929	2.929	2.929	2.929	2.929	2.929

9.1.2.3. Intervention-3: Reducing Post-Harvest Losses

This intervention is aimed at realizing the farmers' community that instead of paying on quantity of dates collected by weight, the harvesting labor should be paid on the basis of quality of dates of desired grade harvested. Their wages will be adjusted in a way that their daily based earnings are not affected. Similarly, instead of packing the harvested dates in large jute or plastic sacks, without proper sorting, corrugated card boxes will be introduced. It is assumed that by adopting the recommended harvesting, grading and packaging measures, the post-harvest losses shall be reduced from current 30% of the produce to 15% in 5 years period. By this way, more than 4,942 tonnes of additional marketable surplus shall be saved from losses in the 5th year of the period, valued at US$2.197 Million (Table 22).

Table 22: Yearly Returns from Controlling Post-Harvest Losses in Muzaffargarh District Dates Cluster of Punjab

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current post-harvest losses by traditional handling (%)	30.00									
Reduction in post-harvest losses by better handling (%)	15.00	3.75	7.50	11.25	15.00	15.00	15.00	15.00	15.00	15.00
Additional prod. by control post-harvest losses (tonnes)		1,031	2,196	3,499	4,942	5,047	5,152	5,259	5,366	5,476

Value of additional prod. from renovated orchards (M. US$)		0.458	0.976	1.555	2.197	2.243	2.290	2.337	2.385	2.434

9.1.2.4. Intervention-4: Improving quality of dates for domestic and international market

This intervention involves supplying better quality dry and fresh dates in the domestic and for the international trade. The underlying purposes of this intervention are: i) to tackle the rising influx of better quality dates from Iran, Iraq and other countries dates in our domestic market; ii) gradually coming out of low-end international markets, particularly in view of falling Indian interests in our dry and fresh dates; iii) escalation of the standards of Pakistani dates in international market in general as other dates producing countries are also striving for that. Therefore, in near future no direct benefits in terms of better prices are not expected, except sustaining our supplies in the current importing countries, as well as looking for new markets for compensating the declining demands from Indian markets. In Punjab province, 90% of total dates production is utilized for *chohara* making. The trends in supplies so generated from Muzaffargarh district's dates cluster is given in Table 23 below.

Table 23: Trends in Supplies of Quality Dates from the Foal Point (Muzaffargarh District) of the Punjab-KP Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Chohara purpose *doka* production as percentage of total production (%)	90.00									
Chohara purpose *doka* available (tonnes)		25,665	28,333	31,145	34,101	34,821	35,549	36,285	37,029	37,781
Current exports from the cluster (tonnes)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exports quality dates to be produced over five years (% prod.)	20.00	5.00	10.00	15.00	20.00	20.00	20.00	20.00	20.00	20.00
Export quality dates produced (tonnes)		1,283	2,833	4,672	6,820	6,964	7,110	7,257	7,406	7,556
Total expected volume to be exported (%)	10.00	2.50	5.00	7.50	10.00	10.00	10.00	10.00	10.00	10.00
Quantity to be sold in domestic high-end market (10% of the domestic market) (tonnes)		642	1,417	2,336	3,410	4,353	5,332	6,350	7,406	8,501
Total qty. of quality dry dates available from the cluster for solar drying (tonnes)		1,925	4,250	7,008	10,230	11,317	12,442	13,607	14,812	16,057

9.1.2.5. Intervention-5: Introducing the Solar Tunnel Dates Drying

This intervention involves supplying solar dryers at the union council levels to FEGS at 20% subsidy and collecting the processed dates by some packaging industry from these small

units**.** It is presumed that in 5-year project period, the 20% of total dates produced in the cluster shall be processed for making *chohara*, which will later on shall be solar dried. By the 5th year, about 10,230 tonnes of dates shall be available for *chohara* dates production, which will be process through solar drying and 6,241 tonnes of *chohara* dates shall be produced. This will generate additional benefit to the farming community to the tune of US$1.387 Million during 5th year of the project (Table 24). A total of 137 solar driers is planned to be distributed on subsidy during the project period by incurring US$1.223 Million on the dryers.

Table 24: Yearly Returns from Solar Drying of Dates in the Focal Point of Punjab-KP Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Quantity of dates available for solar tunnel drying of *chohara* (tonnes)		1,925	4,250	7,008	10,230	11,317	12,442	13,607	14,812	16,057
Coversion factor (1.61 tonnes of *chohara* = t tonne solar dried)	1.61									
Total volume of solar dried *chohara* produced (onnes)		1,174	2,592	4,275	6,241	6,903	7,590	8,300	9,035	9,795
Value of dry dates after deducting raw material cost (M. $)	777.78	0.261	0.576	0.950	1.387	1.534	1.687	1.844	2.008	2.177

9.1.2.6. Intervention-6: Improving Value Addition by Introducing Packhouses for Export Market

Under this intervention the quality of fresh dates will be enhanced through improved value addition like proper grading, packaging, branding, storing, etc. by passing fresh dates through pack-houses. In this intervention value addition of all the additional improved quality dates available shall be carried out in the project period. Under this intervention, the progressive farmers or dates businessmen of high repute shall be encouraged to enter in the export of dates from the sample cluster. For this purpose, pack houses will be provided at a subsidy of 20% to those FEGs who can arrange the remaining 80% cost. A total of 7 pack houses are planned to be provided to the FEGs in this cluster costing about US$0.807 Million. Assuming that the intervention is successfully implemented, then nearly 6,241 tonnes of dates shall be treated for value addition from the cluster during 5th year of the project period, making additional value of US$0.922 Million (Table 25).

Table 25: Yearly Returns from Value Addition of Dry Dates (by Passing Through Pack Houses) in the Focal point of Punjab-KP Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Qty. of *Chohara* to be value added through pack house (tonne)		1,174	2,592	4,275	6,241	6,903	7,590	8,300	9,035	9,795
Conversion factor [1.00 tonne solar	0.95%									

dried = 0.95 tonne packed]										
Total volume of dry dates produced (tonnes)		1,115	2,463	4,061	5,928	6,558	7,210	7,885	8,583	9,305
Price of packed *chohara* (US$/tonne)	933.33									
Expected additional value of packed dry dates after deducting raw material cost (Million US$)		0.174	0.383	0.632	0.922	1.020	1.122	1.227	1.335	1.447

9.1.3. Summary of the Benefits from Interventions

Table-26 summarizes the yearly stream of benefits from the interventions introduced in the dates cluster of Muzaffargarh District.

Table 26: Yearly Expected Gross Returns (000 US$) from the Interventions in the Focal Point of Punjab-KP Cluster

Items	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Intervention-1: Orchards' renovation					235.76	474.48	716.18	960.89	1208.64
Intervention-2: Improved management practices	718.59	1446.18	2182.85	2928.70	2928.70	2928.70	2928.70	2928.70	2928.70
Intervention-3: Controlling post-harvest losses	458.10	976.17	1555.28	2196.53	2242.90	2289.79	2337.19	2385.11	2433.56
Intervention-4: Improving quality of dates									
Intervention-5: Introduction of solar tunnel dates drying	260.93	576.11	949.91	1386.78	1534.06	1686.60	1844.48	2007.79	2176.61
Intervention-6: Value addition by introducing dates pack houses	173.52	383.11	631.69	922.21	1020.15	1121.59	1226.58	1335.18	1447.44
Total =	1611.1	3381.57	5319.74	7434.22	7961.58	8501.16	9053.13	9617.67	10195.0

9.1.4. Costs Associated with Interventions

9.1.4.1. Intervention-1: Orchards Renovation with High Density Plantation

The high priced varieties plantation involves investment at two fronts. On farmers' side, it involves incurring expenses on purchasing certified nursery plants of improved varieties and sowing these plants in the spaces available between the existing trees, plus caring these plants till they start fruiting. On agriculture service providers' side, it involves upgradation of available nurseries in the area for the production of certified plants of modern varieties. For this, they would be first registered and then the mother plants of modern improved varieties shall be provided. Meanwhile, they shall be provided tissue cultured plants for nurturing them till they reach the age of transplanting. The yearly details about the costs of renovating the orchards in the cluster is given in Table 27 below.

Table 27: Yearly Costs of Orchards Renovation with Modern Varieties Plantation in the Focal Point of Punjab-KP Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Orchard renovation (20% area in 5 years)	20.00	4.00	8.00	12.00	16.00	20.00					
Renovated orchards acreage in gestation period (ha)		132	264	396	528	659	528	396	264	132	-
Renovated orchards establishment cost (US$/ha)	1500										
Total cost of orchard renovation (US$)		*197,820*	*395,640*	*593,460*	*791,280*	*989,100*	-	-	-	-	-
Cost of orchard mgmt. in gestation period (US$/ha)	562										
Total cost of orchard management in their gestation period (US$)		74,117	148,233	222,350	296,466	370,583	296,466	222,350	148,233	74,117	-
Acreage of renovated orchard in fruiting (ha)							132	264	396	528	659
Management cost of orchards in fruiting ($)	662						87,305	174,609	261,914	349,218	436,523
Total cluster cost of orchard renov. & management (US$)		271,937	543,873	815,810	1,087,746	1,359,683	383,771	396,959	410,147	423,335	436,523

9.1.4.2. Intervention-2: Raising Productivity by Better Management Practices

For exploiting the productivity potential of the dates orchards of the area, its farmers shall be trained for adopting improved management practices, e.g. proper pollination of the orchards, applying recommended doses of fertilizers and the micronutrients at their optimum application times, spraying the orchards on regular basis to protect from various insects and diseases, weeds control, balanced application of fertilizers, pruning, selection and storage of male spathes, pollinators' training, thinning of fruit bunches and methods of bunch covering during the rains, etc. This involves investment from the farmers as well as expenditures from the research/extension/advisory services related institutions. From the farmers' perspective the yearly costs of adopting better orchard management practices is given in Table 28 below.

Table 28: Yearly Costs of Better Orchard Management in the Focal Point of Punjab-KP Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current cost of orchard management (US$/ha)	222.59									
% increase in mgmt. cost from the current level management practices (%)	297.0	74.35	148.70	223.05	297.40	297.40	297.40	297.40	297.40	297.40
Total additional mgmt. cost from the current level (000 US$)		545.7	1091.3	1637.0	2182.6	2182.6	2182.6	2182.6	2182.6	2182.6

9.1.4.3. Intervention-3: Reducing Post-Harvest Losses

Controlling post-harvest losses involves new investments in harvesting, sorting, packaging, transport and loading/unloading methods. This requires investments from the farmers as well as on the establishment of infrastructure and serve providing industries/sectors. Yearly distribution of costs need to be incurred by farmers/pre-harvest contractors is given in Table 29.

Table 29: Yearly Costs of Controlling Post-Harvest Losses in the Focal Point of Punjab-KP Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current cost of controlling post-harvest losses (US$/ha)	459.21									
Incremental costs of adopting new post-harvest mgmt. practices for controlling post-harvest losses (%)	170.0	42.61	85.23	127.84	170.45	170.45	170.45	170.45	170.45	170.45
Total increase in cost of controlling post-harvest losses (000 US$)		645.2	1290.4	1935.6	2580.8	2580.8	2580.8	2580.8	2580.8	2580.8

9.1.4.4. Intervention-4: Introducing Tunnel Solar Dates Drying

As already mentioned that solar driers will be distributed on 20% subsidy to FEGs at the village level. This will generate employment opportunity for the poor village women, who will work indoor in their native villages, but will increase the operational cost by 172% compared to the current sun drying procedure. The necessary training shall be provided to these working women. Yearly distribution of processing and raw material cost is given in Table 30 below.

Table 30: Yearly Costs of Value Addition by Solar Tunnel Dates in the Focal Point of Punjab-KP Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current sun-drying cost of dates (US$/tonnes)	5.00										
Incremental costs of shifting to solar tunnel dates drying (%)	181.03		45.26	90.51	135.77	181.03	181.03	181.03	181.03	181.03	181.03
Total increase in cost of shifting to solar tunnel dates drying (000 US$)			2.7	11.7	29.0	56.5	62.5	68.7	75.1	81.8	88.7

9.1.4.5. Intervention-5: Improving Value Addition by Introducing Dates Pack Houses

By this intervention, the quality of fresh dates shall be enhanced through improved value addition like grading, packaging, storing, etc. by passing fresh dates through packhouses. In this intervention, the entire quantity of quality dates produced through value addition during the project period shall be processed through pack houses. This percent increase in the value addition operational cost and the year total increase in costs associated with the intervention is given in Table 31 below.

Table 31: Yearly Costs of Value Addition by Introducing Pack Houses in in the Focal Point of Punjab-KP Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current pack house packaging cost of dry dates (US$/tonne)	0.00									
Packhouse cost of quality dates production (US$/tonne)	86.00									
Total increase in cost of pack house dates (000 US$)		101.0	222.9	367.5	536.5	593.5	652.5	713.6	776.8	842.1

9.1.5. Summary of the Costs of Interventions

Table-32 summaries the yearly costs stream associated to various interventions introduced in the dates cluster.

Table 32: Gross Value of Expected Costs (000 US$) of Dates Cluster Development Interventions in the Focal Point of Punjab-KP Cluster

Items	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Intervention-1: Orchards' renovation	-	-	-	-	1359.7	383.8	397.0	410.1	423.3	436.5

Intervention-2: Improved management practices	-	545.7	1091.3	1637.0	2182.6	2182.6	2182.6	2182.6	2182.6	2182.6
Intervention-3: Controlling post-harvest losses	-	645.2	1290.4	1935.6	2580.8	2580.8	2580.8	2580.8	2580.8	2580.8
Intervention-4: Value addition by solar tunnel dates drying										88.66
Intervention-5: Introduction of dates packhouses	-	101.0	222.9	367.5	536.5	593.5	652.5	713.6	776.8	842.13
Total =	271.9	1838.4	3432.2	5057.0	6716.3	5803.5	5882.1	5962.9	6046.0	6131.55

9.1.6. Net Economic Benefits of Interventions

Table 33 pertains to the yearly stream of net-economic benefits after offsetting the direct value chains costs incurred for the development of dates cluster in Muzaffargarh district of the Punjab.

Table 33: Net-Economic Benefits after Offsetting the Direct Value Chains Costs of Development Interventions in the Focal Point of Punjab-KP Cluster

Items	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Total expected gross returns from dates cluster development in Punjab (000 US$)	-	1611.1	3381.6	5319.7	7434.2	7961.6	8501.2	9053.1	9617.7	10195.0
Gross costs to be incurred on cluster development interventions in Pb (000 US$)	271.9	1838.3	3432.1	5056.8	6716.1	5803.3	5882.9	5962.7	6046.9	6131.4
Net-economic benefits (000 US$)	**-271.9**	**-227.2**	**-50.6**	**262.9**	**718.1**	**2158.3**	**2619.3**	**3090.4**	**3571.8**	**4063.6**

9.1.7. Investment Needs for Cluster Development

In order to improve the focal points of the dates cluster, public investment under project approach is needed. As all the above calculations are made on the basis of a 5-year project, therefore, the year stream on investments required for all the six proposed interventions is given in Table 34 below.

Table 34: Public Investment (US$) Needed for the Development of the Focal point of Punjab-KP Cluster

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5
Improving the research infratsructure and operation	200,000	80,000	30,000	30,000	30,000	30,000
Capacity Building and FEGs for improved management practices	67,161	26,864	20,148	10,074	6,716	3,358
Investments required on orchard renovation (US$)	1,564,654	312,931	312,931	312,931	312,931	312,931
Investment required on certified nursery establishment (US$)	161,481	40,370	40,370	40,370	40,370	-

Investments required on pack house (US$)	806,610	115,230	230,460	230,460	230,460	-
Investment required for solar dates driers	1,223,258	232,151	276,796	330,369	383,942	-
Government loans on private investment	233,435	39,949	58,334	64,495	70,656	-
Total Investments needed on the cluster (US$)	4,256,599	847,495	969,039	1,018,699	1,075,076	346,289

9.1.8. Economic Viability of Development Plan

In Table 35, the discounted value of stream of investments incurred under project approach and the net-benefits achieved by the farming and non-farm business community are estimated on yearly basis. It revealed that the Internal Rate of Returns (IRR) for the dates cluster development in Muzaffargarh district is 26.12 percent clearly indicating an economically viable project. It clearly implies that it is clearly worth investing into the cluster for the uplift of the dates production in the area through various proposed farm, domestic and international marketing level investments.

Table 35: Net-Present Value and Internal Rate of Returns on the Costs and Investments in Muzaffargarh District Dates Cluster of Punjab

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Overall net-benefit after deducting all costs & investments incurred in the cluster from the stream of benefits (000 US$)	11678.0	-1119.4	-1196.2	-1069.3	-812.2	371.8	2158.3	2619.3	3090.4	3571.8	4063.6
Discount rate	8.50%										
Net-present value (US$)	4,699,139										
Internal Rate of Returns (%)	26.12%										

9.2. Sindh Dates Cluster (Khairpur Focal Point)

9.2.1. Baseline Status or Prevailing Situation

The baseline status of the dates production in the cluster has been shown Table 36. At present, total dates orchard area in the cluster is about 28.5 thousand ha produced nearly 237 thousand tonnes of dates in 2016-17. The mean dates yield falls at 8.33 tonnes/ha with an average annual growth rate as 1.58% per annum and farm gate price as US$444.44/tonne. The total value of output currently produced accounts US$105.380 Million. At current level of growth rates in yield, very minor increase in earnings from dates can be expected (Table 36).

Table 36: Yearly Baseline Status of Dates Cluster in the Focal Point of Sindh Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Total dates areas in the cluster (ha)	28.5										
Total dates production in the cluster (000 tonnes)	237.1										
Baseline yield (tonnes/ha)	8.33										
Annual yield growth in past 10 years (%)	1.58%										
Average farm gate price (US$/tonne)	285.71										
Average yield growth w/o interventions (tonnes/ha)		8.33	8.59	8.73	8.86	9.00	9.15	9.29	9.44	9.59	9.74
Annual expected production w/o intervention (000 tonnes)		237.1	244.6	248.5	252.4	256.4	260.5	264.6	268.8	273.1	277.4
T. value of cluster output at farm gate (Million US$)		105.4	108.7	110.4	112.2	11.969	115.8	117.6	119.5	121.4	123.3

9.2.2. Benefits Side of Proposed Interventions

9.2.2.1. Intervention-1: Orchards Renovation with High Density Plantation

The first intervention proposed is increasing dates productivity through renovating the current orchard with high valued and high yielding date palm varieties plantation in the cluster. It is assumed that in next 5 years, 20% of the total orchard area of the cluster shall be renovated and the mean dates yield from these orchards shall increase by 25%. In this way, 1139 ha of dates orchards shall be renovated annually. As the gestation period of dates is 5 years, the new inserted plants in the first project year shall start fruiting in 6th year. Therefore, the dates production from the 1st year renovated orchard shall increase by 50% than their sister non-renovated orchards. The total value of additional dates produced from renovated orchards at farm gate price shall be US$1.621 Million, US$3.293 Million and US$8.630 Million in 6th, 7th and 10th year of the project, respectively (Table 37).

Table 37: Yearly Returns from Dates Orchards Renovation with High Density Plantation of Modern Varieties in in the Focal Point of Sindh Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
% area renovated with high density plantation in 5 years	20.00										
% area annually renovated with high density plantation	4.00	4.00	8.00	12.00	16.00	20.00	20.00	20.00	20.00	20.00	20.00
Orchard area that would be renovated (ha)		1,139	2,278	3,417	4,557	5,696	5,696	5,696	5,696	5,696	5,696
Assumed yield increase from renovated orchards (t/ha)	25.00										
Additional prod. due to yield from renovated orchards (tonnes)							2,605	5,292	8,064	10,923	13,870
Value of additional prod. from renovated orchards (M US$)							1.621	3.293	5.018	6.796	8.630

9.2.2.2. Intervention-2: Raising Productivity by Better Management Practices

On the remaining 80% of the gardens, varieties will not be changed but only improved management practices will be introduced. For this purpose, the farmers shall be educated through demonstrations and organizing farmers' field days in the area. The farmers' coaching on improved management practices shall be consisted of weeds control, balanced application of fertilizers, pruning, spraying the orchards on regular basis to protect from various insects and diseases, selection and storage of male spathes, pollinators' training, thinning of fruit bunches and methods of bunch covering during the rains, etc. Based on the results of such experiments on farmers' fields, it is anticipated that the mean dates yield in the areas shall improve by 25% during 5 years of project period with an average yield increase of 0.54 tonnes per ha every year and total increase of 2.25 tonnes per ha in five years. Its benefits are expected to be started and realized by the farming community in 2nd year of the project period. The additional production achieved from adoption of improved management practices resulting additional revenue to the farming community shall be to the tune of US$28.492 Million during 5th year of the project period (Table 38).

Table 38: Yearly Returns from Better Orchard Management in the Focal Point of Sindh Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
% yield increase over five years	25.00	6.25	12.50	18.75	25.00	25.00	25.00	25.00	25.00	25.00
Increase in yield after intervention (t/ha)		0.54	1.09	1.66	2.25	2.29	2.32	2.36	2.40	2.44

Additional production got from enhanced yield (tonnes)		15,289	31,062	47,331	64,107	64,107	64,107	64,107	64,107	64,107
Value of additional prod. from better management practices (M. US$)		6.795	13.805	21.036	28.492	28.49	28.492	28.492	28.492	28.492

9.2.2.3. Intervention-3: Reducing Post-Harvest Losses

This intervention is aimed at realizing the farmers' community that instead of paying on quantity of dates collected by weight, the harvesting labor should be paid on the basis of quality of dates of desired grade harvested. Their charges shall be adjusted in a way that their daily based earnings are not affected. Similarly, instead of packing the harvested dates in large jute or plastic sacks, without proper sorting, corrugated card boxes will be introduced. It is assumed that by adopting the recommended harvesting, grading and packaging measures, the post-harvest losses shall be reduced from current 20% of the produce to 10% in 5 years' period. By this way, more than 32,054 tonnes of additional marketable surplus shall be saved from losses in the 5th year of the period, valued at US$14.246 Million (Table 39).

Table 39: Yearly Returns from Controlling Post-Harvest Losses in the Focal Point of Sindh Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current post-harvest losses by conventional handling (%0	20.00										
Reduction in post-harvest losses by better handling (%)	10.00		2.50	5.00	7.50	10.00	10.00	10.00	10.00	10.00	10.00
Additional prod. by control post-harvest losses (tons)			6,498	13,978	22,482	32,054	32,720	33,402	34,098	34,810	35,537
Value of additional prod. from renovated orchards (Milion US$)			2.888	6.212	9.992	14.246	14.589	14.939	15.298	15.665	16.041

9.2.2.4. Intervention-4: Improving quality of dates for domestic marketing and international trade

This intervention involves supplying better quality dry and fresh dates in the domestic and for the international trade. The underlying purposes of this intervention are: i) to tackle the rising influx of better quality dates from Iran, Iraq and other countries dates in our domestic market; ii) gradually coming out of low-end markets in the international trade, particularly in view of falling Indian interests in our dry and fresh dates; iii) escalation of the standards of Pakistani dates in international market in general as other dates producing countries are also striving for that. Therefore, in near future no direct benefits in terms of better prices are not expected, except sustaining our supplies in the current importing countries, as well as looking for new markets for compensating the declining demands from Indian markets. In Sindh province, 70%

of total dates production is utilized for *chohara* making[13]. The trends in supplies so generated from Khairpur district's dates cluster is given in Table 40 below.

Table 40: Trends in Supplies of Quality Dates from the Focal Point of Sindh Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Chohara purpose *doka* production as percentage of total production (%)	70.00									
Chohara purpose *doka* available (000tonnrd)		186.5	205.5	225.6	246.8	252.7	258.8	265.0	271.4	277.9
Current exports from the cluster (%)	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Exports quality dates to be produced over five years (% of production)	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Export quality dates produced (000 tonnes)		74.59	82.2	90.2	98.7	101.1	103.5	106.0	108.6	111.2
Total expected volume to be exported (%)	10.00	2.50	5.00	7.50	10.00	10.00	10.00	10.00	10.00	10.00
Quantity to be sold in domestic high-end market (10% of the domestic market) (000 tonnes)		4.66	10.27	16.92	24.68	31.59	38.82	46.38	54.28	62.53
Total qty. of quality dry dates available from the cluster for solar drying (tonnes)		79.26	92.46	107.15	123.41	132.69	14,35	152.4	162,84	173,63

9.2.2.5. Intervention-5: Introducing Solar Tunnel Dates Drying

This intervention involves supplying solar driers at the union council levels to FEGS at 20% subsidy and collecting the processed dates by some packaging industry from these small units**.** It is presumed that in 5-year project period, the 70% of total dates produced in the cluster shall be processed for making *chohara*, which will later on shall be solar dried. In this

[13] For *chohara* making, the dates are removed from the bunches at *Khalal* or *Doka* stage. It is boiled in big pans and then either sun-dried under the open sky or using solar tunnel dryers or solar-cum-gas fired tunnel dryers. In tunnel drying, the quality of dry dates or *chohara* produced is of better quality, clean, less humid and free from dust particles.

way, by 5th year, more than 123 thousand tonnes of dates shall be available for solar-tunnel dried *chohara* dates production, which will result in the production of more than 75 thousand tonnes of solar-tunnel dried *chohara* dates during the season, valued at more than US$16.728 Million for the 5th year (Table 41). A total of 1646 solar driers is planned to be distributed on subsidy during the project period by spending US$14.697 Million on the dryers.

Table 41: Yearly Returns from Solar Drying of Dates in the Focal Point of Sindh Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Quantity of dates available for solar tunnel drying of *chohara* (tonnes)		79,255	92,463	107,146	123,407	132,694	142,354	152,399	162,841	173,693
Coversion factor (1.61 tonnes of *chohara* = t tonne solar dried)	1.61									
Total volume of solar dried *chohara* produced (tonnes)		48,346	56,402	65,359	75,278	80,943	86,836	92,963	99,333	105,953
Value of dry dates after deducting raw material cost (M. $)	777.78	10.744	12.534	14.524	16.728	17.987	19.297	20.658	22.074	23.545

9.2.2.6. Intervention-6: Improving Value Addition of Dates by Introducing Pack Houses for Export Market

Under this intervention the quality of fresh dates will be enhanced through improved value addition like proper grading, packaging, branding, storing, etc. by passing fresh dates through pack-houses. In this intervention, value addition of all the additional improved quality dates available shall be carried out in the project period. For this purpose, packhouses will be provided at a subsidy of 20% to those FEGs who can arrange the remaining 80% cost. A total of 84 packhouses are planned to be provided to the FEGs in this cluster costing about US$9.679 Million. Under this intervention, the progressive farmers or dates businessmen of high repute shall be encouraged to enter in the export of dates from the sample cluster. Assuming that the intervention is successfully implemented, then nearly 75.278 thousand tonnes of dates shall be treated for value addition from the cluster during 5th year of the project period, making additional value as of US$11.124 Million (Table 42).

Table 42: Yearly Returns from Value Addition in Dry Dates by Passing through Packhouses for Export Market from the Focal Point of Sindh Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Qty. of *Chohara* to be value added through pack house (tonne)		48,346	56,402	65,359	75,278	80,943	86,836	92,963	99,333	105,953
Conversion factor [1.00 tonne solar dried = 0.95 tonne packed]	0.95%									

Total volume of dry dates produced (tonnes)		45,929	53,582	62,091	71,514	76,896	82,494	88,315	94,366	100,655
Price of packed *chohara* (US$/tonne)	933.33									
Expected value of value added fresh dates available (Million $)	933.33	7.144	8.335	9.658	11.124	11.961	12.832	13.737	14.679	15.657

9.2.3. Summary of the Benefits from Interventions

Table-43 summarizes the yearly stream of benefits from the interventions introduced in the dates cluster of Khairpur District.

Table 43: Yearly Expected Gross Returns (M US$) from the Focal Point of Sindh Cluster

Items	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Intervention-1: Orchards' renovation	-	-	-	-	1.62	3.29	5.02	6.80	8.63
Intervention-2: Improved management practices	6.79	13.81	21.04	28.49	28.49	28.49	28.49	28.49	28.49
Intervention-3: Controlling post-harvest losses	2.89	6.21	9.99	14.25	14.59	14.94	15.30	15.67	16.04
Intervention-4: Improving quality of dates									
Intervention-5: Introduction of solar tunnel dates drying	10.74	12.53	14.52	16.73	17.99	19.30	20.66	22.07	23.55
Intervention-6: Value addition by introducing dates pack houses	7.14	8.34	9.66	11.12	11.96	12.83	13.74	14.68	15.66
Total (US$) =	27.57	40.89	55.21	70.59	74.65	78.85	83.20	87.71	92.37

9.2.4. Costs Associated with Proposed Interventions

9.2.4.1. Intervention-1: Orchards Renovation with High Density Plantation

The high priced varieties plantation involves investment at two fronts. On farmers' side, it involves incurring expenses on purchasing certified nursery of improved varieties and sowing these plants in the large spaces available between the existing trees, plus caring these plants till they start fruiting. On agriculture service providers' side, it involves upgradation of available nurseries in the area for the production of certified plants of modern varieties. For this, they would be first registered and then the mother plants of modern improved varieties shall be provided. Meanwhile, they shall be provided tissue cultured plants for nurturing them till they reach the age of transplanting. The yearly details about the costs of renovating the orchards in the cluster is given in Table 44 below.

Table 44: Yearly Costs of Orchards Renovation with Modern Varieties Plantation in the Focal Point of Sindh Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Orchard renovation (20% area in 5 years)		4.00	8.00	12.00	16.00	20.00	-	-	-	-	-
Renovated orchards acreage in gestation period (ha)		1,139	2,278	3,417	4,557	5,696	4,557	3,417	2,278	1,139	-
Renovated orchards establishment cost (US$/ha)	1500										
Total cost of orchard renovation (000 US$)		1708.7	3417.5	5126.2	6835.0	8543.7	-	-	-	-	-
Cost of orchard mgmt. in gestation period (US$/ha)	490										
Total cost of orchard mgmt. in their gestation period(000 US$)		558.2	1116.4	1674.6	2232.8	2790.9	2232.8	1674.6	1116.4	558.2	-
Acreage of renovated orchards in fruiting (ha)		-	-	-	-	-	1,139	2,278	3,417	4,557	5,696
Management cost of orchards in fruiting (US$)	590	-	-	-	-	-	672,104	1,344,209	2,016,313	2,688,418	3,360,522
Total cluster cost of orchard renov. & management (US$)		2266.9	4533.9	6800.8	9067.7	11334.6	2320.1	1849.2	1378.3	907.4	436.5

9.2.4.2. Intervention-2: Raising Productivity by Better Management Practices

For exploiting the productivity potential of the dates orchards of the area, its farmers shall be trained for adopting improved management practices, e.g. weeds control, applying recommended doses of fertilizers the micronutrients at their optimum application times, pruning, spraying the orchards on regular basis to protect from various insects and diseases, selection and storage of male spathes, pollinators' training, thinning of fruit bunches and methods of bunch covering during the rains, etc. This involves investment from the farmers as well as expenditures from the research/extension/ advisory services related institutions. From

the farmers' perspective the yearly costs of adopting better orchard management practices is given in Table 45 below.

Table 45: Yearly Costs of Better Orchard Management in the Focal Point of Sindh Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current cost of orchard management (US$/ha)	222.59										
% increase in management cost from the current level management practices (%)	265.06		66.26	132.53	198.79	265.06	265.06	265.06	265.06	265.06	265.06
Total additional mgmt. cost from the current level (M. US$)			4.20	8.40	12.60	16.80	16.80	16.80	16.80	16.80	16.80

9.2.4.3. Intervention-3: Reducing Post-Harvest Losses

Controlling post-harvest losses involves new investments in harvesting, sorting, packaging, transport and loading/unloading methods. This requires investments from the farmers as well as on the establishment of infrastructure and serve providing industries/sectors. Yearly distribution of costs need to be incurred by farmers/pre-harvest contractors is given in Table 46.

Table 46: Yearly Costs of Controlling Post-Harvest Losses in the Focal Point of Sindh Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current cost of controlling post-harvest losses (US$/ha)	485.66									
Incremental costs of adopting new post-harvest mgmt. practices for controlling post-harvest losses (%)	172.8	43.2	86.4	129.6	172.8	172.8	172.8	172.8	172.8	172.8
Total increase in cost of controlling post-harvest losses (M. US$)		5.976	11.952	17.929	23.905	23.905	23.905	23.905	23.905	23.905

9.2.4.4. *Intervention-4: Introducing Solar Tunnel Dates Drying*

As already mentioned that solar driers will be distributed on 20% subsidy to FEGs at the village level. This will generate employment opportunity for the poor village women, who will work indoor in their native villages, but will increase the operational cost by 172% compared to the current sun drying procedure. The necessary training shall be provided to the working women. Yearly distribution of processing and raw material cost is given in Table 47 below.

Table 47: Yearly Costs of Solar Tunnel Drying in the Focal Point of Sindh Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current cost of dates drying under the sun (US$/ha)	5.00									
Incremental costs of shifting to solar tunnel dates drying (%)	181.0	45.3	90.5	135.8	181.0	181.0	181.0	181.0	181.0	181.0
Total increase in cost of shifting to solar tunnel dates drying (000$)		109.4	255.3	443.7	681.4	732.6	786.0	841.4	899.1	959.0

9.2.4.5. *Intervention-5: Improved Value Addition of Dates by Introducing Dates Pack Houses*

By this intervention, the quality of fresh dates shall be enhanced through improved value addition like grading, packaging, storing, etc. by passing fresh dates through pack-houses. In this intervention, the entire quantity of quality dates produced through value addition during the project period shall be processed through packhouses. This percent increase in the value addition operational cost and the year total increase in costs associated with the intervention is given in Table 48 below.

Table 48: Yearly Costs of Value Addition by Introducing Packhouses in the Focal Point of Sindh Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current pack house packaging cost of dry dates (US$/tonne)	0.00										
Packhouse cost of quality dates production (US$/tonne)	86.00										
Total increase in cost of pack house dates (000 US$)			4156.6	4849.3	5619.4	6472.2	6959.3	7465.9	7992.7	8540.4	9109.6

9.2.5. Summary of the Costs of Interventions

Table-49 summaries the yearly costs stream associated to various interventions introduced in the dates cluster.

Table 49: Gross Value of Expected Costs (M. US$) of Dates Cluster Development Interventions in the Focal Point of Sindh Cluster

Items	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Intervention-1: Orchards' renovation	2.267	4.534	6.801	9.068	11.335	2.320	1.849	1.378	0.907	0.437
Intervention-2: Improved management practices	-	4.201	8.401	12.602	16.803	16.803	16.803	16.803	16.803	16.803
Intervention-3: Controlling post-harvest losses	-	5.976	11.952	17.929	23.905	23.905	23.905	23.905	23.905	23.905
Intervention-4: Value addition by solar tunnel dates drying	-	0.109	0.255	0.444	0.681	0.733	0.786	0.841	0.899	0.959
Intervention-5: Introduction of dates packhouses	-	4.157	4.849	5.619	6.472	6.959	7.466	7.993	8.540	9.110
Total =	2.267	18.977	32.259	45.662	59.196	51.306	51.981	52.678	53.398	54.142

9.2.6. Net Economic Benefits

Table 50 pertains to the yearly stream of net-economic benefits after offsetting the direct value chains costs incurred for the development of dates cluster in Khairpur district of the Sindh.

Table 50: Net-Economic Benefits after Offsetting the Direct Value Chains Costs of Development Interventions in the Focal Point of Sindh Cluster

Items	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Total expected gross returns from dates cluster develop. in Sindh (000 US$)	-	27570.8	40886.5	55210.8	70591.2	74650.8	78853.8	83204.5	87707.1	92365.9
Gross costs to be incurred on cluster development interventions in Sindh (000 US$)	2266.9	18976.8	32259.2	45661.5	59195.8	51305.5	51980.5	52677.9	53398.3	54142.4
Net-economic benefits (000 US$)	-2266.9	8594.0	8627.3	9549.3	11395.4	23345.2	26873.3	30526.7	34308.9	38223.5

9.2.7. Investments Need for Cluster Development

In order to improve the sample dates cluster, public investment under project approach is needed. As all the above calculations are made on the basis of a 5-year project, therefore, the

year stream on investments required for all the six proposed interventions is given in Table 51 below.

Table 51: Public Investment (US$) for Development of the Focal Point of Sindh Cluster

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5
Improving research infratsructure and operation	1,000,000	400,000	150,000	150,000	150,000	150,000
Capacity Building and FEGs for improved mgmt. practices	580,128	232,051	174,038	87,019	58,013	29,006
Investments required on orchard renovation	13,515,247	2,703,049	2,703,049	2,703,049	2,703,049	2,703,049
Investment required on certified nursery establishment	1,211,111	302,778	302,778	302,778	302,778	-
Investments required on pack house	29,959,800	5,646,270	6,798,570	8,066,100	9,448,860	-
Investment required for solar dates dryers	14,696,951	9,437,836	1,571,484	1,750,062	1,937,569	-
Investments required on Mkt./Export level interventions (US$)	37,037	14,815	11,111	5,556	3,704	1,852
Government loans on private investment	5,135,526	1,734,672	962,556	1,128,859	1,309,439	-
Total Investments needed on the cluster (US$)	66,135,801	20,471,471	12,673,587	14,193,423	15,913,412	2,883,908

9.2.8. Economic Viability of Development Plan

In Table 52, the discounted value of stream of investments incurred under project approach and the net-benefits achieved by the farming and non-farm business community are estimated on yearly basis. It revealed that the Internal Rate of Returns (IRR) for the dates cluster development in Khairpur district is 26.65 percent clearly indicating an economically viable project. It clearly implies that it is clearly worth investing into the cluster for the uplift of the dates production in the area through various proposed farm, domestic and international marketing level investments.

Table 52: Net-Present Value and Internal Rate of Returns of Costs and Investments Incurred in the Focal Point of Sindh Cluster

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Overall net-benefit after deducting all costs & investments incurred in the cluster from the stream of benefits (M. US$)	123.04	-22.74	-4.08	-5.57	-6.36	8.51	23.35	26.87	30.53	34.31	38.22
Discount rate	8.50%										
NPV (US$)	68,525,529										
IRR (%)	37.26%										

9.3. Balochistan Dates Cluster (Turbat and Panjgur as Focal Point)

9.3.1.1. Baseline Status or Prevailing Situation

The baseline status of the dates production in the cluster has been shown Table 53. At present, total dates orchard area in the cluster is about 43588 ha produced 185629 tonnes of dates in 2016-17. The mean dates yield falls at 4.26 tonnes/ha with an average annual growth rate as -0.27% per annum and farm gate price as US$518.52/tonne. The total value of output currently produced accounts US$96.252 Million. At current level of growth rates in yield, very minor increase in earnings from dates can be expected (Table 53).

Table 53: Yearly Baseline Status of Dates Clusters in the Focal Point of Balochistan Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Total dates areas in the cluster (ha)	43,588										
Total dates production in the cluster (tonnes)	185,629										
Baseline yield (t/ha)	4.26										
Annual yield growth in past 10 years (%)	-0.27										
Average farm gate price (US$/tonne)	518.52										
Average yield growth w/o interventions (t/ha)		4.26	4.21	4.19	4.16	4.14	4.11	4.09	4.07	4.04	4.02
Annual expected prod. w/o intervention (tonnes)		185,629	183,499	182,446	181,399	180,358	179,323	178,294	177,270	176,253	175,242
T. value of cluster output at farm gate (Million US$)		96.252	95.725	95.463	95.201	94.941	94.681	94.421	94.163	93.905	93.648

9.3.2. Benefits Side of Proposed Interventions

9.3.1.1. Intervention-1: Orchards Renovation with High Density Plantation

The first intervention proposed is increasing dates productivity through renovating the current orchard with high valued and high yielding dates varieties plantation in the cluster. The improved management practices will also be adopted on the renovated farms. It is assumed that in coming 5 years, 20% of the total orchard area of the cluster shall be renovated and the mean dates yield from these orchards shall increase by 80%. In this way, 1744 ha of dates orchards shall be renovated annually. As the gestation period of dates is 5 years, the new inserted plants shall start fruiting in 6th year. Therefore, the dates production from the 1st year renovated orchard shall be more than double than their sister non-renovated orchards. The total value of additional dates produced from renovated orchards at farm gate price shall be US$3.030 Million and US$6.043 million in 6th and 7th year of the project, respectively (Table 54).

Table 54: Yearly Returns from Orchards Renovation with High Density Plantation of Modern Varieties in the Focal Point of Balochistan Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
% area renovated with high density plantation in 5 years	20.00										
% area annually renovated with high density plantation	4.00	4.00	8.00	12.00	16.00	20.00	20.00	20.00	20.00	20.00	20.00
Orchard area to be renovated (ha)		1,744	3,487	5,231	6,974	8,718	8,718	8,718	8,718	8,718	8,718
Assumed yield increase from renovated orchards (t/ha)	80.00										
Additional prod. due to yield from renovat. orchards (tonnes)	-	-	-	-	-	-	5,843	11,654	17,434	23,181	28,897
Value of additional production from renovated orchards (M. US$)	-	-	-	-	-	-	3.030	6.043	9.040	12.020	14.984

9.3.1.2. Intervention-2: Raising Productivity by Better Management Practices

On the remaining 80% of the gardens, varieties will not be changed but only improved management practices will be introduced. For this purpose, the farmers shall be educated through demonstrations and organizing farmers' field days in the area. The farmers' coaching on improved management practices shall be consisted of weeds control, balanced application of fertilizers, pruning, spraying the orchards on regular basis to protect from various insects and diseases, selection and storage of male spathes, pollinators' training, thinning of fruit bunches and methods of bunch covering during the rains. Based on the results of such experiments on farmers' fields, it is anticipated that the mean dates yield in the areas shall improve by 25% during 5 years of project period with an average yield increase of 0.26 tonnes per ha every year and total increase of 1.05 tonnes per ha in five years. Its benefits are expected to be started and realized by the farming community in 2nd year of the project period. The additional production achieved from adoption of improved management practices resulting additional revenue to the farming community is shown in Table 55.

Table 55: Yearly Returns from Better Orchard Management in the Focal Point of Balochistan Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
% yield increase over five years (%)	25.00		6.25	12.50	18.75	25.00	25.00	25.00	25.00	25.00	25.00
Increase in yield after intervention (t/ha)			0.26	0.53	0.79	1.05	1.05	1.04	1.04	1.04	1.04

Additional production got from enhanced yield (tonnes)			11,538	23,013	34,425	45,775	45,775	45,775	45,775	45,775	45,775
Value of additional prod. from better management practices (Milion $)			5.982	11.932	17.850	23.735	23.735	23.735	23.735	23.735	23.735

9.3.1.3. Intervention-3: Reducing Post-Harvest Losses

This intervention is aimed at realizing the farmers' community that instead of paying on quantity of dates collected by weight, the harvesting labor should be paid on the basis of quality of dates of desired grade harvested. Their charges shall be adjusted in a way that their daily based earnings are not affected. Similarly, instead of packing the harvested dates in large jute or plastic sacks, without proper sorting, corrugated card boxes will be introduced. It is assumed that by adopting the recommended harvesting, grading and packaging measures, the post-harvest losses shall be reduced from current 30% of the produce to 10% in 5 years' period. By this way, more than 45,775 tonnes of additional marketable surplus shall be saved from losses in the 5th year of the period, valued at US$23.735 million (Table 56).

Table 56: Yearly Returns from Controlling Post-Harvest Losses in the Focal Point of Balochistan Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current post-harvest losses by traditional handling (%)	30.00										
Reduction in post-harvest losses by better handling (%)	10.00	-	5.00	10.00	15.00	20.00	20.00	20.00	20.00	20.00	20.00
Additional prod. by control post-harvest losses (tonnes)			9,808	20,712	32,704	45,775	46,843	47,905	48,962	50,012	51,056
Value of additional prod. from renovated orchards (Milion $)			5.085	10.740	16.958	23.735	24.289	24.840	25.388	25.932	26.473

9.3.1.4. Intervention-4: Improving quality of dates for domestic marketing and international trade

This intervention involves supplying better quality dry and fresh dates in the domestic and for the international trade. The underlying purposes of this intervention are: i) to tackle the rising influx of better quality dates from Iran, Iraq and other countries dates in our domestic market; ii) gradually coming out of low-end markets in the international trade, particularly in view of falling Indian interests in our dry and fresh dates; iii) escalation of the standards of Pakistani dates in international market in general as other dates producing countries are also striving for that. Therefore, in near future no direct benefits in terms of better prices are not expected, except sustaining our supplies in the current importing countries, as well as looking for new markets for compensating the declining demands from Indian markets. In Balochistan province, 90% of total dates production is utilized for fresh dates making. The trends in

supplies so generated from Turbat and Panjgur districts' dates clusters is given in Table 57 below.

Table 57: Trends in Supplies of Quality Fresh Dates from the Focal Point of Balochistan Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Fresh dates as percentage of total production (%)	90.00									
Fresh dates available (onnest)										
Current exports from the cluster (% prod.)	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Exports quality dates to be produced over five years (% prod.)	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Export quality dates produced (tonnes)		92,681	102,524	112,830	123,592	126,477	129,345	132,196	135,031	137,850
Total expected vol. to be exported (%)	10.00	2.50	5.00	7.50	10.00	10.00	10.00	10.00	10.00	10.00
Quantity to be sold in domestic high-end market (10% of the domestic market) (tonnes)		4,634	10,252	16,924	24,718	31,619	38,803	46,269	54,013	62,033
Total qty. of quality dry dates available from the cluster for solar drying (tonnes)		97,315	112,777	129,754	148,311	158,096	168,148	178,465	189,044	199,883

9.3.1.5. Intervention-5: Introducing Solar Tunnel Dates Drying

This intervention involves supplying solar driers at the union council levels to FEGS at 20% subsidy and collecting the processed dates by some packaging industry from these small units**.** It is presumed that in 5-year project period, 90% of total dates production in the cluster shall be processed for making fresh dates, which will later on shall be solar tunnel dried. In this way, by 5th year, 148.131 thousand tonnes of dates shall be available for *chohara* dates production, which will result in the production of 97.315 thousand tonnes of quality fresh dates shall be produced in the season, and more than US$28.834 Million business shall be created to the farming community (Table 58). A total of 1977 solar driers is planned to be distributed on subsidy during the project period by spending US$17.652 Million on the dryers.

Table 58: Yearly Returns from Solar Drying of Dates in the Focal Point of Balochistan Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Quantity of dates available for solar tunnel drying (tonnes)		97,315	112,777	129,754	148,311	158,096	168,148	178,465	189,044	199,883

Coversion factor (1 t of fresh dates = 0.75 tonne solar dried dates)	0.75									
Total volume of solar tunnel dried fresh dates produced (tonnes)		72,986	84,583	97,315	111,233	118,572	126,111	133,849	141,783	149,912
Value of dry dates after deducting raw material cost (Milion US$)	907.41	18.922	21.929	25.230	28.838	30.741	32.696	34.702	36.759	38.866

9.3.1.6. Intervention-6: Improving Value Addition of Fresh Dates by Introducing Packhouses for Export Market

Under this intervention the quality of fresh dates will be enhanced through improved value addition like proper grading, packaging, branding, storing, etc. by passing fresh dates through pack-houses. In this intervention, value addition of all the additional improved quality dates available shall be carried out in the project period. For this purpose, pack houses will be provided at a subsidy of 20% to those FEGs who can arrange the remaining 80% cost. A total of 123 pack houses are planned to be provided to the FEGs in this cluster costing about US$14.173 Million. Assuming that the intervention is successfully implemented, then more than 111 thousand tonnes dates shall be processed towards fresh dates during 5th year of the project. More than 105 thousand tonnes high quality fresh dates shall be produced during the year, having value amounting US$19.177 Million (Table 59).

Table 59: Yearly Returns from Value Addition in Dates by Passing through Pack Houses for Export Market from the Focal Point of Balochistan Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Qty. of fresh dates to be value added through pack house (tonne)		72,986	84,583	97,315	111,233	118,572	126,111	133,849	141,783	149,912
Conversion factor [1.00 tonne solar dried = 0.95 tonne packed]	0.95%									
Total volume of fresh dates produced (tonnes)		69,337	80,354	92,450	105,671	112,643	119,806	127,156	134,694	142,417
Price of packed fresh dates (US$/tonne)	1089									
Expected value of value added fresh dates available (Million $)	1089	12.583	14.583	16.778	19.177	20.443	21.743	23.077	24.444	25.846

9.3.3. Summary of the Benefits from Interventions

Table-60 summarizes the yearly stream of benefits from the interventions introduced in the dates cluster of Turbat and Panjgur Districts.

Table 60: Yearly Expected Gross Returns (Million US$) from Investments on Dates Cluster Development Interventions in the Focal Point of Balochistan Cluster

Items	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Intervention-1: Orchards' renovation					3.0	6.0	9.0	12.0	15.0
Intervention-2: Improved management practices	6.0	11.9	17.9	23.7	23.7	23.7	23.7	23.7	23.7
Intervention-3: Controlling post-harvest losses	5.1	10.7	17.0	23.7	24.3	24.8	25.4	25.9	26.5
Intervention-4: Improving quality of dates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Intervention-5: Introduction of solar tunnel dates drying	18.9	21.9	25.2	28.8	30.7	32.7	34.7	36.8	38.9
Intervention-6: Value addition by introducing dates pack houses	12.6	14.6	16.8	19.2	20.4	21.7	23.1	24.4	25.8
Total (US$) =	42.6	59.2	76.8	95.5	102.3	109.1	116.0	122.9	130.0

9.3.4. Costs Associated with Proposed Interventions

9.3.4.1. Intervention-1: Orchards Renovation with High Density Plantation

The high priced varieties plantation involves investment at two fronts. On farmers' side, it involves incurring expenses on purchasing certified nursery of improved varieties and sowing these plants in the large spaces available between the existing trees, plus caring these plants till they start fruiting. On agriculture service providers' side, it involves upgradation of available nurseries in the area for the production of certified plants of modern varieties. For this, they would be first registered and then the mother plants of modern improved varieties shall be provided. Meanwhile, they shall be provided tissue cultured plants for nurturing them till they reach the age of transplanting. The yearly details about the costs of renovating the orchards in the cluster is given in Table 61 below.

Table 61: Yearly Costs of Orchards Renovation with Modern Varieties Plantation in the Focal Point of Balochistan Cluster

Items	Input	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Orchard renovation (% area in 5 years)	20.00	4.00	8.00	12.00	16.00	20.00					
Renovated orchards acreage in gestation period (ha)		1,744	3,487	5,231	6,974	8,718	6,974	5,231	3,487	1,744	-

Cost of renovated orchards establish (US$/ha)	1200										
Total cost of orchard renovation (000 US$)		2092.2	4184.4	6276.7	8368.9	10461.1	-	-	-	-	-
Cost of orchard mgmt. in the gestation period (US$/ha)	490										
Total cost of orchard mgmt. in the gestation period (000 US$)		854.3	1708.7	2563.0	3417.3	4271.6	3417.3	2563.0	1708.7	854.3	-
Acreage of renovated orchards in fruiting(ha)							1,744	3,487	5,231	6,974	8,718
Management cost of orchards in fruiting (M. US$)							1.029	2.057	3.086	4.115	5.143
Total cluster cost of orchard renov. & management (M. US$)		2.95	5.89	8.84	11.79	14.73	4.45	4.62	4.79	4.97	5.14

9.3.4.2. Intervention-2: Raising Productivity by Better Management Practices

For exploiting the productivity potential of the dates orchards of the area, its farmers shall be trained for adopting improved management practices, e.g. weeds control, applying recommended doses of fertilizers the micronutrients at their optimum application times, pruning, spraying the orchards on regular basis to protect from various insects and diseases, selection and storage of male spathes, pollinators' training, thinning of fruit bunches and methods of bunch covering during the rains, etc. This involves investment from the farmers as well as expenditures from the research/extension/advisory services related institutions. From the farmers' perspective the yearly costs of adopting better orchard management practices is given in Table 62 below.

Table 62: Yearly Costs of Better Orchard Management in the Focal Point of Balochistan Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current orchard managmnt cost (US$/ha)	222.59									
% increase in management cost from the current level management practices (%)	265.06	66.26	132.53	198.79	265.06	265.06	265.06	265.06	265.06	265.06
Total additional mgmt. cost from the current level (M. US$)		6.43	12.86	19.29	25.72	25.72	25.72	25.72	25.72	25.72

9.3.4.3. Intervention-3: Controlling Post-Harvest Losses

Controlling post-harvest losses involves new investments in harvesting, sorting, packaging, transport and loading/unloading methods. This requires investments from the farmers as well as on the establishment of infrastructure and serve providing industries/sectors. Yearly distribution of costs need to be incurred by farmers/pre-harvest contractors is given in Table 63.

Table 63: Yearly Costs of Controlling Post-Harvest Losses in the Focal Point of Balochistan Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current cost of controlling post-harvest losses (US$/ha)	485.66									
Incremental costs of adopting new post-harvest management practices for controlling post-harvest losses (%)	172.83	43.21	86.42	129.63	172.83	172.83	172.83	172.83	172.83	172.83
Total increase in cost of controlling post-harvest losses (M. US$)		9.15	18.29	27.44	36.59	36.59	36.59	36.59	36.59	36.59

9.3.4.4. Intervention-4: Introducing Solar Tunnel Dates Drying

As already mentioned that solar driers will be distributed on 20% subsidy to FEGs at the village level. This will generate employment opportunity for the poor village women who will work indoor in their native villages, but will increase the operational cost by 172% compared to the current sun drying procedure. The necessary training shall be provided to these working women. Yearly distribution of processing and raw material cost is given in Table 64 below.

Table 64: Yearly Costs of Value Addition by Solar Tunnel Drying of in the Focal Point of Balochistan Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current cost of dates drying under the sun (US$/ha)	5.00									
Incremental costs of shifting to solar tunnel dates drying (%)	181.03	45.26	90.51	135.77	181.03	181.03	181.03	181.03	181.03	181.03
Total increase in cost of shifting to solar tunnel dates drying (M. US$)		0.17	0.38	0.66	1.01	1.07	1.14	1.21	1.28	1.36

9.3.4.5. Intervention-5: Improved Value Addition of Dates by Introducing Dates Pack Houses

By this intervention, the quality of fresh dates shall be enhanced through improved value addition like grading, packaging, storing, etc. by passing fresh dates through pack-houses. In this intervention, the entire quantity of quality dates produced through value addition during the project period shall be processed through pack houses. This percent increase in the value addition operational cost and the year total increase in costs associated with the intervention is given in Table 65 below.

Table 65: Yearly Costs of Value Added Fresh Dates Production in the Focal Point of Balochistan Cluster

Items	Input	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Current pack house packaging cost of fresh dates (US$/tonne)	0.00									
Pack house cost of quality dates production (US$/tonne)	86.00									
Total increase in cost of pack house fresh dates production (M. US$)		6.28	7.27	8.37	9.56	10.19	10.84	11.51	12.19	12.89

9.3.5. Summary of the Costs of Interventions

Table-66 summaries the yearly costs stream associated to various interventions introduced in the Dates cluster.

Table 66: Gross Value of Expected Costs (M. US$) of Dates Cluster Development Interventions in the Focal Point of Balochistan Cluster

Items	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Intervention-1: Orchards' renovation	2.947	5.893	8.840	11.786	14.733	4.446	4.620	4.795	4.969	5.143
Intervention-2: Improved management practices	-	6.429	12.858	19.288	25.717	25.717	25.717	25.717	25.717	25.717
Intervention-3: Controlling post-harvest losses	-	9.147	18.294	27.441	36.587	36.587	36.587	36.587	36.587	36.587
Intervention-4: Value addition by solar tunnel dates drying	-	0.165	0.383	0.661	1.007	1.073	1.141	1.212	1.283	1.357
Intervention-5: Introduction of dates packhouses	-	6.275	7.272	8.367	9.564	10.195	10.843	11.508	12.190	12.889
Total (M. US$) =	2.947	27.909	47.647	67.542	87.607	78.020	78.912	79.824	80.754	81.702

9.3.6. Net Economic Benefits after Offsetting Direct Value Chain Costs of Development Interventions

Table 67 pertains to the yearly stream of net-economic benefits after offsetting the direct value chains costs incurred for the development of Dates cluster in Turbat and Panjgur Districts of the Balochistan.

Table 67: Net-Economic Benefits after Offsetting the Direct Value Chains Costs of Development Interventions in the Focal Point of Balochistan Cluster

Items	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Total expected gross returns from dates cluster development in Bal. (M. US$)	-	42.579	59.194	76.833	95.511	102.269	109.095	115.987	122.944	129.966
Gross costs to be incurred on cluster development interventions in Bal.(M. US$)	2.947	27.909	47.647	67.542	87.607	78.020	78.912	79.824	80.754	81.702
Net-economic benefits (M. US$)	-2.947	14.669	11.547	9.291	7.903	24.250	30.183	36.163	42.190	48.264

9.3.7. Investments Need to be Made for Cluster Development

In order to improve the sample Dates cluster, public investment under project approach is needed. As all the above calculations are made on the basis of a 5-year project, therefore, the year stream of investments required for all the six proposed interventions is given in Table 68.

Table 68: Public Investment (US$) Needed for the Development of the Focal Point of Balochistan Cluster

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5
Improving the research infratsructure & oper.	800,000	320,000	120,000	120,000	120,000	120,000
Capacity Building and FEGs for improved management practices	887,904	355,161	266,371	133,186	88,790	44,395
Investments required on orchard renovation	21,296,903	4,259,381	4,259,381	4,259,381	4,259,381	4,259,381
Investment required on certified nursery estab	1,857,037	464,259	464,259	464,259	464,259	
Investments required on pack house	14,173,290	9,333,630	1,497,990	1,613,220	1,728,450	
Investment requied for solar dates dryers	17,652,413	11,589,698	1,839,351	2,017,929	2,205,436	
Investments required on Marketing/Export level interventions	37,037	14,815	11,111	5,556	3,704	1,852

Government loans on private investments	3,659,956	2,406,183	383,794	417,582	452,397	-
Total Investments needed on the cluster	60,364,540	28,743,127	8,842,257	9,031,112	9,322,416	4,425,628

9.3.8. Economic Viability of Dates Cluster Development Plan

In Table 69, the discounted value of stream of investments incurred under project approach and the net-benefits achieved by the farming and non-farm business community are estimated on yearly basis. It revealed that the Internal Rate of Returns (IRR) for the dates cluster development in Turbat and Panjgur Districts is 32.57 percent clearly indicating an economically viable project. It clearly implies that it is clearly worth investing into the cluster for the uplift of the dates production in the area through various proposed farm, domestic and international marketing level investments.

Table 69: Net-Present Value and Internal Rate of Returns of Costs and Investments Incurred in the Focal Point of Balochistan Cluster

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
Overall net-benefit after deducting all costs & investments incurred in the cluster from the stream of benefits (M. US$)	161.149	-31.690	5.827	2.516	-0.032	3.478	24.250	30.183	36.163	42.190	48.264
Discount rate	8.50%										
Net-present value (US$)	72,338,729										
Internal Rate of Returns (%)	32.57%										

10. CONCLUSION

Date palm is an important fruit crop for Pakistan, particularly for the dwellers of marginal areas in all the four provinces of the country for food security and rural employment concerns. Its production in Pakistan seems in crisis during 2001-17 because of its declining production. Trade in dates, however, seems to perform relatively well during the period because of the expansion in the export of dates at quite a high rate. The export of dates from Pakistan has reached to US$108 Million in 2017. However, such a high growth in the export of dates is not sustainable because of its declining per ha yield in the country. Expansion in export along with declining production has reduced the per capita consumption of dates in Pakistan by about 42%, which cannot be continued unabated as Pakistani people do like to consume dates especially in the month of Ramadan and during marriage ceremonies. The declining in productivity, production, per capita availability vis-à-vis improvement in growth in trade and rising influx of fresh dates from Iran, Iraq and other countries is quite worrisome for the research, policy and development practitioners in the country. On the other hand, Pakistani yield is now 13% lower than the world average yield. Moreover, Pakistani dates in international markets fetch only 60% of the world average export price indicating issues in its value chain resulting in poor quality dates.

The purpose of the analysis in this study was to conduct end-to-end analysis of the entire value chain of dates including production, marketing, value addition, processing, and trade, identify the gaps and potential along the chain, and suggest economically viable policy, technological, and institutional interventions to enhance the competitiveness of Pakistani dates in international market. This analysis is conducted on cluster basis to incorporate the regional variation in production, marketing, and processing opportunities in each cluster while suggesting interventions along the value chain.

To achieve the objectives of the study, a large number of stakeholders along the dates value chain were consulted, data related to dates production, marketing, trade, etc. were analyzed, and literature were reviewed. An MS-EXCEL sheet based model was also developed to estimate the economic feasibility of various interventions in each cluster. Based on the available district-level production data, three dates producing clusters i.e., Sindh Cluster, Balochistan Cluster and Punjab Cluster are identified for detailed analysis.

In consultation with stakeholders, several challenges of dates industry of Pakistan from production to harvesting and marketing are identified. On production side, water scarcity especially in Baluchistan dates cluster, traditional methods of spathes selection and pollination, non-covering of fruit bunches during rainy season (rather than preferring to pick for making *chohara* or other low quality/price fetching products), fruit bunch pruning, dates drying under the open sky, weak research and extension capacities, absence of the mechanism to replace old with new high-yielding varieties and lack of nurseries with certified mother-blocks are the main challenges. Lack of processing infrastructure at village level and capacity to operate these infrastructure are the main issue on processing side. On marketing side, lack of value chain segments including farm-level cold storage, improper packing and presentation are major constraints, which eventually lead to selling of our dates low-end markets in the world. Secondly, Pakistan was historically heavily relying on dry dates export

to India, and future prospects of this market are also gloomy, in view massive dates plantation in desert ecologies along with Pakistan's borders.

To overcome these issues, this study suggests interventions at the cluster level for making the dates a competitive and export oriented commodity of Pakistan. These interventions includes renovation of old gardens with high-density quality producing dates orchard, introducing improved management practices, general improvement in the quality of dry and fresh dates produced, linking traders with international markets through providing information portals and e-commerce, and incentivizing dates pack-houses and dates drier at the union council level through FEGs. It has been observed that the cost of these interventions will not be too high compared to their returns, thus it will able to pay back the investments made by generating positive Net Present Value (NPV) and Internal Rate of Return in all three clusters under consideration.

All three provincial clusters need due upgradation, but keeping in view the composition of dates varieties grown and agro-ecological conditions. For instance, in Punjab, the degree of harshness in terms of total rainfall in monsoon season is much higher than Sindh and Balochistan. In Balochistan dates growing clusters, the higher rainfall occurs only in August month. In Sindh, the duration of mon-soon rains is considerably long[14]. The proposed cluster development strategy is consisted of renovation of existing orchards with plants of higher yielding, modern and exotic varieties, educating farmers for adopting improved orchard management practices, controlling harvest and post-harvest losses by adopting better pollination strategies and fruit bunch management, shifting to solar tunnel dates drying and employment state-of-the-art packaging technologies. As considerable quantities of our dates are exported, therefore, with these measures, the general quality and presentation of our dates in international market shall improve. Moreover, with improve quality dates, we can explore our space in high-markets in the world, which is now much necessary in view of decline future prospects of exporting dates to India.

In order to achieve the above delineated objectives and implement various interventions, total project investments needed are to the tune of US$4.257 Million for Muzaffargarh cluster in Punjab, US$66.136 Million for Khairpur cluster in Sindh and US$70.129 Million for Turbat+Panjgur cluster in Balochistan. These investments need to be made in area like: i) improving the dates related research infrastructure and operations in provinces; ii) capacity building of the farmers and farmers' enterprise groups; iii) back-stopping support for renovation of existing dates orchards; iv) establishment of certified nurseries in the clusters; v) establishment of pack house facilities in the clusters; vi) provision of solar tunnel dates dryers; vii) linking farmers' enterprise groups and traders with domestic and international markets; and viii) government loans on private investments. It is assumed that in this total investment, about 28% will be borne by the federal and provincial governments, and remaining 72% by the private sector. The federal government will bear 70% of the total cost, while the provincial governments remaining 30% through their respective annual development plans.

[14] Average annual rainfall in Muzaffargarh district is 157 mm, 110 mm in Khairpur, 111 mm in Panjgur and 123 mm in Turbat. However, the total monsoon rainfalls during July-September period in Muzaffargarh, Khairpur, Panjgur and Turbat districts are 88, 63, 32, 29 mm, respectively.

As a result, after the successful implementation of the 5-years long proposed project, it is anticipated that during 10th year, more than 51 thousand tonnes of addition dates shall be achieved from renovated plantation, more than 116 thousand tonnes from the adoption of improved management practices, and above 92 thousand tonnes from the practicing various measures aimed at controlling post-harvest losses. In total, nearly 266 thousand tonnes very high quality dates (*chohara* and fresh dates) shall be available for processing through 214 pack houses. The dates so shall be produced, be able to better prices in both the domestic and international markets. This improvement in production will generate thousands of additional jobs in rural areas.

As far as 5-year project investments are concerned, in total above US$108.144 Million investment is needed with provincial distribution as US$4.257 Million for Punjab, US$43.523 Million for Sindh, US$60.364 Million for Balochistan clusters. As all the proposed interventions are individually economically viable in all the provincial dates clusters, therefore, their net present values (NPVs) were US$ 11.678 Million, US$145.653 Million, US$161.149 Million, respectively. The overall Internal Rate of Return (IRR) for these clusters was estimated 26.12%, 37.26% and 32.57% for Punjab, Sindh and Balochistan clusters, respectively. This clearly implies that it is profitable to invest in dates clusters of all three provinces of the country. Moreover, it shall also provide income and employment generating opportunities for the local dwellers.

To make this initiative successful, it is imperative to adopt the integrated cluster approach by strengthening the date palm related research facilities, mobilize provincial extension to enable them to build capacities of all stakeholders along the value chain, organize Farmers' Entrepreneur Group (FEGs), and arrange loans so that stakeholders can fund the additional operational costs induced by the upgradation investments.

11. ANNEXURES

Annexure 1: List of Stakeholders consulted

Sr. No.	Name	Date Visited	Stakeholder	Telephone number	District
1	Haji Mohammad Umar	10/10/2018	Farmer	0321-3672685	Turbat
2	Mr. Mohammad Yousaf	10/10/2018	Farmer	0322-3922047	Turbat
3	Mr. Ghulam Mohammad	10/10/2018	Farmer	0322-8265699	Turbat
4	Mr. Noor Mohammad Baloch	04/10/2018	DG Agriculture Research Sind	0300-8995717	Karachi
5	Haji Abdul Haleem	06/10/2018	Farmer	0300-3143622	Khairpur
6	Dr. Atiq Ahmad Alizai	10/09/2018	Assistant Professor Gomal University	0321-9602847	D.I Khan
7	Mr. Imranullah	10/09/2018	Research Institute	0344-8705158	D.I. Khan
8	Mr. Mohammad Iqbal Baloch	10/09/2018	Farmer	0341-9776970	D.I. Khan
9	Mr. Zamir Khan Kanju	10/09/2018	Farmer	0346-5558158	D.I. Khan
10	Hafiz Abdul Ghafar	10/09/2018	Farmer	0301-8797124	D.I. Khan
11	Mr. Mohammad Iqbal	10/09/2018	Farmer	0343-8961406	D.I. Khan
12	Mr. Waheed Ahmad	05/10/2018	V. President of F&V Exporters	0321-8272772	Karachi
13	Zamir Khan	10/09/2018	Trader	0346-5558158	D.I. Khan
14	Mr. Mohammad Iqbal Baloch	10/09/2018	Nursery business	0336-7221626	D.I. Khan
15	Mr. Mohammad Naeem Baloch	19/10/2018	Directorate of Agri. Research	0336-2600377	Turbat
16	Mr. Imranullah	10/09/2018	Agriculture Research Institute	0344-8705158	D.I. Khan
17	Dr. Abid	25/08/2018	DG Punjab Agriculture Research	0300-5478226	Faisalabad
18	Mr. Mohammad Ikhlaq	25/08/2018	Horticulturist, HRI, Bahawalpur	0333-6446033	Bahawalpur
19	Mr. Inam	15/10/2018	BARI Chakwal	0331-5243923	Chakwal
20	Mr. Ahmad Raza	15/08/2018	Secretary Agri. & Coop, Balochistan	0300-9384865	Quetta
21	Mr. Inam Ulhaq	17/08/2018	DG Balochistan Agri. Extension	0336 8313554	Quetta

22	Agha Zaheer Uddin	04/10/2018	Secretary Agri. Department Sind	0300 2555688	Karachi
23	Mr. Noor Mohammad Baloch	04/10/2018	D. G. Agriculture Research Sindh	0300 8995717	Karachi
24	Dr. Syed Allah Dino	06/10/2018		0300 3551849	Sukkur

Annexure 2. List of References

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Annexure-3: Farm size composition of different focal districts in dates clusters if Punjab, Sindh and Balochistan

District	Marginal (upto 5 acres)	Small (> 5 ac. - 12.5 ac.)	Medium (> 12.5 ac - 25 ac.)	Large (> 5 ac. - 12.5 ac.)	Landlords (> 12.5 ac - 25 ac.)	Total
Muzaffargarh						
Farming population - Numbers Percent	205366 (70.1%)	66908 (22.8%)	15904 (5.4%)	3766 (1.3%)	902 (0.3%)	292846 (100.0%)
Farming Area - Area (acres) Percent	325788 (25.2%)	493368 (38.2%)	263178 (20.4%)	115209 (8.9%)	94651 (7.3%)	1292194 (100.0%)
Khairpur						
Farming population - Numbers Percent	89688 (73.3%)	26686 (21.8%)	4729 (3.9%)	905 (0.7%)	392 (0.3%)	122400 (100.0%)
Farming Area - Area (acres) Percent	169984 (33.6%)	203735 (40.3%)	79598 (15.7%)	27056 (5.3%)	25765 (5.1%)	506138 (100.0%)
Sukkur						
Farming population - Numbers Percent	21793 (58.6%)	10947 (29.4%)	2524 (6.8%)	1215 (3.3%)	716 (1.9%)	37195 (100.0%)
Farming Area - Area (acres) Percent	49130 (16.6%)	88695 (30.1%)	40796 (13.8%)	36766 (12.5%)	79761 (27.0%)	295148 (100.0%)
Turbat						
Farming population - Numbers - Percent	5909 (52.1%)	3049 (26.9%)	1163 (10.3%)	687 (6.1%)	536 (4.7%)	11344 (100.0%)
Farming Area - Area (acres) - Percent	12730 (8.4%)	23457 (15.5%)	19815 (13.1%)	21898 (14.5%)	73435 (48.5%)	151335 (100.0%)
Panjgur						
Farming population - Numbers Percent	198k (36.2%)	1848 (33.6%)	915 (16.7%)	545 (9.9%)	197 (3.6%)	5492 (100.0%)
Farming Area - Area (acres) Percent	5212 (7.6%)	14546 (21.3%)	15749 (23.1%)	16856 (24.7%)	15945 (23.3%)	68308 (100.0%)

Annexure-4: Itemized distribution of high priced date orchard plantation

Sr. #	Cost items	Improved Management practice
1.	Row x Row Distance (Feet)	14.75
2.	Plant x Plant Distance (Feet)	14.75
3.	Area of Acre	43,560 ft^2
4.	Total Number of Plants/Acre	200
5.	Total Number of Plants/Ha	500
6.	Mortality Allowance	5%
7.		
8.	Price per 100 Plants (US$)	500
9.	Plants cost per ha (US$)	2,630
10.	Labor Cost/Ha (US$)	200
11.	Layout + irrigation system (US$)	1,500
12.	Total Orchard Establishment Cost/Ha (US$)	4,330

Sr. #	**Cost items**	**Improved Management practice (US$/ha)**	**Current management practice (US$/ha)**
1.	Labor cost	111	50
2.	Fertilizer Cost (Macronutrients)	111	50
3.	Fertilizer Cost (Micronutrients)	111	0
4.	Farm Yard Manure	185	93
5.	Sprays	93	0
6.	Total Management Cost/ha	611	193
7.	Increase in Cost	3.17	

Annexure-5: Feasibility Study for Dates pack house

Pakistan is the fifth largest producer of dates (*Phoenix dactylifera L.)* or 'Khajoor'. Dates have vast potential of export; the major countries importing both fresh and dried dates from Pakistan are India, USA, UK, Canada, Germany, Denmark, Malaysia and Indonesia. However, efforts are required to apply post-harvest management and processing techniques to qualifying the international standards. The polluted dates with mud which is mostly present on the packed Pakistani dates was due to the poor handling of fruit during harvest rather than processing. There are few plants working on dates processing at the "Khairpur", however, the standards of the processed dates in these processing units need to be improved. It is one of the challenges in front of the industry to increase the price of Pakistani dates to resist the competent prices of the international market. But, fund is still the main hindrance facing the research institutes to continue in this sector and conduct the required research whether on the product of current plants or establish a world-model small processing plant. Prices of early season dates are always expensive than the mid-season dates. Handling the crop after harvest is lacking the experience. Subsequently the microbial load of the dates was dramatically increased before processing and storage which caused problems for processors. Processing of such dates can be improved through a good treatment for curing away from boiling process for *Chohara* making. Subsequently, grading the fruit according to their size is very important for marketing. There are nowadays modern machines available for dates processing.

Objectives

The objective of this feasibility study is to provide information to future investors regarding

Low cost Preservation of dates and

- Storage of dates by cleaning, Insect pest and diseases inspection, grading, sorting, quality control, packing, cooling, food safety, loading etc.

The diagrammatic process flow is described below;

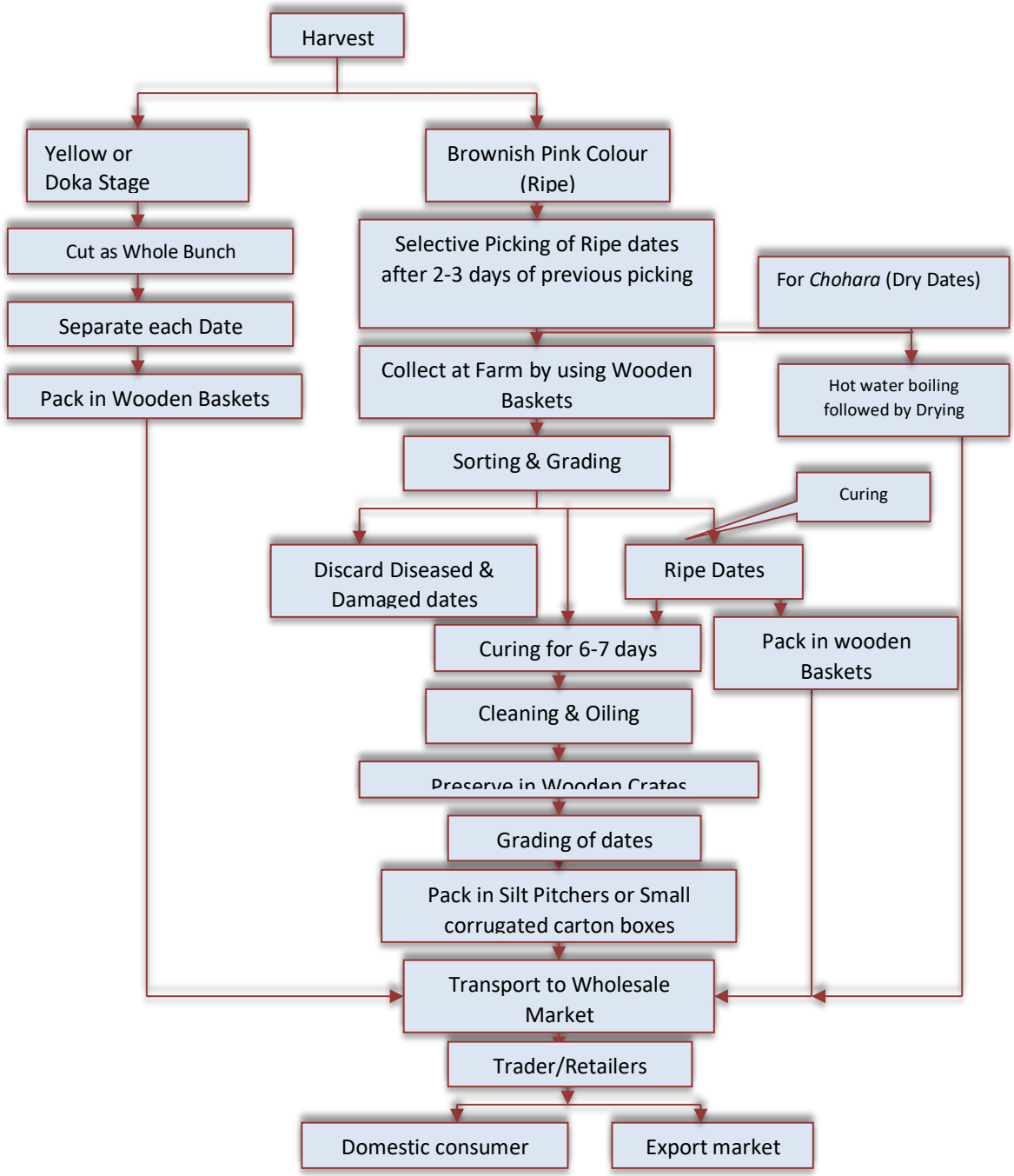


Figure 3: Process flow of post-harvest handling of dates

Packing Process

For designing a pack house following stages are required to be considered in general:

- ***Step One***

The first step is to know what the volume of dates will be processed during the season. This will determine what equipment will be needed and how big the building and cold storage should be. An important consideration for the packing shed location is the nearness to the production field and access roads. Since the packing shed is usually in operation during the hot summer months, a site with shade would be beneficial, although this may not be feasible

for a large operation. To keep the building cool, good ventilation and fans will be needed. Insulation will also help keep the building cool.

- ***Step Two***

Next, develop a flow diagram of all the post-harvest handling processes, which will be used with each crop. This diagram will help with the layout development of the packing shed.

The produce should always move in one direction, with no crossovers of the product from each step in the packing operation. This has become more important, as fresh produce handling methods must now include procedures and practices to prevent the spread of pathogens. Since there are no steps, like heating, to eradicate pathogens, action must be taken to prevent contamination and recontamination. There should be one door for receiving produce from the field, and one door for shipping packed produce out.

- ***Step Three***

Arrangements must be made for a good water source and adequate utilities. Water used to wash the produce must be potable (safe to drink). An approximately 2-inch main water line with 1-inch laterals is recommended. The floors should be sloped to 6 inches wide drains that are 6- to 8-inches deep. Hot water is needed for cleanup and workers' personal hygiene. The produce washing water should be chlorinated from 100 to 200 ppm. This recommended level kill pathogens that cause produce decay. However, it is not high enough to kill some food borne pathogens. The chlorine level should be checked throughout the day. As time passes, chlorine ions bind to organic matter and lose their effectiveness. Chlorination can be done by using household bleach, swimming pool chlorine or injection of compressed chlorine gas into the washing water. If a dump tank is used, the water should be changed frequently, especially if root crops or ones that had contact with the ground are being packed. Dirty water creates dirty produce.

Special attention needs to be given to the electrical requirements of the packing shed. It may be housing automated washing and sizing equipment, precooling facilities and cold storage units. The refrigeration equipment for the cold storage and chilling water for hydro-cooling often requires 3-Phase electrical power.

- ***Step Four***

The disposal of both liquid and solid waste is an important consideration in designing and setting up a packing shed. Maintaining and conserving water quality becomes an issue for produce operations— how to properly handle wastewater from the packing line can also become a problem. Wastewater should never be dumped into the household septic system or the septic system for the toilets, showers and sinks in the packing facility.

The volume of wastewater will overwhelm these systems and reduce their effectiveness. Floor drains will be needed in the facility to carry wastewater to a separate septic field. The solid waste (culled produce) may be composted, spread on fallow fields or sold as animal feed.

- ***Step Five***

Design a receiving area and packing line, which is fit for individual needs. The receiving area should be elevated so that produce can be easily unloaded off the trucks or wagons carrying it from the field.

The height will depend on the vehicles used. Dollies, pallet jacks, and forklifts can then be used to load several harvest containers. The shipping area should also be elevated for easy loading to markets (Figure 2).

Figure 4: Loading Dock

- ***Packing Lines***

The packing line is always multifunctional, regardless of whether it is a sink and table or a high-speed automated conveyor line. Photographs of different types of packing facilities are given below

Figure 5: Large scale packing line

Figure 5: Large scale packing line

Figure 7: Small scale packing line

Below are the parts of an all-purpose packing line:

- ❑ A receiving area, which can include a dump tank to initially clean and cool produce.
- ❑ A washing area, which can include the dump tank and a spray washer/brusher. This can be part of a conveyor belt system that automatically moves the produce, or simply a stock tank. The water used should be chlorinated at 100 to 200 ppm (Figure 8).

Figure 8: Automatic washer

- A drying area for the wet produce.
- Before being packed into containers, produce may be dried on sponges in a conveyor system or on screening tables.
- An area for grading and sizing. Some culling can be done initially in the receiving area, especially if the produce is diseased, low grade or deformed. This can be a large table where produce can be spread out for inspection, a rotating table or conveyor belt with a seizer.
- An area for packing produce into shipping, holding or marketing containers. This is often done in conjunction with grading and sizing.

There are specialized pieces of equipment for specific crops.

- Apples, citrus, cucumbers, peppers and tomatoes are waxed to limit water loss for the wholesale market—therefore, these need a waxer.
- Although wholesale containers are a prescribed size for each type of fruit or vegetable, most are either sold by weight or must be a minimum weight.
- Scales must be certified by Department of Agriculture Division of Weights and Measurements.
- After produce has been packed into shipping containers, the container should be labeled with what it is; the size, count or net weight; grade; the shipper's name and address; the dates packed and a tracking code that incorporates the harvest dates, bin number, packing time, packer number, inspector number and gassing room number for tomatoes and Honeydew melons.

Components of a Packhouse

Apart from main packing lines, the following facilities are also required to be made part of pack house for its proper management and handling practices.

- Product arrival and Pre cleaning/sorting
- Main grading washing and packing hall
- Cold storage

Product arrival and Pre-cleaning/sorting

The amount of heat in produce is governed by the temperature around it. The temperature difference between newly harvested produce and its optimum storage temperature is an indicator of field-heat. Rapidly lowering the temperature of harvested produce to near storage

temperature is known as pre-cooling, or removal of field-heat. Produce is usually pre-cooled to 78 or 88 percent of the temperature difference. Additional cooling is limited by the time and energy required to reduce the produce temperature to the optimum storage temperature.

Pre-cooling equipment and procedures need to be incorporated into the packing shed design. Packed produce should pass quickly and efficiently from the packing line to the pre-cooling area. Removal of field heat from the produce is important to prolong and maintain its post-harvest life.

Many methods are available to pre-cool fruits and vegetables. It is essential to rapidly cool produce to optimum storage temperature. Studies shown that pre-cooling greatly increases produce storage life. Without pre-cooling, many common fruits and vegetables would not be available in quantity and quality. Cold storage slows produce respiration and breakdown by enzymes, slows water loss and wilting, slows or stops growth of decay-producing microorganisms, slows the production of ethylene, the natural ripening agent, and “buys time” for proper marketing. Metabolic activity of fruits and vegetables produces heat. Produce also stores and absorbs heat. The objective of optimum storage conditions is to limit the production, storage and absorption of heat by produce.
Following are the most common pre-cooling methods used internationally:

- Room Cooling
- Hydro-cooling
- Evaporative Cooling

If hydro cooling is used, special attention must be made to how the cooling water is managed. If the water source can supply both the packing line and the hydro-cooling, then where and how the waste water will be disposed needs to be addressed and dealt with.

If air-cooling is used, extra cold storage units and high-capacity refrigeration units will be needed. Cold storage is the last stop before the produce is shipped to market. For a small grower who markets what they pack daily, this may be just a cool corner by the door before it is loaded for market.

Refrigerated cold storage is recommended if the produce is not marketed every day. It should be close to the shipping area.

Main grading washing and packing hall:

The main grading washing and packaging hall is the place where most of the operation will be conducted. A proposed layout of the facility is attached as under;

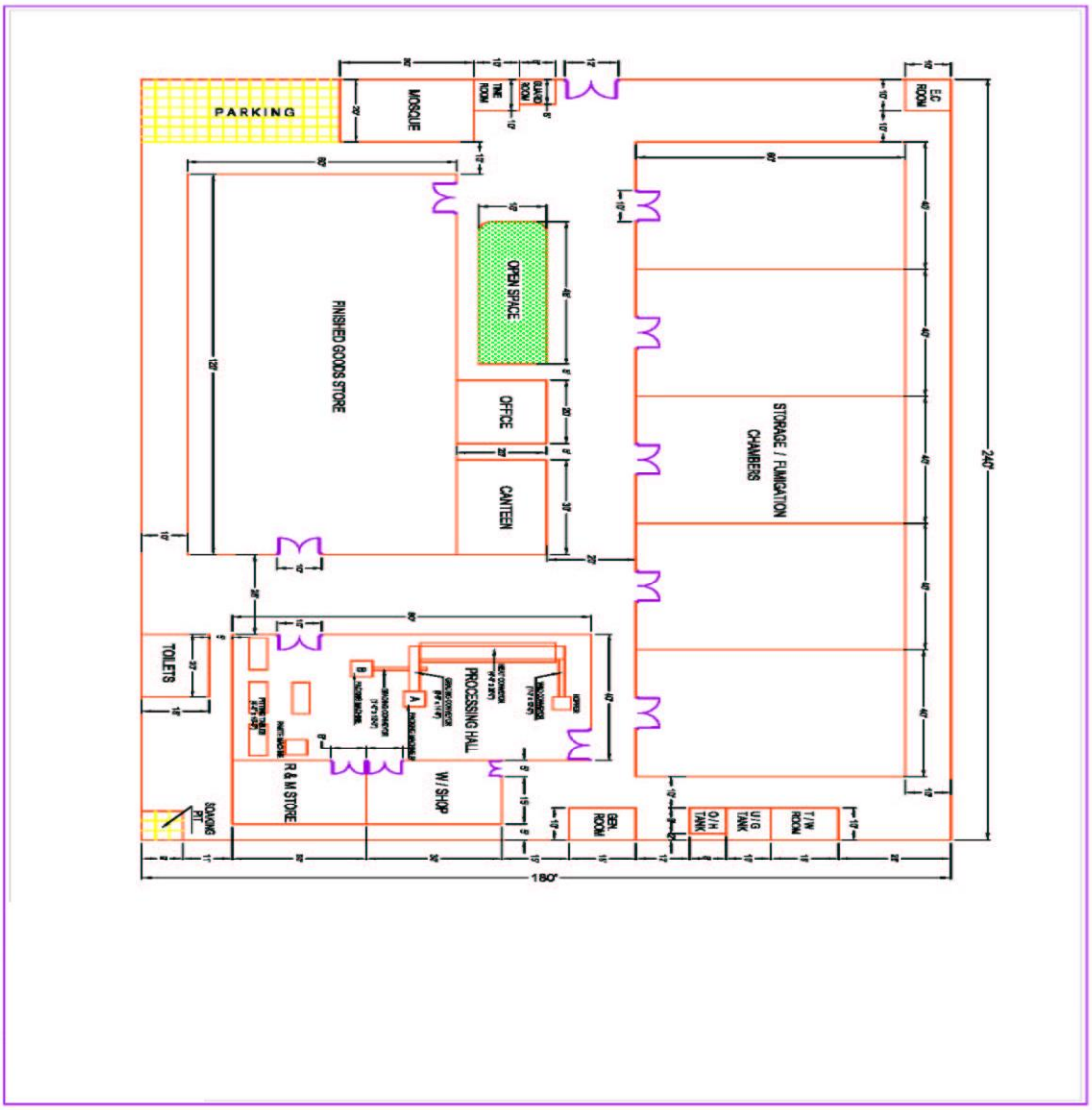


Figure 9: Map of the dates packhouse

Machinery and Equipment:

Selection of plant and machinery is the most important decision for setting up a food processing unit. All machinery and equipment used in the processing line should have proper efficiency. All the plant and machinery should be erected in such a way that the material flow is unidirectional to avoid cross contaminations. The machinery should not occupy more than 1/3rd of the total floor area for smooth operation of labour.

1. Chain Pulley Block
   - Capacity: 5 Tonne
   - Supplier: Max Industries, India
   - Supplier Product Code: HH2050
   - Price: US $1200
   - Power Source: Hand Pulled
2. Motorized Conveyor for Bulk Material Handling
   - Supplier: AMC System Technology (Suzhou) Co., Ltd
   - Model No. – AMCRL006

- Dimension (L*W*H) – Customized
- Voltage – 110V/220V/380V
- Power – 1500 W or Customized
- Capacity – 1500kg or customized
- Price – US $1300

3. Hydraulic Pallet lift (manual)
   - Supplier: Baoding Dali Hoisting Machinery Co. Ltd
   - Model No. – PDL -3T hand Pallet
   - Price – US $250
4. Box Strapping Machine
   - Supplier: Henan Bedo Machinery Equipment Co. Ltd
   - Model No. – BD-001
   - Voltage – 220V
   - Power – 50 KW
   - Price – US $250
5. Electronic Weighing Machine
   - Supplier: Yuvo
   - Model No. – 730
   - Voltage – 220V
   - Capacity – 1500kg
   - Price – US $900
6. Shrink Wrapping Machine
   - Supplier: Ruian Yongxin Machinery Factory
   - Model No. – BTH 450 + BM500L
   - Dimension (L*W*H) – 3850*1500*1300mm
   - Voltage – 220V/380V
   - Power – 50Hz
   - Price – US $3000
7. Grading and Sorting Table
   - Supplier: Tianjin Sure International Trading Co. Ltd
   - Model No. – Sure -CBM
   - Dimension – 1000 - 10000mm
   - Voltage – Customized
   - Power – 0.18 – 2.5KW
   - Price – US $ 3000
8. Platform Type Scales
   - Supplier: Sanghai Uni-weigh System (Tech)Co. Ltd
   - Price – US $ 1700
9. Tray Wrapping Machine
   - Supplier: Shandong China Coal Group Ltd
   - Model No. – HW450
   - Dimension – 540*680*200mm
   - Voltage – 220V
   - Power – 270W
   - Price – US $ 1800
10. Hot Air Dryer
    - Supplier: Henan Xingyang Mining Machinery Manufactory
    - Model No. – ZT
    - Dimension – Depends on the model
    - Voltage – 380V
    - Price – US $ 8,000
11. Washer

- Supplier: Zhengzhou Azeous Machinery Co. Ltd
- Model No. – AUSNW
- Dimension (L*W*H) – 3800*760*1200mm
- Voltage – 380v/50hz/3phase
- Power – 3.5KW
- Capacity – 500kg – 4000kg/hr
- Price – US $ 7000

12. Small cold store
    - Supplier: Taizhou Nimbus Machinery Co. Ltd
    - Price – US $3400

Table 70: Pack house project summary

Plant capacity	10 Tonnes per day; 900 tonnes annually
No. of shifts	One (8 hours per shift) per day
Working days in a year	90

Capital Costs:

For building and civil work about 6,000 sq. feet of land will be required for this project and built up area required will be 1500 sq. ft. consisting of production hall, washing, packaging, storage etc. The cost of building and civil work would be US$16000 at a rate of US$10/square feet

Plant and Machinery:

The cost of plant & machinery is estimated at US$ 59100 including installation and commissioning. The installed production capacity will be 10 tonnes per day. The cost estimates for plant & machinery will be worked out based on the cost figures available from budgetary offers and/or orders placed for similar items in the recent past, duly updated to cover the price escalation in the intervening period.

Table 71: Plant and Machinery

S. No.	Particulars	Qty.	Rate (US$)
1.	Solar generator	1	8900
2.	Chain Pulley Block	1	1200
3.	Motorized conveyor for bulk material handling	1	1300
4.	Hydraulic pallet lift manual	1	250
5.	Box strapping machine	1	250
6.	Electronic weighing machines (1500Kg.)	1	900
7.	Shrink Wrapping Machine	1	6000
8.	Grading & Sorting Table	1	3000
9.	Inspection Tables	3	300
10.	Platform Type Scales (30kg)	2	1700
11.	Platform Type Scales with Printer (15 kg)	10	150
12.	Platform type scales (120 kg)	5	100
13.	UPS for above Machines	5	200
14.	Tray Wrapping Machine	1	1800
15.	Hot Air Dryer – for Removing water applied Externally	1	8000

16.	Waxing Unit	1	2500
17.	Washer	1	7000
18.	Automatic vegetable grading and sorting line (1 tonne per hour)	1	15000
19.	Packaging machine, Pouch sealing machine	1	170
20.	Cold Storage	1	7000
21.	PU Building for Pack house (1500 sq. ft.)	1	16000
22.	Ethylene Generator 3 nos. (Sure Ripe)	1	200
23.	Ethy-gen II Concentrate (45 cases)	1	200
24.	Gastech. Air Sampling Kit Unit 1 no. 1	1	180
25.	Ethylene Monitoring Tube - 1 Box	1	180
26.	Carbon di-oxide Monitoring Unit	1	400
27.	1 0.04 0.04 30 Additional Dryers for Removing Moisture- 1MT Per Day	1	120
28.	Pallets and Bins		3000
	Total		**86000**

Misc. Fixed Asset Costs:

US$ **21500** has been estimated under the heading of miscellaneous fixed assets. The details of electrical installations for power distribution have been considered commensurate with the power load and process control requirements. Other miscellaneous fixed assets including furniture, office machinery & equipment, equipment for water supply, office stationery, telephone and refreshment, workshop, fire-fighting equipment, etc. will be provided on a lump sum basis as per information available with the consultants for similar assets. The details of miscellaneous fixed assets and their associated costs are shown in table below:

Table 72: Miscellaneous fixed asset cost

S. No.	Particulars	Qty.	Rate (US$)
1.	Office Equipment	1	2000
2.	Furniture and Fixture	1	3000
3.	Miscellaneous Accessories	1	2000
4.	Vegetable Display Crate	50	150
5.	Display Board	5	50
6.	Fire Fighting	1	50
7.	Computer with Accessories	2	1000
8.	ERP System	1	10000
9.	Water Treatment Plant – 500 litres per hour	1	1000
10.	Loading Tempo	1	250
11.	Electrical and water pipes Installation	1	2000
	Total		**21500**

Pre-Operative Expenses:

Expenses incurred prior to commencement of commercial production are covered under this head that total US$ **31700.** Pre-operative expenses include establishment cost, rent, taxes, traveling expenses and other miscellaneous expenses. It has been assumed that the funds from various sources shall be available, as required. Based on the project implementation schedule, the expected completion dates of various activities and the estimated phasing of

cash requirements, interest during construction has been computed. Other expenses, under this head have been estimated on a block basis, based on information available for similar projects.

Table 73: Pre-Operative Expenses

Sr. No.	Particular (for 1 year)	Amount (US$)
1.	Interest up to production @ 16% on term loan amount of US$ 52600 **(30% of total project cost)**	15780
2.	Electricity charges during construction period	1200
3.	Marketing Launch Expenses	1000
4.	Technology Know-how and consultancy fees	5000
5.	Training expenses	1500
6.	Travelling Expenses	1000
	Total	**31700**

Cost of raw material:

Based on a processing capacity of 10 tonnes per day taking into account and 90 days of working per year, the annual raw material consumption of the pack house is 900 tonnes. The cost of fresh Dates based on its average selling price as determined through interview with randomly selected farmers and converting it into US$ (with conversion rate of one US$=135) is $167/tonne. Adding US$20 per tonne transportation cost from the field to pack house, the raw material cost for pack house would be US$400.

Table 74: Cost of raw material

Particulars	Rate per tonne (US$) for the raw carrot and turnip at the wholesale/pack house	Qty. (Tonnes) per season	Raw material cost (US$)
Dates	400	900	657,000

Land Lease Charge:

Required land is 6,000 sq. ft. which has been considered on lease @ US$200 per annum for first three years and @ US$200 for the fourth year and subsequently @ 5% increase every year.

Table 75: Land lease charges

S. No.	Year	Lease charges Per annum (US$)
1.	1st year	300
2.	2nd year	300
3.	3rd year	315
4.	4th year	331
5.	5th year	347
	Total	**1593**

Electricity and Water Consumption Charges:

The unit cost of electricity has been considered @ PKR.20.70/ unit assuming that the entire power requirement is met from the grid. A power supply of 60 KVA is deemed appropriate. The expense on water supply, treatment and distribution has been suitably considered, based on the tariff by water and sanitation agency (WASA) for per month consumption of water tariff of @ 92.82 PKR/thousand gallons. Water requirements are approximately 500 gallons per day.

Table 76: Electricity and water consumption charges

S. No.	Description	Amount Per Annum (US$)
1.	Power Consumption	4000
2.	Water Consumption	200
	Total	**4200**

Human Resource Cost

One pack house manager, one accountant for six months, one supervisor for six months technical staff Salaries & wages (including benefits) for different categories of employees have been considered based on present day expenses being incurred by other industries in the vicinity. The breakdown of manpower and incidence of salaries & wages are detailed in the table Salary & Wages. Salary & wages are increased @ 5% every year

Table 77: Salary and wages

Sr. No.	Description	Requirement	Salary/month (US$)	Salary/annum (US$)
1.	Packhouse manager	1	750	9000
2.	Accountant	1	520	6240
3.	Supervisor	2	740	8880
4.	Skilled Workers	4	1200	1440
5.	Driver	1	370	4440
6.	Security Guard	1	225	5400
	Total		**3805**	**48360**

Table 78: Cost of Project

Sr. No.	Particular	Value (US$)
	Fixed costs	
1.	Plant and Machinery	86000
2.	Misc. Fixed Assets	21580
3.	Pre-operative expenses	52600
	Operating costs	
1.	Cost of raw material	657000
2.	Land lease charges	1593
3.	Electricity and water consumption	4200
4.	Salary and wages (For 180 days)	48360
5.	Margin Money for Working Capital	1500
6.	Contingencies 5% of Fixed Assets	2158
	Total variable costs	**874,991**

Table 79: Project Income Statement

Revenues	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue (US$)						
Quantity of Dates that goes in value addition or capacity of pack house (tonnes)		900	900	900	900	900

Price of the value added Dates (US$/tonne)		730	730	730	730	730
Total revenues (US$)		657000	657000	657000	657000	657000
Direct varaible Costs						
Raw material price (US$/tonne)		400	400	400	400	400
Raw material cost (us$)		360000	360000	360000	360000	0
Packing costs (@PKR10 per 1 kg box)		6667	6667	6667	6667	
Labor cost		48360	48360	48360	48360	
Electricity and water		4200	4200	4200	4200	
1601	1601	1601	1601			
Land lease charges (5%) increment on annual	300	300	315	331	347	
Marketing (US$10/tonne)		9000	9000	9000	9000	
Office administration		370	370	370	370	
430898	430913	430929	430945	400		
Gross profit		226102	226087	226071	226055	656600
Indirect fixed cost						
Machinery	-160100					
Licensing and regulatory fee	-150	0	0	0	0	
Total	**-160250**	**0**	**0**	**0**	**0**	
Grand total cost	**-160250**	**430898**	**430913**	**430929**	**430945**	**0**
Net profit (Net cash flow)	**-160250**	**226102**	**226087**	**226071**	**226055**	**657000**
Discount rate	8.5%					
NPV		937,542				
IRR		144%				

Net profit (Net cash flow) = 657,000
NPV = 937,542
IRR = 144%

Project Viability:

The Internal Rate of Return of the project is estimated at **144**%, which is significantly higher than the bank return rate of 16%. Hence, the project is deemed financially viable. The NPV of the project is positive (US$**937,542**) at a discount factor of 16% during the first 5 years of operation considered. This implies that the project generates sufficient funds to cover all its cost, including loan repayments and interest payments during the period. This also indicates that the project is financially viable over the long term.

Annexure-6: Dates drying units (*Chohara* making)

There is no statistics available that exactly how much fresh dates fruit is destined for *Chohara* making (drying). However, it has been estimated that about 70-80% of fresh *Dhakki* dates of D.I. Khan was used for making *Chohara*. But according to researchers and farmers of the area that closer of border business with neighbouring country now most of the fruit is marketed as fresh. However, there still a demand of hygienically produced dates (*Chohara*) does exist. The following figures of solar dryer unit are of a farmer of Khairpur, Sindh who was provided the said solar dryer by the Pakistan Agriculture Research Council. The farmer was satisfied with the performance of said unit.

Figure 10: A duct for solar drying unit

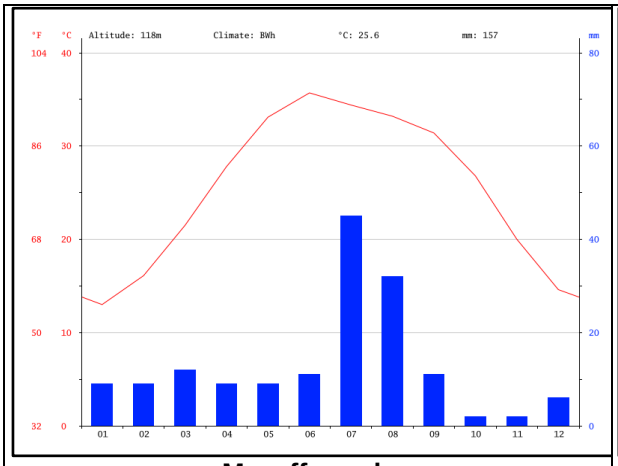
Figure 11: Exhaust duct for solar drying unit.

Figure 12: Dried dates (*Chohara*) by using solar drying unit.

Figure 13: Clean and neat dried dates (*Chohara*).

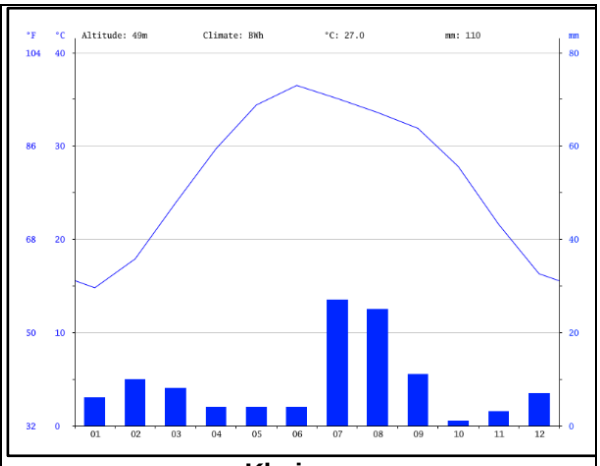
Annexure-7: Temperature and Rainfall Patterns Across Clusters

Average Monthly temperature and rainfall patterns at Muzaffargarh, Khairpur, Panjgur & Turbat



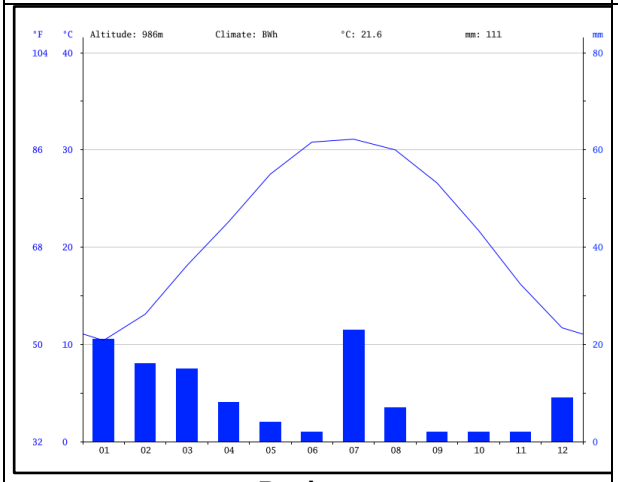
Muzaffargarh

Source: https://en.climate-data.org/asia/pakistan/punjab/muzaffargarh-3082/



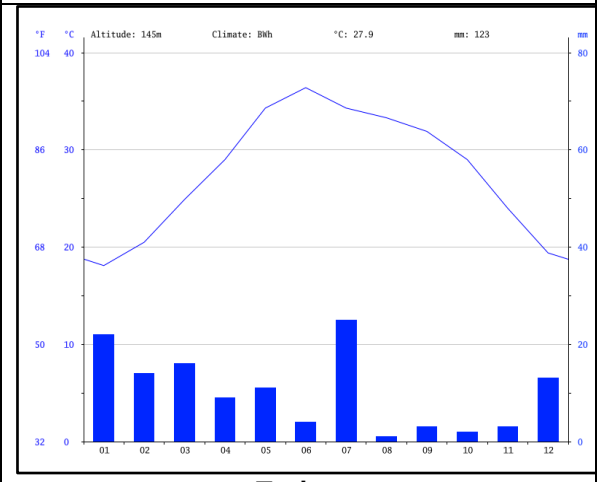
Khairpur

Source: https://en.climate-data.org/asia/pakistan/sindh/khairpur-488253/



Panjgur

Source: https://en.climate-data.org/asia/pakistan/balochistan/panjgur-28812/



Turbat

Source: https://en.climate-data.org/asia/pakistan/balochistan/turbat-28064/