CLUSTER DEVELOPMENT BASED AGRICULTURE TRANSFORMATION PLAN VISION-2025

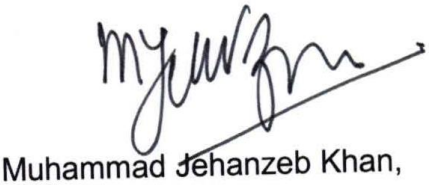
Chili Cluster Feasibility and Transformation Study

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** (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 would like to grateful acknowledge to **Dr. Imran Ali Rajput**, (Research Fellow, PSDP, PARC-AZRI, Umerkot) he has patiently helped me and provided his judicious advices to report writing.

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. Attaullah Khan
The 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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ACRONYMS

ICM	Integrated Crop Management
USAID	United States Agency for International Development.
GDP	Grand Domestic Product
PAC	Pakistan Agriculture Collation
PARC	Pakistan Agriculture Research Council
FAO	Food & Agriculture Organization
ZTBL	Zarai Taraqiati Bank Limited
CDF	Community Development Fund
DoA	Department of Agriculture
CBR	Central Board of Revenue
MoD	Ministry of Defence
AZRI	Arid Zone Research Institute
SARC	Southern-zone Agricultural Research Center
TDAP	Trade Development Authority Pakistan
MNSF&R	Ministry of National Food Security & Research
ADP	Annual Development Plan
EU	European Union
FFS	Farmer Field School
CFEG	Chili Farmer Enterprise Group
GAP	Good Agriculture Practices
GI	Geographical Identification
GoP	Government of Pakistan
ISO	International Standard Organization
Kg	Kilogram
KP	Khyber Pakhtunkhwa
NARC	National Agricultural Research Centre
MINFAL	Ministry of Food, Agriculture and Livestock
NARC	National Agriculture Research Council
NGOs	Non-Governmental Organizations
PARC	Pakistan Agriculture Research Council

PKR	Pakistani Rupee
PHDEC	Pakistan Horticulture Development and Export Company
R&D	Research & Development
SWOT	Strengths, Weaknesses, Opportunities, Threats
UAE	United Arab Emirates
UK	United Kingdom
USA	United States of America
US$	United States Dollar
VO	Village Organization
MDF	Management and development Foundation
SAGP	Sindh Agriculture Growth Program
PAC	Pakistan Agriculture collation
SMEDA	Small and Medium Enterprises Development Authority
SGS	Society General Surveillance
TDAP	Trade Development Authority of Pakistan

Executive Summary

Worldwide chili is cultivated on 1.86 million ha producing 4.63 million tonnes of dry chilies with an average yield of 2.48 tonnes per ha. Pakistan with 158 thousand has under chili cultivation stands at 3rd rank in world chili area while with its production of 143 thousand tonnes, it ranks 4th in production. Pakistan contributes 3.5% to global area under chili cultivation, while its contribution in total chili production is 3.20%. The average chili yield in Pakistan is 2.27 tonne per ha as compared to the world average of 2.48 tonne per ha which is also lower than the neighbouring countries average yields.

The world export of dry chili has reached at 0.71 million tonnes valued at US$1.66 billion. More than one third of the total global production is traded internationally, while Pakistan trades 8% of its production. Pakistan's share in world chili trade is only 0.66%. India is the top exporter of chili earning over US$450 million annually.

The historical trends from 2001-16 has indicated that Pakistan's chili production has been increasing at 1.7% per annum, compared to its population growth rate of 2.1% implying that unless the domestic production rate is increased, Pakistan's chili export will shrink and we even have to resort to its import to meet the domestic needs. Increase in chili production in Pakistan is much lower than that in the world indicating that Pakistan is losing its comparative position in the world chili market. Moreover, growth in per ha chili yield is slow compared to the world average thus the country is also losing its comparative position in international market. Moreover, the growth in Pakistan's export has been stagnated and it earns lower price for its exported chili compared to the world average export price. To address these trends, Planning Commission of Pakistan has launched this study to understand the whole value chain of chili in the regional context. This study first identifies the major chili growing clusters in the country, characterizes the clusters, identifies gaps and opportunities and then suggests viable interventions at the cluster level to improve the competitiveness of chili production in the national and international markets.

Chili cultivation in Pakistan is concentrated in two contiguous districts of Sindh viz Kunri and Mirpur Khas, which are identified as main chili cluster with Kunri tehsil as its centre point in this study. Kunri has biggest chili market in Pakistan and is well connected with other markets in the country.

As part of this study, several performance gaps were identified in the production, processing and trading components of the value chain, specifically with the technology, market structure and availability of input in chili cluster of Pakistan. These include climate change related impacts, such as emergence of diseases and insect pests especially viruses and aflatoxin, increased drying/maturity time etc. At production level, the lack of improved commercial chili cultivars/hybrids to produce high quality marketable produce and poor management practices such as imbalance fertilizer use, injudicious fungicide application etc. which not only keep the productivity low but also increase the production costs. At trade level, little analysis and understanding of international market and un-availability of varieties preferred

in various markets. Ungraded, low quality and highly aflatoxin infested produce reduces the exports. At value chain level, appropriate packaging, storage and transport for trading for the high-value dry chili markets are absent. Moreover, mishandling of chili produce at post-harvest stage causes heavy infestation of aflatoxin which makes Pakistan uncompetitive in chili trade. Compared to the current export of 4.66 thousand tonnes, the country has the potential to export many times more chilies, which would help it earning millions of additional much needed foreign exchange annually.

In order to address multilevel challenges from production to product and market development, benchmarks and performance targets to be set, based on global average for yield, quality and export, the interventions were designed to meet these benchmarks over the period of five years. Based on these parameters and keeping in view the gaps and constraints, specific interventions are proposed for the chili cluster. These interventions includes 20% subsidy on the chili hybrids seed, introducing modern management chili practices, incentivizing private sector to invests on improved value chain management infrastructure like mechanical sun-drying, pack houses etc., promoting contract farming to ensure quality, capacity building of stakeholders for quality management in chili, improving technical and institutional capacities for R&D and coordination among state institution responsible for R&D and trade promotion, promoting best practices such as globally accepted phytosanitary standards and certification regimes, creating enabling policy and regulatory framework, promoting branding and presentation and linking traders with potential markets. These interventions should be initiated by government and executed in collaboration with private sector including farmers, traders and their groups/associations.

Total estimated investment for these interventions to be introduced at the centre points of Sindh cluster in the project mode to be implemented five years is US$15.22 million. Out of this 55% cost will be borne by the government to strengthen R&D on chili value chain, building capacities of the stakeholders to produce and manage the quality of chili in the value chain, provide subsidies on the promotion of modern hybrid seed, mechanized sun-dryers and pack houses and supplying loans for the first year of the establishment of these infrastructure. It is expected that with these incentives, the private sector will bring the remaining 45% investment.

This investment will improve the value chain activities, thus would require additional operation costs to conduct these activities. The value of additional operational cost during the 5th year of the project would be US$24.7 million. These investments and operational costs would generate the gross revenue across the whole value chain amounting to US$38.0 (undiscounted) during the last year of the project. Accounting for all the fixed investment and variable costs including the production, processing and marketing cost over the period of five years, the total present value of economic returns is expected to be $5.7 million within the five year of project life and the estimated Internal Rate of Return (IRR) for Umerkot-Sindh is 34%. The details on the investment on various interventions and their impacts can be seen in the Summary Sheet given below.

To achieve these benefits, the study suggests strengthening the chili research, organizing producers into Framers Entrepreneur Groups (FEGs) and building capacity of farmers and other value chain agents to produce, handle and trade quality chilies in national and international markets.

Summary Sheet of Chili Cluster

	Kunri Cluster
Area under cultivation in focal point (ha)	**13,812**
Total Production (tonnes)	**40,168**
Yield (tonne/ha)	2.91
Area of the cluster (ha)	**28,377**
Production of the cluster (tonnes)	**75,290**
Additional production from enhanced yield –Improved management practices(ton)	13,209
Additional value from increased yield in 5th year – Improved practices (US$)	**9,906,865**
Enhanced marketable production due to reduced PH losses tonne	8,586
Additional value from less reduction in 5th year (US$)	**6,439,462**
Total volume of dry chili produced (tonnes)	3,291
Additional value of dry chili in 5th year (US$)	**5,486,565**
Total expected volume of to be exported (ton)	4,608
Expected additional value from exports in 5th year (US$)	**8,257,165**
Enhanced value of production due to improved value chain-international market in 5th year (US$)	**7,876,693**
Chili processing units required	**36**
Investment (US$)	
Strengthening of chili research	**4000000**
Capacity building/ stakeholders training (US$)	**2250844**
Improved seed supply	**3273956**
Processing level interventions (US$)	**3750319**
Value chain infrastructure (one pack-house each year)	**1000000**
Marketing/Export level interventions (US$)	**400000**
Loans on value chain infrastructures	**546287**
Total investments (US$)	**15221406**
Public Investment (US$ Million)	8.482
Private Investment (US$ Million)	6.739
Economic Analysis (US$)	
Total production increase in 5th year (tonne)	**21795**
Gross revenue (undiscounted) in 5th year	**37,966,751**
Additional operation costs in 5th year	**24,666,485**
Net cash flow (undiscounted) in 5th year	**12,481,777**
NPV	**5,742,661**
IRR	**34%**

1 INTRODUCTION

1.1. Chili sector in Pakistan

Chili (*Capsicum annuum L.*) one of the most important commercial crop of Pakistan belongs to the Solanaceae family which represents a diverse plant group. The genus name *Capsicum* derived from the Latin word '*capsa*' meaning chest or box because of the shape of fruit which encloses seeds very neatly, as in the box. Chilies are cultivated mainly in tropical and sub-tropical countries (Panda, 2014).

Chili is an important spice and used as salad, medicine and industrial product. It is consumed as fresh, dry, powder, paste or as sauce. It enhances food palatability, inducing the consumption of other foods. Chilies are valued worldwide as natural flavor, colorant, food additives, pigments and for physiological and pharmaceutical uses (Pineda *et al.*, 2007). It also contained considerable amounts of antioxidants such as vitamin E and C and carotenoids. Chilies, depending upon its use, are classified as vegetables, medicinal herbs, spices and ornamental plants.

Chili is considered as one of the important cash crops. Its attractive color is because of presence of a pigment known as 'Capsanthin' and the pungency due to an alkaloid capsaicin. Chili is also known to have medicinal value, as it prevents heart attack by dilating the blood vessels. Chili can be divided based on its heat level as follows:

- Sweet/Mild Chili Peppers: 0 – 2500 Scovilles
- Medium Chili Peppers: 2501 – 15,000 Scovilles
- Medium-Hot Chili Peppers: 15,001 – 100,000 Scovilles
- Hot Chili Peppers: 100,001 – 300,000 Scovilles
- Super-hot: 300,001 + Scovilles

Chili is grown in both tropical and sub-tropical climate as it comes up well in warm humid climate with an optimum temperature of 25° to 30°C. It is grown as a rain-fed crop at an annual rainfall of 25-30 cm. However, excessive rainfall is harmful to the crop causing defoliation. Although it can be growth on all types of soils, it is best suited for sandy loams and clay loams with proper drainage. Chili is grown both in Kharif and Rabi seasons. Crop takes around 180-200 days for maturity. Green chilies are harvested at regular intervals for vegetable purpose. Fully ripe chilies are harvested at the maturity for the production of dry red chilies. Amongst the various types of chili, the Dundicut[1] varieties, such as Longi and Mexi, are the most desired and are highly demanded in the domestic and international markets. Hybrid varieties are also available in the market with good production potential, but do not compete well in quality with the traditional Dundicut varieties in respects of color, aroma and heat index.

[1] For explaination of Dundicut chili, see: https://en.wikipedia.org/wiki/Dundicut

Pakistan is cultivating chili on 158 thousand ha and producing about 143 million tonnes of chili. Highest acreage of chilies comes from Sindh followed by Punjab, Balochistan and KP (Table 1).

Table 1: Major Chili Producing Provinces in Pakistan (As of 2016)

S #	Province	Production (000 tonnes)	Production Share (%)	Area (000 ha)	Area share (%)	Yield (tonnes/ha)
1	Sindh	126.2	88.31	131.5	83.28	2.4
2	Punjab	10.1	7.11	15.1	9.56	1.6
3	KP	0.4	0.27	1.0	0.63	1.2
4	Balochistan	6.2	4.36	10.4	6.58	1.5
5	Pakistan	142.9	100%	157.9	100%	2.2

Source: MNFS&R (2018)

During 2001-16, area under chili in Pakistan has experienced a declining trend at 0.19% per annum, while production have increased at 1.71% per annum rate (Table 2), which is lower than its population growth. Per ha yield has increased at 1.9% per annum during the period. The area under Dundi cut traditional and well demanded verities is progressively reducing. This may be due to unfavorable chili prices in the national and international market.

Table 2: Production Trends of Chilies in Pakistan during 2001-15

Year	Sindh			Pakistan		
	Area (ha)	Prod. (tonnes)	Yield (tonnes/ha)	Area (ha)	Prod. (tonnes)	Yield (tonnes/ha)
2001	72.1	153	2.12	84.5	174.6	2.1
2002	38.6	76.6	1.98	48.7	93.3	1.9
2003	47.4	84.5	1.78	56.4	98.9	1.8
2004	46.9	82.2	1.75	55.8	96.4	1.7
2005	40.5	77.7	1.92	48.7	90.5	1.9
2006	55.4	108.8	1.96	64.6	122.9	1.9
2007	38.8	56.6	1.46	47.3	69.5	1.5
2008	54.2	104.2	1.92	64.2	116.1	1.8
2009	63.7	172.2	2.70	73.8	187.7	2.5
2010	64.4	172.8	2.68	74.7	188.8	2.5
2011	52.8	158.2	3.00	63.6	171.8	2.7
2012	16.5	37.7	2.28	27.4	54.1	2.0
2013	52.2	129.9	2.49	63.6	147.2	2.3
2014	52.1	129.6	2.49	63.2	146.5	2.3
2015	52.1	123.8	2.38	62.5	139.9	2.2
2016	52.8	124.3	2.35	63.1	140.0	2.2
Average growth rate (%)	**-0.53^{ns}**	**1.85^{ns}**	**2.40**	**-0.19^{ns}**	**1.71^{ns}**	**1.90**

Note: ^{NS} implies that the estimated growth rates through log linear trends are not significant at the 5% level.
Source: FAO. (2017). FAOSTAT, Production, Crops: http://www.fao.org/faostat/en/#data/QC

1.2. Global Context

Worldwide chili (dry) is cultivated on about 1.86 million ha producing about 4.6 million tonnes of dry chili, which gives an average per ha yield of 2.49 tonnes. Pakistan is far behind the world averages in terms of per ha yield, exportability, establishment of value chain, etc. Despite the favorable environment for chili production, Pakistan gets 91% of the world average yield. Although farm gate prices of chili in Pakistan are 32% lower than the world average, indicating its competitiveness at the farm level, it exports only 3% of its production as compared to 15% of the global chili production that is traded internationally. The export price of Pakistan chili is only 76% of the world average export price suggesting less developed value chain of chili in the country (Table 3).

Table 3: Comparison of world vs. Pakistani chili sector during 2016

Parameter	World	Pakistan	Share (%)
Area (000 ha)	1857	65.1	3.51
Production (000) tonne-dry	4626	148.1	3.20
Value of production (Million US$)	4959	107.33	2.16
Yield (tonne/ha)-dry	2.49	2.27	91.31
Farm gate price (US$/tonne)	1072	725	67.61
Quantity of international trade (000 tonnes)	706	4.7	0.66
Value of international trade (Million US$)	1664	8.357	0.50
Export quantity as % of production	15%	3%	-
Export value as % of production value	34%	8%	-
Average export prices (US$/tonne)	2355	1792	76.10

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

International chili production has been increasing at an average annual growth rate of 3.28% during 2001-2016 (Table 4), which is higher than the world's increase in the population growth of 1.19% per annum, suggesting that the per capita chili consumption has been increasing at over 2% per annum during the period. This increase in production mainly came from the increase in per ha yield which has increased at a rate of 2.96% per annum, while area under chili expanded at 0.32% per annum, which is not statistically significant. It is worth noting that both increase in production at the world level is much higher than that in Pakistan, suggesting that Pakistan is not only losing its international position in chili production but also its competitiveness in international market because of the slower growth in per ha yield (Table 2).

During 2001-16, international chili export has been growing at 5.1% per annum in terms of export quantities and its export value at more than 10% per annum. In the same period, export from Pakistan has been almost stagnated in terms of quantity (because of wide variation) and in terms value the growth rate is much smaller than the world growth (Table 4).

Table 4: Trend in international chili production and trade during 2001-16

Year	Chili Production			World Chili Export		Pakistan Chili Export	
	Area	Production	Yield	Quantities	Values	Quantities	Values
	(000 ha)	(000 tonne)	(tonne/ha)	(000 tonne)	M. US$	(000 tonnes)	M. US$
2001	1729	2475	1.43	291.2	345.2	2.22	2177
2002	1708	2357	1.38	339.0	382.6	1.29	1701
2003	1651	2722	1.65	370.1	453.3	3.59	3520
2004	1622	2743	1.69	417.9	572.0	3.78	3767
2005	1554	2728	1.76	423.8	608.4	2.97	3231
2006	1610	2851	1.77	465.4	691.0	7.41	6192
2007	1693	2977	1.76	503.2	856.8	6.38	6897
2008	1654	3068	1.85	510.6	958.0	2.63	3686
2009	1637	3049	1.86	532.4	933.7	4.03	5896
2010	1656	3088	1.86	533.9	983.5	4.64	7053
2011	1656	3187	1.93	536.2	1317.2	1.58	4302
2012	1710	3377	1.97	651.3	1320.5	1.88	7061
2013	1680	3583	2.13	581.4	1231.2	4.90	8619
2014	1674	3697	2.21	631.9	1371.1	2.52	4867
2015	1719	4012	2.33	650.7	1428.8	2.90	7030
2016	1835	4063	2.21	706.44	1663,8	4.66	8357
Growth rate (%)	**0.32^{ns}**	**3.28**	**2.96**	**5.08**	**10.12**	**1.29^{ns}**	**7.92**

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

Note: ^{NS} implies that the growth rate estimated through log-linear function is not significant at 5% level. Other growth rate having no subscript implies that they are highly significant at least at the 1% level.

India is the main competitor in dry chili production as she contributes about 45% in chili area as well as in production remotely followed by Ethiopia in area and Thailand in production, China is at number 9 in area and at 3rd rank in production because of its high per ha yield (Table 5). Pakistan ranks at 7th position in area and at 6th position in chili production in the world.

Table 5: Major chili producing countries of the world, 2017

Rank	Country	Area (000 ha)	Share (%)	Country	Production (000 t0ns)	Share (%)
1	India	840	45.2	India	2096	45.3
2	Ethiopia	163	8.8	Thailand	350	7.6
3	Myanmar	109	5.9	China, mainland	314	6.8
4	Bangladesh	103	5.6	Ethiopia	307	6.6
5	Thailand	100	5.4	CÃ´te d'Ivoire	157	3.4
6	Viet Nam	66	3.6	Pakistan	148	3.2
7	Pakistan	65	3.5	Bangladesh	137	3.0
8	Romania	51	2.7	Myanmar	131	2.8
9	China, mainland	47	2.5	Ghana	120	2.6
10	Nigeria	40	2.1	Viet Nam	96	2.1

Source: FAOSTAT, Prices, Producers Prices-Annual http://www.fao.org/faostat/en/#data/PP

Countries who lead in chili produced also lead in export. India is at first rank in exporting chili quantity as well in earning foreign exchange amounting to US$452 million. This is remotely followed by China. The rank of Pakistan in exporting chilies is very lower at 8th position as compared to the neighboring countries of India and China (Table 6).

Table 6: Top Chili Exporting Countries of the World (2016)

Rank	Country	Quantity (000 Tonnes)	Value (Million US$)	Share (%) in quantity
1	India	290.4	451.7	41.1
2	China	96.5	249.5	13.7
3	Peru	41.1	91.0	5.8
4	Spain	39.7	120.3	5.6
5	Mexico	22.1	45.6	3.1
6	Tunisia	17.6	1.3	2.5
7	USA	5.3	17.5	0.8
8	Pakistan	4.9	8.6	0.7
9	Germany	5.0	33.5	0.7
10	Malaysia	3.9	5.7	0.6

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

For export of chilies, following parameters are important:

i) Scoville Scale
ii) Pungency
iii) ASTA color
iv) Crude Fiber
v) Light Filth
vi) Moisture
vii) Aflatoxin, and
viii) Non-Volatile Ether Extract.

Major chili importing countries are USA, Thailand, Vietnam, Sri Lanka, Spain and Malaysia imported respectively US$305, US$173, US$147, US$103, US$95, US$92 million of chili during 2016.

The above analysis suggests that during 2001-16 Pakistan chili production has been increasing at 1.7% per annum, compared to its population growth rate of 2.1% implying that unless the domestic production rate is increased, Pakistan's chili export will shrink and we even have to resort to its import to meet the domestic needs. Increase in chili production in Pakistan is much lower than that in the world implying that Pakistan is losing its comparative position in the world chili market. Moreover, growth in per ha chili yield is slow compared to the world average thus the country is also losing its comparative position in international market. Moreover, the growth in Pakistan's export has been stagnated and it earns lower price for its exported chili compared to the world average export price. To stop these trends, Planning Commission of Pakistan has sponsored this study to understand the whole value chain of chili in the regional context. This study first identifies the major chili growing cluster in the country, characterizes the cluster, identifies gaps and opportunities, and then suggest viable interventions at the cluster level to improve the competitiveness of chili production in the national and international markets.

2. GOAL AND PUPOSE

Pakistan is the main stakeholder of Asia for chili industry and plays a vital role in export as compared to other countries of the world. The prime objective of this study is to suggest interventions for the purpose of improving the value chain of chili so that the competitiveness of chili product can be improved in national and international markets. The specific objectives are:

1. To identify the major chili producing clusters in Punjab, Pakistan;
2. To characterize each cluster and conduct a diagnosis and SWOT of chili value chain in each cluster;
3. To identify technological, institutional, infrastructure and policy gaps in each cluster;
4. Assess the potential of chili production in each cluster;
5. Suggest technological, institutional, infrastructure and policy interventions to achieve the cluster potentials;
6. Conduct economic feasibility of the suggested interventions;
7. Make suggestions to improve the competitiveness of the chili sector in Pakistan.

3. METHODOLOGY

The data and information related to the characteristics, gaps, potential and needed interventions to overcome the gaps in chili clusters were collected from three sources:

a) *Macro-Data.* Relevant macro data were collected from various published and unpublished reports of government and non-governmental organizations and internet search on chili value chain (See Annexure-1 for the list of data sources)

b) *Literature Review.* The literature related to the functioning, gaps, and interventions in chili value chain is reviewed and synthesized (See Annexure-2 for the list of literature reviewed).

c) *Stakeholders Consultations.* Primary information was collected through meetings, consultations, key informant interviews, surveys and focus group discussions using structured tools and open-end questionnaires (for list of traders, see Annexure-3 and annexure 4 for photos of the meeting and sites visited).

Following generic parameters and indicators are used in collecting the data:

1. Global context of chili sector;
2. Production potential and review of chili sector;
3. Cost of production, harvesting, post-harvest processing of chili from the growers and grower associations;
4. Marketing, trading, and processing from traders, wholesalers, retailers, and processors;
5. Issues and constraints relating to production, picking, drying, selling, marketing, trading, and processing from all stakeholders;
6. Recommendations and benchmarks based on global parameters;

The information was collected from different stakeholders first to identify the chili clusters in the country and then used subjective judgment in prescribing the characteristics of each cluster, identifying cluster's strengths, weaknesses, opportunities, and threats (SWOT), investigating the functioning of existing value chain, and quantifying the cluster potentials. Based on the above analysis, the interventions for improvement in each cluster are suggested. The cost and benefits of each intervention are also estimated to finally work out the Internal Rate of Return of the whole package. For this an EXL sheet based model developed by CABI is used.

4. LITERATURE REVIEW

Chilies are known from pre-historic times in Peru and believed to have originated in the tropical America. It is also said that chilies have originated in the Latin American regions of the New Mexico and Guatemala as a wild crop around 7500 BC, as per the remains of the pre-historic Peru. Columbus carried chili seeds to Spain in 1493. The cultivation of chili spread rapidly from Spain to Europe. The Portuguese brought capsicum from Brazil to India during the year 1584. Chilies became popular in the whole of Asia rapidly and native Asians started cultivating this crop as well. The south Asian climate suited this crop, and since its introduction in the 16th century chili has been increasingly cultivated in south Asia. Chilies are the cheapest spices available in India and are eaten across all groups (Sanusi and Ayinde, 2013).

4.1. National scenario

Like the other horticulture products in Pakistan, chili suffers from low productivity, low quality, high wastage and low exports. The farmers use low yielding seeds. They do not have access to modern farming practices and techniques. High levels of aflatoxin are found in chili from Pakistan (above the international export standards). The EU allows up to 10 micrograms of Aflatoxin in chili, whereas a 2006 study found an average of over 32 microgram aflatoxin in different chili samples collected from Pakistan (Patterson, 2006). About 10-12% of the produce is wasted due to poor post-harvest handling (Zahoor & Arocha, 2014). This is mainly caused by drying chilies on ground, which can be avoided using geotextile sheets while drying chilies in the sun.

There are several other impediments in the supply chain management. Commission agents provide loans to grower who are bound to sell the produce through them and often are charged a higher commission. Since commission agents' profits depends on the volume of transaction there is incentive to increase margins by mixing different grades of chilies and keeping the moisture content high. This has serious implications for the level of aflatoxin and overall quality of chili that reaches the consumers. There is also a lack of direct relationship between growers and processors/exporters required to expand the export market (FAO, 2014).

The government of Pakistan and other national and international aid agencies have undertaken several projects to improve the production and marketing of chili in Pakistan. USAID is in the process of building 588 solar dryers in Kunri to reduce the number of days required to dry the chilies form 8-10 days to 4-5 days under the project Agribusiness Support Fund. It projected a 20% growth in income for the chili farmers (Sindh Board of Investment 2010).

Sahoo (2012) examined the impact of bilateral trade on the economic growth of trading countries. Ahmed and Samad (2011) proposed the improvements to enhance trade of chili powder between South Asian countries including Pakistan, India and Afghanistan by

harmonizing the regulatory framework of controlling authorities at the border crossings and customs procedures. Husain (2011) discussed that the chili trade with India is beneficial as it creates win-win situation for both the countries.

Vast majority of fresh chili is sold on the domestic market rather than exported. (Zahoor & Arocha, 2014) show that commission agents have a significant market power. They provide loans to grower who are bound to sell their produce to them and often are charged a higher commission. Since commission agents' profits depends on the volume of transaction, there is incentive to increase the margins by keeping the moisture content high.

Red chili, a major crop of Pakistan, is an important ingredient in food as an essence and taste. Chilies are one of the largest traded spices in the international market Hassan *et al.* (2005. Kunri, a small town of Umerkot district, is the home of red chilies. It contributes around 85% of Pakistan red chili production and is known as one of the largest production center for red chilies in Asia. The three major types of chilies grown in the chili cluster of Kunri are: Maxi, Desi & Nageena (Sindh Board of Investment 2010).

4.2. Threats

Temperature and humidity are the crucial factors that can influence the toxin production before and after harvest of the crop. Improper picking practices and inadequate post-harvest processing of the chilies may lead to increase the level of Aflatoxin. Aflatoxin infection may also occur due to the mechanical damages, stress conditions or damages by birds, mammal or insects etc. (Khan *et al.,* 2017).

Varadharajan and Veeravel (1995) studied population dynamics of chili thrips, *S. dorsalis,* by monitoring the pest with yellow sticky traps at Annamalainagar, India and found that its population is positively correlated with temperature and negatively with rains. Rani (2001) noticed the peak activity of mites during June to July month in Devanahalli village of Bangalore. Tatagar (2002) revealed that, the leaf curl damage due to thrips ranged from 0 to 3.20 LCI/plant. In general damage due to mite was very less, (0 to 1.40 LCI/plant). Further, fruit borer damage was moderate and ranged from 4.0 to 35.0 per cent. Natural enemies such as coccinellids, phytoseiid mites, spiders and chrysoperla were also recorded.

Due to its importance, a fine literature is available about the economic analysis of capsicum production in chili producing countries, especially in India. But little information on the economics of chili production, marketing, and trading practices is available in Sindh as well as in Balochistan, Pakistan. Therefore, a comprehensive study is required about the economic analysis and modeling of output and inputs in open field capsicum production.

5. CLUSTER IDENTIFICATION

5.1. Geographical location of chili Cluster

Although chili is grown throughout the country (Figure 1), but its cultivation is concentrated in two districts of Sindh, i.e. Umerkot and Mirpurkhas, which contribute 90% of chili production in the country (Table 8). These districts of Sindh are known as the largest contiguous production areas of red chilies in Asia. Kunri tehsil of Umerkot is considered as he focal point for chili cluster. The highest concentration of chili cultivation in Kunri and its largest market in the country have made the crop in the tehsil as a cash crop parallel to cotton.

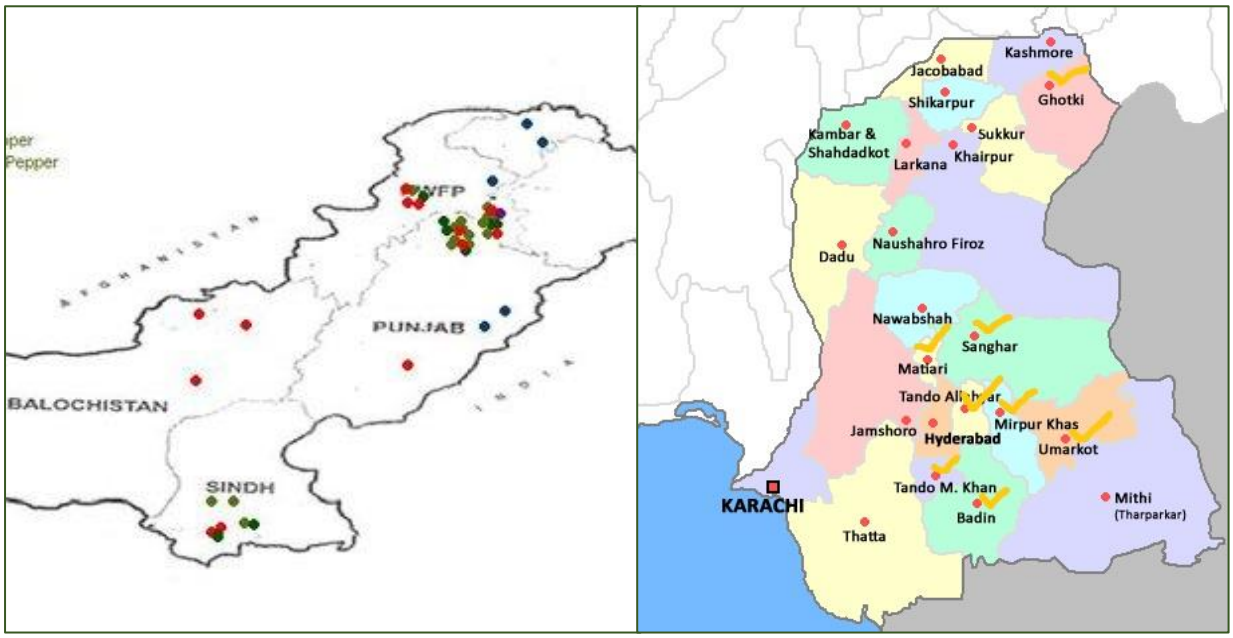


Figure 1: Map of Pakistan & Sindh Showing Chilies Production areas

Table 7: Chili Production in Sindh (As of 2016)

S#.	District/Location	Area (ha)	Production (tonnes)	Production (% of Total)
1	Umerkot	13812	40168	53.3
2	Sanghar	1432	2351	3.1
3	Mirpurkhas	10551	27550	36.6
4	Matiari	1041	2325	4.3
5	Tando Allahyar	926	1665	2.2
6	T.M. Khan	615	1231	1.6
	TOTAL	**28,377**	**75,290**	**100.0**

Source: amis.pk Survey Data (2016)

5.2. Characteristics of chili cluster

Farmers of the tehsil Kunri mainly cultivate chilies and supply to national and international market, while farmers in adjacent districts grow chili along with other crops like cotton, sugarcane, and banana. The climate of the district of Umerkot is suited for the cultivation of chilies. The farmers of this area are very familiar with this crop. The Umerkot is the tail area of all the canals and mostly soil of the district is sandy loam to clay. The temperature is favourable for this crop. The humidity remains between 60-75 and temperature between 25-40^{0}C during the crop period. The detail characterization of chili cluster is given in Table 8.

In chili cluster of Sindh, a number of chili varieties are grown. Amongst the various types of chili, the Dundicut varieties, such as *Longi* and *Mexi*, are the most desired and are highly demanded in the domestic and international markets. Hybrid varieties are also available in the market with good production potential, but do not compare well in quality with the traditional Dundicut varieties with respects to color, aroma and pungency index.

Table 8: Characteristic and Comparison of Chili Cluster

Salient Features of chilies Cluster	
Salient Features	Sind Cluster
Product	Chili dry Chili powder
Districts	Umerkot and part of Mirpurkhas, Badin
Area of the cluster: (000 Ha)	13812 (Both Clusters) There is separate data of the cluster
Production: (000 Tones)	58.6
Average yield: (Tones/Ha)	4.7 tonnes and 08.0 tonnes hybrid
Focal point	Kunri area 80% and production
Percentage of the crop area that lies in the cluster (chilies area of the cluster/chilies area in the country)	40.00
Percentage of the total cropped area in the cluster (chili area in the cluster/total cropped area in the cluster)	60.00
Geographical and Environmental Factor	Suitable alluvial soils
	Flat plain
	25° 22′ 12″ N, 69° 43′ 48″ E
	• Poor quality underground water and shortage of canal water. • Water access through Jamarao, Mithrao and Thar canal irrigation on gravity flow is cheaper and use of lifting and tube wells increasing the cost of production.
	Average annual rainfall 180 to 250 mm

Salient Features of chilies Cluster		
	• Arid climate condition with very hot and dry summers • 30-35 °C, early growth stages. • Fruiting requires 35-45°C and fruit development needs 35 to 45°C	
	• Fog occurs during the winter season. • Fog remains for three days to 1 week. • Some time it causes, reduced fruit set, pollen sterility or flowers may drop.	
	• Chili is a hot season crop, it grows well under hot temperature • Best growth and quality fruit are obtained in Sindh when the temperature is warm during the early development and hot near maturity.	
Chili growers	There are approximately 2200 chili farmers in Kunri. • The vast majority of farmers grow chilies less than 10 acres. • Very few commercial farmers cultivate chili on more than 50 acres. • Large farmers (more than 50 acres) hire Farm Manager who decides the farm management practices. • These managers are experienced agriculturist but don't have formal degree	
Variety Feature	OP variety	Hybrid variety
	• Plant height of different OPs types ranges from 90 to 110 cm • No. of branches 7-15 • Stem girth 17- 25mm • Fruit size of different Dandi cut/ loungi types are small, round to pointed (approx. 1/2" to 1.5 " long). • Leaf color is Light green to green or dark green. • This variety remains in the field for 8 months. • The next crop like wheat can be cultivated as follow crop. • The leaves are alternate, elliptical to lanceolate, with smooth margins. • Its many-branched plant, often shrubby in appearance. • Flowers are off-white (sometimes purplish) in color. • The flowers are small about 1 to 1.5 cm in diameter. • Seeds; round in shape. • Compressed orbicular and minutely pitted. • Color at maturity is whitish yellow. • 3-4 mm diameter and weighing around 6 mg • Inflorescence; Cymose often solitary cyme.	• Hybrid varieties plant height ranges from 60-90 cm • No. of branches 10-11 • Stem girth 12-19mm. • Fruits are long and cylindrical with 5-16 cm length. • Leaf color is Light green to green or dark green. • These varieties remain in the field for 10-11 months. • The next crop like wheat is not possible as fallow crop. • The leaves are alternate, elliptical to lanceolate, with smooth margins and pointed leaf tips. • Hybrid varieties are annual but often cultivated as a perennial. • It has many-branches, and are shrubby in appearance. • The flowers are off-white (sometimes purplish) in color. • The flowers are small about 1 to 1.5 cm in

Salient Features of chilies Cluster		
		diameter • Seed are round in shape, compressed orbicular and minutely pitted. • Color at maturity is whitish yellow. • 3-4 mm diameter and weighing around 6 mg. • Inflorescence; Cymose often solitary cyme.
Product Feature	OP Variety • OP variety (Dandicut) red chili paper is dark red chili peppers, known in Asia as Lal Mirch. • Sold after dried and have 55000-65000 SHU heat value	OP Varieties • Hybrid chilies are red chili paper with its pedicle. • Sold after dried and have more than 100000-350000 SHU heat value and no aroma
	• Nagina • Kunri-I • Kunri-Pak • Longi	• Skylane-I • Skylane-II • Sanam • Red Line-I • Royal Red (Longi)
	• The good healthy fruits have 70-80 seeds/fruit. • Pods look like barriers, varying in size shape and weight. • Fruit changes its color from green to red with shiny bright red thin skin having yellowish seeds. • 75-80% moisture at the time of picking • Fruits detached from its pedicel when picked so it's called as Dandicut. • The fruits maintain aroma, taste and color. • Heat value for a period of two to three years even after processing. • Fruits contain 8-9% moisture is considered as good.	• Good healthy fruit contains 35-40 seed/fruit. • Pods shape is cylindrical with varying sizes and weights. • Fruits color changes from green to red with bright red thin skin having yellowish seeds. • 70-80% moisture at the time of picking. • Fruits not detached with its pedicel. • All the hybrid varieties can't retain their color, aroma and taste after two to three months' time period. • After drying fruits with 10-12% moisture consider as good.
	• Main diseases; (Leaf Curl, damping off, Mosaic Virus, Powdery Mildew, Downy Mildew, Root Rot, Fusarium wilt) are reported in chilies in this cluster • Insect pests; (Aphid, Whitefly, Jassid, Thrips and Army worm)	• Some resistance to the diseases as compared to OP variety. These varieties are comparatively less susceptible to diseases i.e. Leaf Curl, Damping

Salient Features of chilies Cluster		
	• Weeds (Itsit, Chabbar, Kabbah, Waho, Lunak, Hazardani etc.)	off, Mosaic Virus, Powdery Mildew, Downy Mildew, Root Rot, Fusarium wilt. • Insect pests; (Aphid, Whitefly, Jassid, Thrips and Army worm) • Weeds (Itsit, Chabbar, Kabbah, Waho, Lunak, Hazardani etc.)
Nursery and Planting	• Longi is grown in Umerkot (Kunri), Tando Jan Muhammad, Mirpurkhas, Sanghar, Badin • Nursery of OP is raised in February and transplanting in March and April. • Nursery of hybrid is raised in December and transplanted in February-March	
	• Chilies nursery are sown in well prepared nursery beds. • The nursery bed is raised from ground level and is prepared by soil mixing with compost and sand.	
	• Seeds are treated with fungicides before sowing and covered thinly with sand/wheat straw/FYM after sowing on beds. • The seeds germinate after 5 to 7 days. 3. About 40 – 45 days old seedlings are transplanted in the field.	
	• Row to row distance 18-24 inches	
	• Plant to plant distance 12-18 inches	
Inputs/Management Practices	• Farmers are using below average and imbalance inputs, which therefore impact the yield. • Actual use fertilizer dose for Dandicut chilies is one bag of DAP and one bag of potassium Sulphate before sowing • Farmers use 2-3 bags of urea; first dose is applied after 20 days of nursery transplantation, second at flowering stage and third at fruiting stage. • Weeding; 2-3 times in a season. • Flooding or furrow irrigation after every 15-20 days' interval • Intercropping with onion or coriander is generally followed in Kunri • Sucking pests reduces the yield by 35% and reduces the quality of fruits. Different fungicides (azoxystrobin, Copper oxychloride etc.)	
Pruning/Harvesting	• Chili picking starts from August till November to December.	
	• Farmers picks the mature semi mature and immature fruits at the end of the season and mix them together	
	• Progressive farmers dry their fruits by spreading out thin layer on green net/ mats in the sun, but the most of farmers dry their fruits on soil surface mostly on saline soils.	
	• After picking of the fresh mature fruits, it is put in the plastic bags and left in these bags for 4-6 hrs. • These plastic bags create heat which damages the color and seed viability at early stage. This act increases the chances of Aflatoxin	

Salient Features of chilies Cluster	
	infection. • These filled bags are shifted on tractor trolley in stack form along with the labor sitting on these bags. • Due to this activity the chili fruits are punctured/ busted and prone to the attack of fungal diseases.
Packaging/Transportation/Marketing	• Most of the farmers do not have any knowledge of modern packaging or post-harvest management techniques
	• About 30 % of the small farmers sort dry chilies into different grades and most farmers transport their produce in jute bags to market.
	• Chilies are transported from field to market through, donkey cart, Tractor trolley, pickups and trucks etc.
Wholesaler/Retailer	• Retailer or wholesalers buy the dry chili from farmers through their connection or through commission agents.
	• The auction in the wholesale market is generally based on the color, shapes and quality of dry chili and also based on demand of the processor/exporters.
	• Final grading is done by the retailers but recommended grading is not currently followed.
	• Most farmers lease out their fields for 3-5 years to the contractor. Contractors usually financed by small or sometimes big commission agents or wholesalers. • Thus, the contractors are obliged to sell the produce to the landing commission agents who in turn sale their produce to leading commission agent in chili market.
	• The commission agents and wholesale merchants do keep accounts of their transactions, but reluctant to provide true information of quality & quantity from their books.
	• Some small farmers who don't lease out their field and make a contract with commission agents who provide all inputs to the farmers and farmer in turn are obliged to provide the output to the commission agents. • It's noticed that the price of output the farmers receive is 100 rupees/40 kg less than market price.
	• Large scale farmers get higher prices for their produce by selling though online trading or directly to exporters.
	• Only few farmers get full payment at the time of sale, whereas most payments in split in cash or kind (mainly agri. inputs).
New Technologies/facility	• The private seed companies introduced the hybrid chilies seed which gives more than double yield as compared to OP varieties. • SAGP and MDF provide green nets for the drying of chilies. and rechargeable sprayers on subsidized rates. • Pakistan Agriculture Collation started E-marketing. • PAC and Shan started contract farming.
Infrastructure	• Road facilities improved. • SMEDA develop the chili drying unit near the Kunri.

Salient Features of chilies Cluster	
	• Government of Sindh established the Chili Research Station near Kunri where three varieties were developed. • Local government developed the Chili Mandi in Kunri city.
Exporters	• Exports of Dandicut chili from exports of chili from Pakistan decreased gradually over the last decade from 7.39 thousand tonnes in 2005-06 to only 2.08 tonnes in 2015-16. • Export reduces due to Aflatoxin, floods of 2010 and 2011, shortage of irrigation water, low demand of exporters.
Supply Chain	• Absence of timely flow of credible data on production and lack of information of exportable produce creates difficulties in the planning of processing of chilies. • Value chain competitiveness of the mix spices is more related to the factors other than chilies, such as the price of complementary inputs like other spices, vegetables, natural extracts or chemicals. • The Market Development Facility also enabled National Foods to hire staff in Kunri, to advise and train farmers on better cultivation practices to supply quality produce in market. • There are so many companies are like Shan Foods, Mehran, Zaiqa, National foods manufacturing the mix spices and chili powder packet for local and international market. • Shan and National companies are doing contract farming for the quality produce by providing technical assistance and inputs and they buying back on incentive prices of Rs.1000/40kg of dry chilies.
Certification	• Society General Surveillance (SGS) offered stand-alone or integrated solutions to assist organizations that are involved in agrochemicals, seed, fertilizers, farm machinery and supplies, financial and insurance industries, storage, processing facilities and logistical construction, preparation of fresh produce for market and prepared food products. • Bureau Veritas Certification Pakistan provides guidance to many chili base processors in exporting certified branded products

Salient Features of chilies Cluster	
Subsidies/Incentives/Facilities	• SAGP and MDF supported National Foods providing geo-textile sheets to its farmers. • Aflatoxin fungus enters the chili from the ground during the chili drying process. • Drying the chili on the geo-textile sheet helps to check the Aflatoxin levels. • SMEDA took initiative and develop a common facility in collaboration with stakeholders to dry the chilies in drying plant. This plant was developed on the farmer's land with total cost of 24.00 million. • This facility is still not functionalized properly to facilitate the farmers. • PARC, TDAP, UASID-AMD, SAGP and other different organizations organize seminars at different crop stages at Kunri and surroundings areas for producing the good quality crop. • Growers are being given 70 percent subsidy by SAGP on baskets, green nets dryers etc. for collecting and drying chilies, while they receive Rs. 1,000/40 kg dried chilies extra as quality premium on their Aflatoxin free consignments. • PARC through technical support and SAGP provided technology packages for reducing Aflatoxin contamination through introducing polyester drying mats, along with similar sheets to cover the crop to prevent dew formation on the harvested crop are provided to famer and grower associations on 30 percent cost-sharing bases.
Socioeconomic networking/Gender involvement	• Training programs in pre and post-harvest practices by USAID team in collaboration with PARC-AZRI scientists provide the opportunity to interact with chili growers, and processors. • The USAID sponsored technical trainings being conducted in the field to promote good agricultural practices. • Similar trainings are also being conducted in other chili growing areas in Sindh including Naukot, Kunri and Umerkot. • SAGP and MDF provide pre and post-harvest training to chili farmers which are expected to improve the welfare of the women engaged in chili cultivation.

Salient Features of chilies Cluster	
	• Many farmers follow the advices and precautionary measures from the trainings and improving their cultivation techniques. • This had a direct impact on the quality of chili, farmers' livelihood, and now they are able to earn a higher price from their produce. • Chili Grower Association has 200 members in Kunri area. • Chili Grower Association has training hall facility where farmers are getting training at different times organized by the different organizations • Pakistani chili exports become more competitive in the international area by introducing innovative technology and providing technical assistance. • The United States Agency for International Development (USAID) has initiated a project to promote good agricultural practices among the chili farmers of Umerkot district. • ZTBL and other commercial banks launch a special loaning scheme to reduce marketing losses and pre-harvest sale of crops. • Estimates show around 250 chili farming families have benefited from the MDF partnership with National Foods. • The Agribusiness Project (TAP) funded by USAID-Pakistan, strengthened local capacity within key value chains to increase sales in domestic and foreign markets.

5.3. Description of chili value chain

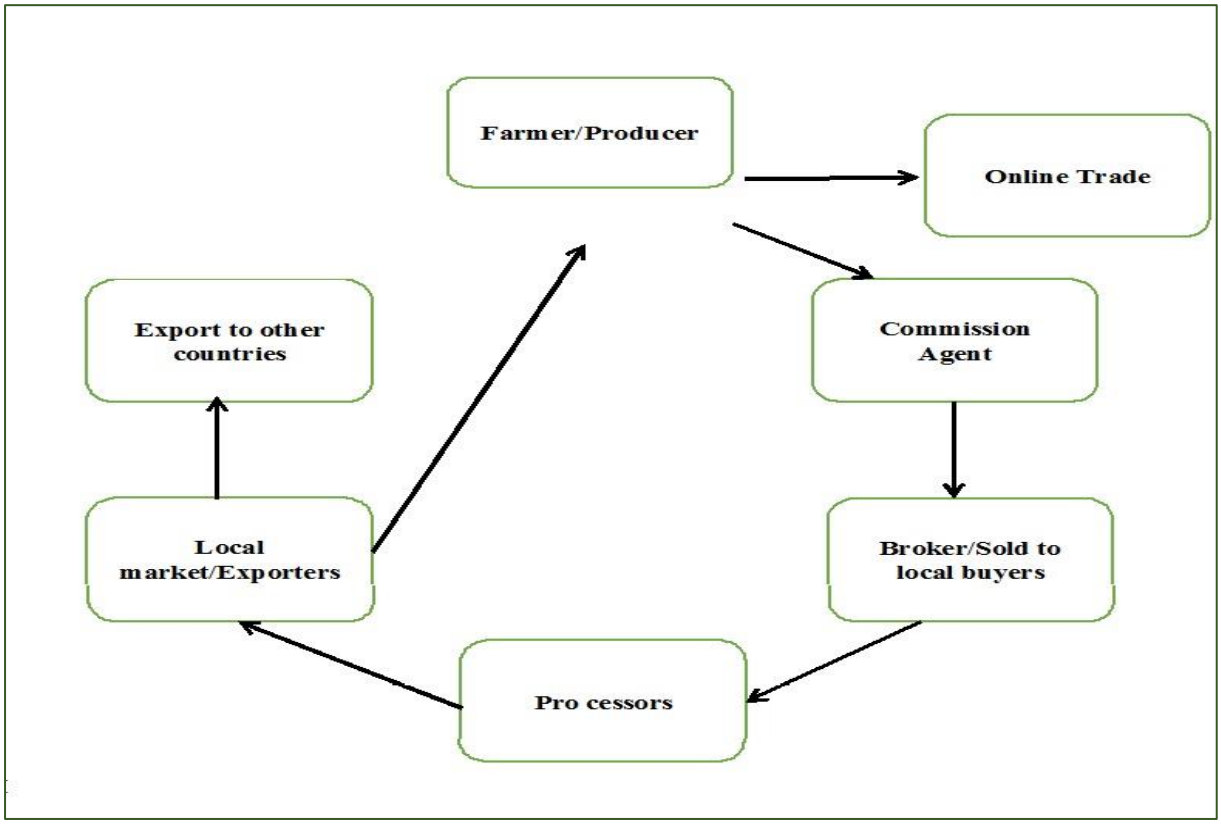
After harvesting, farmers let the chili dry on floor and sell the produce as whole fruit to commission agent in the local market or trade it on online with the help of Pakistan Agricultural Coalition (Figure 2). The drying extends the shelf-life, therefore, no preservatives are added. This form can be considered as an intermediate product, as in many countries the whole dried chili is processed to further products like chili powder or flakes. Farmers directly do not do any sort of value addition to their product. The exporters reported that the quality of chilies from the cluster is unsatisfactory, and to meet the international buyers' demand, they have to do business with India.

The irregular supply of the good quality chilies is a big threat for chili business. During 2018, for example, due to shortage of water, the production reduced by 25% compared to the normal year supply and prices of the produce shoot up more than double than the previous year. This increase in chili price in domestic market has made India more competitive where prices are less than one half. The fluctuation in chili production and its low quality is causing a big challenge for the export of chilies from Pakistan.

As chilies are mainly used as a spice not as a main vegetable, its value chain competitiveness is more related to the factors other than chili inputs, like for example, relative prices of other foods, such as other spices, vegetables, natural extracts or chemicals.

When discussed with farmers to take some responsibility of value addition which will increase their profit margin, they believe that it is the job of processors and it is difficult for farmers' community to process chili. Moreover, processors are very stronger than farmer's community, so let them do their business and let farmers grow chilies and hand over the product to the processors as usual.

Figure 2: Red Chilies Flakes/ Powder



The processing and grinding of chilies are normally done on an industrial level at home, either for their personal consumption or for reselling it locally. Simultaneously few private companies are also doing some processing of chili into spices and chili powder and exporting with brand name to different countries. Chili flakes and powder are produced through grinding dried chili. Chili flakes and powder are very popular in Pakistan and can be found in most of the local dishes.

Figure 3: Red chili, chili powder and chili flakes

5.4. SWOT Analysis

5.4.1. Overview

The SWOT analysis was carried out in focus group discussions conducted in major chili-producing areas of Sindh with the consultation and participation of different stakeholders and growers of chilies. The results are organized around the value chain functions, including inputs, production, storage, and marketing (Table 9).

5.4.2. SWOT of Chili Cluster

This chili cluster has many strengths and opportunities, including favorable agro-ecological conditions — water, climate and off-season production with major competitor countries. Major weaknesses are policy and priority neglect with inadequate investment in research, technology development/breeding, extension, marketing, etc. Threats include insect pests and diseases and natural disasters, such as thrips, whitefly, bud mite, anthracnose, leaf wilting, powdery mildew, climate change, water shortage, poor quality seed, poor market infrastructure, energy shortages for lifting water, and non-transparent trading practices in local market systems. These factors generally hold back investment into the value chain, inhibiting its development.

Table 9: SWOT Analysis of Chili Cluster (Umerkot)

Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
Environment/ Climate Change	Sandy soil texture, hot climate, and well drained land in Umerkot cluster which are suitable for chili cultivation	Sudden rise in temperature affect flowering and fruit setting. The rains during the drying process caused serious threats to farmers	Mechanical dryers and drying on raised beds by raising product through green net above the ground can save the crop from rains.	shortage of water during nursery sowing period (Feb-May)
	Availability of canal irrigation throughout the year from Nara and Rohri canals	Periodic distribution of irrigation	Rightly distribution of irrigation water by the authorities	Water shortage during the flowering and fruiting stage and rainfall during drying
Input Supplies	Regular supply of fertilizer and pesticide by many National / Multinational Companies well in time	Non-availability or shortage of demanded fertilizer and micronutrients	Government of Sindh established soil testing labs at district level. Utilize these labs for the fertilizer selection and improve the organic matter in the soil	Adulteration in chemicals and fertilizer. The use of un-certified seed of Dandicut. Adulterations in Hybrid seeds are available in market and farmers paying huge amount for hybrids but quality is adulterated.
	Non-availability of Dandi cut Chili seed in the market	Farmers using diseased seeds which is stored in very un-hygienic stores of the commission agents	The seed bank for Dandicut chili seed can be developed in this area	Use of contaminated seed
Cluster interaction	Limited number of farmers in Chili cluster	Little interaction among farmers and researchers	Possibility of learning from progressive farmers in the cluster	Suddenly appearance of chili leaf curling that causes the stunting of the crop
		Producers have little information about the quality requirements in national and international market	Strong relation between Commission Agents/Wholesaler and Contractors (each have knowledge about quality demand at least in national market) can be transformed into quality-based supply contract	Pesticide residues, Aflatoxin contamination, picking of immature fruits and mixing with fully matured chili fruits
		No contract farming with defined quantities and quality parameter		Exporting of poor quality uncertified chilies has threatened its whole export

Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
		Limited credit availability from formal institutes for any actor of cluster	Farmer associations will be useful for self-support system	Commission agents crediting the farmers and they are bound to sale their product to them. The decision of farmers collapsed.
Production Management practices	Experienced farmers who knows Chilies for a long time	Unavailability of certified seed of Dandicut chilies and lack of knowledge for the nursery development. The Hybrid seed of chilies are very costly and adulterated	Availability of training modules in several national institutes i.e. PARC/NARC, provincial departments, private sector, etc. and international organizations (FAO) to train farmers about latest methods of nursery raising, plant protection, intercropping, harvesting, preparing proper seed beds, efficient irrigation method, etc. have made the training of farmers and nurserymen for better yield and healthy product.	Lack of interest of the farmers and trainers
		Use of balance fertilizers and fungicides to grow healthy chilies		Farmers get inputs on credit from the commission agents so farmers have to buy whatever inputs they suggest and have with them
		Maintenance of plant population/acre		Saplings often died after transplantation due to the attack of the fusarium.
		Over irrigation wasted the water and spreading the disease spores in the field		low attention of the farmers about the diseases and suffocation due to heavy irrigation
		Injudicious use of pesticide	Plant Protection Department of Governments of Sindh and PARC have some capacity (which need to be enhanced) to train farmers on sanitary and phyto-sanitary measures and good agricultural practices	Lack of farmers because they are mostly illiterate and dependent of the land owners and common agents.
		Improper handling after harvesting	Possibility of farmers training by printing messages on cloth bags and plastic carriages specifically to	Farmer using the empty bags of the fertilizers which increase the heat value of the freshly

Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
			be designed to be use for the shifting of the product from field to drying floor	picked fruits that deteriorate the quality of the product
		No contract farming with defined quantities and quality parameter	Corporate farming must be revived and new farmers associations will be developed for the improvement of the chili product	Cooperation not be sustained due to personal interest
		Some literate farmers exporting their products through online trading but majority of the farmers are unaware about this system. Facility must be diverted to small land holding farmers	Training for the online trading and production of good quality chilies must be provided to the small/illiterate farmers community as they all be benefited	Lack of famers or PAC interest
Transportation	Good road infrastructure connecting Chili cluster with all big cities and the biggest port in the country	Jute bags are used for the shifting of dried chilies from farmers to Karachi and Lahore	The plastic carts are available in the market which introduced by the Sindh government through their SAGP project can be used to save the dried chilies from damage and moisture increase.	Availability of these carts and farmers interest
		Improper staking during transportation	SOPs must be developed to proper handling of the dried chilies by avoiding external pressure on the bags	Illiterate farmers and lack of farmers interest
Marketing	Higher price of Dandicut than other Chili varieties both un domestic and international markets	Farmers disconnect with the market	Financial support by the commission agents to farmers/Producers can be converted into quality based delivery/contract farming	Lack of farmers interest and issue of advance credit by the commission agents
	Payment on the basis of variety	No proper grading by the farmers at farm level The quality parameters for is not very clear to farmers		
		Auctioning in the wholesale market with visual and spot grading	New Market Act in Sindh has created big opportunity to reform the old market practices	Supermarkets may exclude small farmers from the

Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
			in the province	quality market
		Little capacity of farmers and traders little quality infrastructure to produce, handle, and market the quality product	Emerging supermarkets can introduce contract farming which may improve retailing quality, and reduce post-harvest losses and trading margin	
Trade/Export	The aroma and color of Dandicut makes its export value since long time	New or improved variety not introduced. To reduce leaf curling stunting of the crop	Framers interest on Dandicut Low yield of diverted to hybrid varieties and Dandicut variety disappeared	Slow development of quality infrastructure, lack of stakeholders interest in capacity building to produce and maintain quality, and increasing demand for higher and high may lead to lose the Dandicut chili export even to local markets
	Established market link in traditional markets, in UAE, Middle east and other golf countries		The collaboration of government of Sind through Sind Agriculture Department the Chili Board will be developed or getting support by USAID to overcome constraints in reaching high end export-market may open up big opportunities for Dandicut chilies export	
	Few farmers have started exporting chilies through online trading facility provided by the PAC at Kunri		Sind Agriculture Project or ZTBL offers funds to establish farm-level quality infrastructure like seed bank facilities and other infrastructure like solar driers, quality storage, Packing carts, Transportation methods etc.	Private seed companies may be create problems, low interest of donors and un-availability of healthy seed for all farmers
Processing	The products prepared by the different companies i.e. Shan, Zaiqa, Mehran, National, Shangrilla etc.	Very limited time span when Chilies are available (July to November) for export	Huge demand for processed chilies product within the country and abroad	Big processing firms from China through CPEC with big incentives from the Govt. of Pakistan may grab the whole chilies processing market

Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
	The processor demanded the Aflatoxin free, good quality dried chilies to make different products and export to different countries, by paying incentives to the farmers	• Lack of knowledge and skill to apply proper processing technologies to avoid aflatoxin problem. • The incentives to control aflatoxin are not enough to attract the farmers	Government incentives for the import of agriculture machinery especially seed separaters, color sorter and grading machinery	High cost inefficient processing increases the price of the commodity in local market

6. CHALLENGES FACE BY THE CLUSTERS

6.1. Climate Change and Water Shortage

Climate change is a reality and has severely affected overall agriculture production, crop cycle and more specifically the production of chilies. Late/low rain falls in lower Sindh and strong dusty/sandy winds and storms during flowering/ blossom time adversely impact the yield and quality of the produce. Climate change related impacts, such as aflatoxin, emergence of diseases and insect pests, increased drying/maturity time have emerged as climate related issues in chili cluster. Research and development efforts are needed to address these threats by evaluating the new lines of the chilies.

Dandicut chilies which are very attractive to the exporters and demanded by all the countries are cultivated in Umerkot district. Now different varieties of Dundicut have been added like hybrid Marvi, Skylane-1, Sanam and hybrid Lounge. Red chili market of Kunri is the largest chili markets in Asia, where around 10,000 bags of dried whole chili (25kg each) are received daily during 2016. The area lacked facilities including processing, storage, market place, Aflatoxin testing lab. etc. “The area needs well-equipped modern laboratories for testing the quality and aflatoxin level as well as equipment and facilities for keeping the produce safe from rain and natural elements,” High levels of aflatoxin in locally dried chili, lack of resistance varieties against aflatoxin, and old farming practices and techniques is major issues faced by local farmers. These issues limit the produce to meet international export standards.

6.2. Constraints at Production Level

The yield of chilies is low and below the potential yield by most of the farmers. The reasons behind that are the low-quality seeds, adulterated chemical and fertilizers, unbalanced fertigation, shortage of water, improper land preparation, developing of unhealthy nursery plants, injudicious use of fungicides, poor post-harvest management like improper packing and transportation of the final produce. Furthermore, the farmers picked immature fruits during the end of the season and mix these fruits with fully matured fruits. Leaf curl virus threats the production of this crop in standing during the early stage (Table 11).

6.3. Constraints at Processing Level

“Traditional practice of drying chilies on the ground results high infestation of aflatoxin which can cause liver cancer. Some 40-300 ppm aflatoxin has found in the chili produced in the cluster (Udomkun, 2017) thus increasing the chance of its rejection by the exporters. In accordance with European Union (EU) regulations, only 5 µg kg of aflatoxin B1 and 10 µg kg of total aflatoxin in peppers are allowed. According to the international survey (European and

Japanese), approximately 80% chilies from Pakistan contain aflatoxins, while 10% of the aflatoxins are generally authorized in the international market.

Aflatoxin and chemical residues are two important limitations for the export of chilies in Europe, Japan and the United States, as buyers in these countries expect a high level of hygiene and sanitation during processing and processing. European countries and Japan have banned the importation of chili from Pakistan due to high levels of aflatoxin contamination.

Table 10: Gaps and Constraints at Production Level

Parameter	Chili Cluster (Umerkot)
New germplasm	Dandicut variety cultivated since last decades and no new high yielding disease resistance variety is introduced by the researchers.
Nurseries	Using low quality seed and traditional methods for nurseries development in open field without seed treatment, lack of vector control and basal fertilizer application.
Nursery size	Small size with poor quality mix seed
Certified saplings	Non- availability
Extension services	Weak
Commercial inputs	Injudicious use and adulterated, especially fungicide
Labor input	Family
Use of fungicide	Injudicious without analysing the need and effectiveness.
Disease infestation	Virus infestation especially Leaf Curl at standing crop is quite serious.

The processors reported that the ungraded, poor quality, and damaged fruits with disease infestation are received from the local market. Most of the processors are contacting with progressive farmers and facilitating them by providing pre- and post-harvest management practices to grow healthy produce. The farmers producing the good quality, disease free produce is getting incentives of Rs800-1000/40kg. The good quality produce is directly sold from the farm to processors like national and international companies like Shan, Zaiqa, Mehran, Shangrilla, National, etc. or exporter.

The supply chain to maintain the good quality of the produce at reasonable cost is a big constraint. In chili cluster, market linkages are heavily reliant on the tenacity of the individual processor, creating a constricted market structure. However, due to the lack of overseas buyers, processors compete for customers and there is no collaboration or horizontal integration between processors to fulfil bigger orders and access bigger markets. Table 12 presents an overview of constraints at processing level barriers to entry into chili value chain as processor are market linkages and investment capital.

Table 11: Gaps and Constraints at Processing Level

Parameter	Chili Cluster (Umerkot)
Presence of aflatoxin	High
Processing and value addition technologies in use	Limited and cause heavy aflatoxin infestation
Storage	Not available
Technologies for processed products	Quite advance technologies are available to mix spices in big cities, although for chili powder the technology is primitive at local level.
Space for investment projects	Yes
Tools for packing and carriage	Nil at farm level
Contract farming for fixed quality and price with provision of technologies and inputs	• Exist between processors and large farmers. • Informal contracts between commission agents and small farmers or between contractor and commission agent exist, but these are not quality, time and price based

6.4. Constraints at Trading Level

The irregular supply of good quality produce with low farm gate price is big issues in trading in local as well as in international market. There is no storage and grading facility at farmers' level. The dried whole chilies are transported in the jute bags that increase the moisture level of the produce and ultimately increase the chances of the aflatoxin infection which can restrict the export. Heavy rains during summer, floods and shortage of irrigation water produce low quality chili which restricts its business in the national and international market. The online trading was started by the Pakistan Agriculture Collation (PAC) at Kunri since 2015. However, the basic requirement of online trading is the regular supply of good quality produce, which is not normally the case in the cluster. Moreover, the farmers avoid doing business through PAC because they are bound with the commission agents who are financing them during the cultivation of the crop. Little effort is made to understand the attributes of international demands and varieties are not developed keeping in mind these demands in various markets.

Table 12: Gaps and Constraints at Trading Level

Parameter	Chilies cluster (Umerkot)
Marketing channels	Traditional
On line trading	Limited
Understanding of export market	Little understanding of the atrributes on international demand and turning production to these demands.
Certifications (phytosanitary)	Limited
Branding	Exist only in mixed spices. For dried chili and chili powder, limited branding only.
Fluctuation is prices	Fluctuation in prices over the years is quite high
Improper packing and transportation	Increase the chance of aflatoxin infection and post-harvest losses.

7. CLUSTER DEVELOPMENT POTENTIAL

7.1. Overview

Pakistan is one of the top ten red chili producing and exporting countries in the world. Chilies are an essential part of everyday food in Pakistan and chili trade plays an important role in the local economy of district Umerkot. Amongst the various types of chilies, the Dundicut varieties, such as *Longi* and *Mexi*, are the most desired and are highly demanded varieties in the domestic and international markets. Hybrid varieties are also available in the market with good production potential, but do not compare well in quality with the traditional Dundicut varieties in respects of color, aroma and heat index.

7.2. Production Potential

Pakistan produced about 140 thousand tonnes of chili during 2016-17. This contributes about 4% of the total world production of chili. The present production, however is much less than what Pakistan produced in 2009-10, i.e., 188.9 thousand tonnes.

Several interlinked factors limit chilies production in realizing its true potential. According to studies carried out by Pakistan Agriculture Research Council (PARC), the yield can be increased to 23% by just sieving and separating the small sized seed from the longer seeds and treating them with fungicide and insecticides (AMD Grants Manual. 2017). Therefore, if seed processing is streamlined and registered processed seed is provided to chili farmers, substantial scope exists to boost per ha productivity of Dundicut verities. Similarly, commercial certified nurseries that can provide seedling developed from healthy and disease-free seeds in the chili growing areas can also substantially enhance chili productivity. Moreover, hybrid chili varieties which have much higher yield potential are commercially available and can be promoted. In addition, the use of judicious inputs can improve chili yield. Our discussion with stakeholders suggests that if disease free certified seed is supplied and farmers are trained for appropriate production technologies, achieving 50% higher productivity in five years is a reasonable achievable goal.

7.3. Reduction in Post-Harvest Losses

One of the major concerns of agriculture in the country is high post-harvest losses almost in all agriculture commodities. The estimated losses account for nearly 30-35% of chili production in Sindh (SAGP, 2013). It has been shown through experiments that proper drying, packaging, and transporting of chili can half the post-harvest losses in chili (SBI 2010). So, technology and understanding of these technologies already exist to reduce to

one-half the post-harvest losses in chili. This will generate US$ 107 million to various stakeholders along the value chain.

7.4. Improved Processing

Presently, very little amounts of chilies are processed in the country, while internationally the export value and quantity of dried chilies, as reviewed earlier, is much higher than the fresh chilies. The technology for the processing of fresh to dry chilies is very simple. It requires some mechanical/solar dryers to save the time and disease infection. Chilies mostly get matured during the months of June-September. This is the time of monsoon and farmers facing trouble to dry their produce in the open field. There was no other source for the drying of the harvested chilies. The processing units will be established near the field area or in the hub of the major growing area of crop to save the transporting charges and time. The labor charges of the big cities are higher so the cost ratio can be reduced by processing the produce at farm level. In this contest local farmers may be kept as partners and profit share will be finalized with the farmers. This activity will generate the 3-4% employment at small cities and farmers will own the enterprise and produce good quality produce for the processing.

7.5. Production to Export Ratio

The potential for increasing exports of whole, powder and crushed chilies in consumer packs is very high, provided we meet the quality requirements of importing countries by preventing contamination from external sources during harvesting, post-harvesting, processing and storage processes. As noted earlier, world chili export is increasing at 5.08% per annum, while Pakistan's chili export is increasing at only 1.29% per annum. Pakistan can claim this expanding international market of chili by adopting appropriate trade policies and linking Pakistani trader with international market especially in the major chili importing countries. Moreover, globally export-production ratio is 15%, while Pakistan exports only 3% of its chili production. This is despite the fact that farm gate prices of chilies are low in Pakistan compared to the average farm gate price globally, therefore providing a comparative edge to Pakistani traders. Thus, there is substantial scope to enhance export-production ratio of chili from 3% to 10%. This will generate US$107 in foreign exchange earnings and enhance income of various chili stakeholders along the value chain.

7.6. Quality and Price

One of the areas of concern in chilies sector of Pakistan, as noted earlier, is that it earns lower price for its exported chili compared to the world average export price suggesting inability of Pakistani traders to meet international quality standards. To bring the quality of Pakistani exported chili at par to the international average quality will require proper handling of the produce along the value chain to protect it from aflatoxin, give poor drying, certify all processes along the value chain, put proper packaging materials, and provide improved

transportation, etc. Such value addition activities will generate US$107 million additional foreign exchange earnings as well as additional income in the whole value chain. Moreover, the quality of 10% of chili production destined to local market can be improved at par to international export price which will generate US$107 to various stakeholders in the value chain.

7.7. International Standards

To improve the quality and price of chilies to international level, we have to adopt international quality standards at each segment of the value chain. To improve the competitiveness of Pakistan's chili sector, establishment of disease free nurseries in the chili growing areas of Sindh province are utmost important.

8. PLAN, POLICIES AND STRATEGIES

8.1. Plan

Based on the gaps and potentials identified in previous sections, following plan with fixed target is made for a five-year development project to upgrade the chili competitiveness in the domestic and international markets.

Sr. #	Targets
1	To increase per ha chili yield by 30% over five years
2	Reduce post-harvest losses by about one half from 30% to 15%
3	Increase the mechanical sun drying of chili from less than 1% to 5% of the fresh produce
4	Increase the chili export up to 10% of its domestic production
5	Improve the chili value chain so that its export price is at least equal to the world average prices, and 5% of its production can achieve price in the domestic equal to the average international export price

8.2. Policy Reforms

At the policy level, the current practice of providing general subsidies and “export rebates” to selected commodities should be eliminated, and replaced with need-based subsidies to drive investments at the cluster level. For instance, in chili cluster a dedicated Chili Research and Development Center need to be established. The cluster’s major investment requirement is to replace the old virus infested bunches with high-yielding bunches of modern varieties prepared through tissue culture. Incentives are required to establish collection centers at the union council level so that farmers can bring their produce to these centers and trade their produce in the national and international markets, rather than bringing their produce in far flung wholesale markets. Investment is needed to train the farmers and other stakeholders in the value chain to enable them to produce chili to the demand of the market. Moreover, incentives would be needed to establish cottage chili processing industry with proper quality standards and branding and link the traders with international chili markets. Information Focal Point in Chili Research and Development Centers would be required at the union council level that can inform the farmers and traders about the changing chili standards in the international markets. Moreover, a nationwide program should be developed in which all rural districts can compete for Cluster Development Grants to specialize in high-value crops for export.

8.3. Production Level Strategies

A multi-year program is needed to locally produce commercial varieties/hybrids that are suited to local environment, provision of technical guidelines for establishing, managing and certification of This may include developing facilities in different locations in the cluster that can provide improved seed to private nurseries. These varieties should be registered under the truth-in-label rules and regulatory framework should be provided to implement these rules. These developed saplings will then be supplied to farmers under the truth-in-label rules in the medium term under the supervision of the experts.

The available hybrids varieties with the commercial seed sector should be demonstrated and promoted. Farming systems in the cluster are typically subsistence oriented. Chilies are planted in small fields and collecting small scattered quantities into a large quality-uniform lot will require lots of planning at the union council level and training of farmers to produce uniform chili product. The farmers need to be organized into Farmers Entrepreneur Groups (FEGs) that can facilitate farmers to work together, ensure uniform quality to traders, and provide information about prices, quality, and technology to individual farmers. Moreover, government should link all cluster-specific infrastructure and input incentives with the formulation of FEGs.

8.4. Marketing and Trading Level Strategies

To implement the supply chain improvements, several major changes must be made in the value chain segment in addition to introduction of improved varieties and farm management practices at the farm-level. As discussed earlier, the biggest challenges for chili processors is the difficulties they face in engaging with the premium overseas and domestic markets due to their small size with aflatoxin infested and high toxic residues, ungraded material, long distance from the market, poor quality produce and irregular supply.

The vibrant association of processors/traders should be established as a platform for promoting processed uniform-quality and aflatoxin free chili products overseas and domestically. The individual members of the association can distribute the big orders among individual traders based on their capacity to supply the quality produce. The association will ensure the uniform quality to importers traders from other countries. The individual members of the association will make contracts with FEGs to get the quality and standard produce from them. Marketing and promotion costs will be shared across the association and products will be marketed as a brand.

Collection centers will be established at the union council level which will have all the needed facilities like cemented and covered shed, grader, and packaging, storing and communication facilities, etc. The farmers will trade national and internationally through the collection center. The government will incentivize the establishment of the collection center on cost-sharing basis and may initially support the center by providing administrative staff the cost of which will gradually and ultimately shared by the FEGs. With the improvement in

storage and transport technologies, marketing of dried chilies from the cluster to down-country and overseas will become possible.

Potential market linkages include contacting and visiting (a) overseas processors using new technologies for production, post-harvest handing, processing. (b) Chains of health food shops and (c) foreign and domestic supermarkets/convenience stores and, (d) e-commerce platforms selling ready-to-eat dried chilies.

8.5. Research and Extension Level Strategies

The research on chili will be strengthened by establishing a dedicated Chili Research and Development Center in Kunri. The center will facilitate research to resolve issues along the whole chili value chain including production, processing, storage, etc. The Center will be run by a Board of Directors in which all chili stakeholders will be included and its chairman will be elected by the stakeholders. The board will decide the research agenda of the center and monitor its research. The funding of the center will be shared by the stakeholders and Sindh and Federal governments. The Center can also compete from the national research grant fund that would be established to promote output oriented research. The center will also establish information cell which will collect the information related to chili price, quality, improved technologies in production and processing, and disseminate these to appropriate stakeholders. Although agenda of research will be determined by the stakeholders through the Board, but immediate issues to resolve are development of virus resistant varieties/hybrids which are also suitable under drought conditions, value chain management of chili to overcome aflatoxin issue, understand the consumers' preferences in various markets and develop technologies to meet these requirements. The Center should collaborate with international centers, like World Vegetable Center who has collected quite big and diversified germplasm and has developed good virus resistant varieties.

9. BENEFITS ANS COSTS OF CLUSTERING

9.1. Overview

Interventions are being proposed here to increase chili yield, reduce post-harvest losses, improve value chain, and convert basic crop production into high value-added products; so as to enhance export and increase the overall value of the produce for the farmers and for other sector stakeholders.

The economic and financial analysis of chili cluster in Umerkot Sindh has been carried out by identifying the benefits of the proposed interventions and their associated costs. Cost and benefit analysis have been done in a five-year timeframe. Discounted cash flow analysis has been carried out to work out the economic viability of the proposed interventions in terms of NPV and IRR.

9.2. Key Interventions and Benefits

Following four key interventions have been proposed for transformation of Chili cluster.

1. Improvement in chili yield by introducing new varieties and improved management practices
2. Introduction of improved harvesting practices and post-harvesting handing to reduce chili post-harvest losses
3. Improving chili processing/drying infrastructure
4. Linking stakeholders with international markets to increase chili exports
5. Encouragement of chili value chain infrastructure to enhance quality

The expected benefits by implementing the proposed interventions have been based on certain assumptions which have been decided in discussion with chili sector experts. Expected benefits have been calculated with reference to the baseline situation of the cluster. Based on the assumptions, the value addition by implementing these interventions has been calculated in a five-year timeframe.

The resources required for the implementation of the proposed interventions package includes i) additional operational costs of improved chili production, value chain development, and processing, and ii) sector development investments like R&D by government, iii) fixed capital investment in machinery, etc. by government and private sector. The whole analysis has been based on incremental costs and benefits of the proposed interventions.

The detailed feasibility of chili processing unit is separately estimated and explained in Appendix. For each cluster, the number of chili processing units required was estimated

based on the estimated chili quantities that will be processed and capacity of the production unit. Total investment and operational costs of processing in each cluster were incorporated in the main feasibility model. However, in the following section, we just explained the feasibility of the whole package of interventions.

9.3. Sindh Chili Cluster

9.3.1. Current Situation

The study has considered 13,812 has of area under chili production in the focal point of Sindh chili cluster which is currently producing 40,168 tonnes of chilies per year. Current yield in the cluster is 2.91 tonnes/ha; growing at an annual rate of 1.86%. Table 14 shows the cluster's current production performance.

Table 13: Sindh Cluster – Current Production Situation

Area under cultivation in cluster (ha)	13,812
Total Production (tonne)	40,168
Production yield (tonnes/ha)	2.91
Annual yield growth without intervention	1.86%
Farm gate price of chili (US$/tonnes)	750

Chili production and its value at the current farm gate price in the next five years in a no-intervention scenario are shown in table 15.

Table 14: Sindh Cluster – Chili Production in No-Intervention Scenario

	Year 2	Year 3	Year 4	Year 5
Default yield (tonnes/ha)	3.02	3.07	3.13	3.19
Annual expected production without intervention (tonnes)	41,662	42,437	43,226	44,031
Total value of production at farm gate (US$)	**31,246,687**	**31,827,876**	**32,419,874**	**33,022,884**

9.3.2. Interventions and Benefits

Intervention 1 – Introduction of Improved Farm Management Practices and varieties

Improved management practices, and R&D in chili cultivation will lead to increase in crop production yield. The research will develop and supply certified seeds to increase the chili yield. Large scale field demonstration of improved farm management practices and new best performing varieties will also be carried out by the provincial extension department and development partners starting from the first year and continue until the fourth year. Seeds

will be provided to farmers are discounted rates. It is estimated that these efforts in Sindh cluster will increase the chili yield by 30% over a period of five years. However, it is assumed that farmers will gradually adopt new practices and variety; thus, yield increase in the cluster will also be gradual at a rate of 7.5% per year starting from the second year. Based on these assumptions, the value of increased chili production at the existing rate of US$ 750 per tonne is shown in table 16.

Table 15: Sindh Cluster - Increased Chili Value by Increased Production Yield

	Year 2	Year 3	Year 4	Year 5
Current Yield without interventions (tonnes/ha)	3.02	3.07	3.13	3.19
Yield increase over four years (tonnes)	7.50%	15.00%	22.50%	30.00%
Increase in yield (tonnes/ha)	0.23	0.46	0.70	0.96
Additional production from enhanced yield (tonnes)	3,125	6,366	9,726	13,209
Expected additional value (US$)	**2,343,502**	**4,774,181**	**7,294,472**	**9,906,865**

Intervention 2 – Improved Harvesting and Post-Harvest Handling to Reduce Post-Harvest Losses

Chili crop faces the issue of high post-harvest losses of up to 30%. Farmers will be trained on post-harvest practices for chili by introducing technologies used in China, Thailand and other friendly countries. Groups of farmers, traders and scientists will be sent to these countries for training on post-harvest practices and certifications in processing and food safety and quality management systems. It has been estimated that with these proposed improved farm management and post-harvest practices, these losses can be reduced to 15%. This will lead to increasing the value of the chili crop for the farmer and the downstream players in the value chain. It has been assumed that reduction in post-harvest losses will occur from the second year of interventions when the results of improved value chain management practices will be realized. Again, the adoption of these practices will be gradual by the farmers, thus a linear gradual reduction in losses at a rate of 3.75% per year has been assumed. Based on these assumptions, the value of increased chili production in Sindh cluster at the existing rate of US$ 750 per tonne is shown in **Error! Reference source not found.**16.

Table 16: Sindh Cluster – Increased Chili Production by Reducing Post-Harvest Losses

	Year 2	Year 3	Year 4	Year 5
Post-harvest losses after intervention (tonnes)	26.25%	22.50%	18.75%	15.00%
Increased marketable Production due to reduced losses (tonnes)	1,680	3,660	5,957	8,586

Expected additional value (US$)	**1,259,632**	**2,745,154**	**4,467,864**	**6,439,462**

Intervention 3 – Improved Processing/Drying

Chili can be processed to increase its value and converted into chili powder, chili flakes, etc. It has been estimated that 5% of the total production from the cluster will be processed into quality chili powder which can be sold in the local and export markets. For this purpose, solar driers will be introduced and incentivized at FEGs level. The additional quality processing of 5% chili will be achieved in four years at a linear rate of 1.25% per year. It is estimated that 6 small solar dryers will be required in the whole cluster to process 5% chili production into chili powder by fifth year. Chili solar processing units will be provided at 30% subsidy rates to those farmers who organize themselves into Farmers Enterprise Groups (FEG) and deposit in advance 70% of the plant cost. The provincial government will provide the funds of subsidy. This intervention will add value to the chili production from the cluster. Projected values of this value addition activity at a processed chili price of US$ 1667 per tonne is shown in table17. Detailed feasibility of chili drier is presented in Annexure 5.

Table 17: Sindh Cluster - Value Addition by Chili Powder Production

	Year 1	Year 2	Year 3	Year 4	Year 5
Production to be processed into dried chili powder (tonnes)	1.25%	2.50%	3.75%	5.00%	1.25%
Chili converted into dried powder (tonnes)	581	1,312	2,209	3,291	581
Total volume of dried chili produced (tonnes)	581	1,312	2,209	3,291	581
Expected additional value (US$)		968,244	2,186,393	3,682,587	5,486,565

Intervention 4 – Linking Stakeholders with International Markets

The proposed plan envisages increasing chili exports of the country. Pakistan currently exports 3% of the total national production of chili which is very low. It is estimated that with focused efforts, it will be possible to export 10% of the total production of the Sindh chili cluster. These efforts will include sponsored trip of current and intended chili exporters to potential markets, sponsored participation of exporter to international food festivals, introducing chili brands, setting up an information desk by the Department of Agriculture to provide information related to international chili market requirements, etc. National competition will be organized for designing attractive packaging as per the international specifications. Chilies will be included in bilateral/multilateral trade agreements with friendly countries. Umerkot will be promoted as a health food destination through national and international events. A linear export growth at the rate of 1.75% per year has been assumed. Additional exports have been valued at the existing average export price of US$ 1792 per tonne. It is assumed that increased exports will start from the second year of interventions. Based on these assumptions, the value of increased chili exports is shown in table 18

Table 18: Sindh Cluster – Increased Chili Exports Value

	Year 2	Year 3	Year 4	Year 5
Increase in export to production ratios over five years (%)	1.75%	3.50%	5.25%	7.00%
Expected increased volume to be exported (tonnes)	813	1,836	3,093	4,608
Expected additional value from exports (000 US$)	1,457.2	3,290.5	5,542.2	8,257.2

Intervention 5 – Improving Value Chain Infrastructure to Enhance Quality

The improved value chain activities as highlighted in the post-harvest section, processing section and improved interaction with international market as highlighted in the previous section will improve the quality and price of chili to be marketed in the national and international markets. In addition, pack houses will be provided to interested FEGs at 30% subsidy as in the case of chili driers. A total of 36 pack-houses will be required to pass all the export and 5% of the total output destined in the domestic market.

It has been estimated that these measures will that the exporter will be able to achieve the average international export price of US$2355 instead of current Pakistani export price of US$1792. This improvement in price will be achieved at a linear rate in four years; with the export price being increased by US$ 141 per tonne each year. For the domestic market, it is assumed that 5% of the total production from the cluster will be sold at par with the export market price. This will be achieved in four years with the addition of 1.25% each year. Benefits from this intervention over four years are shown in Table 19.

Table 19: Sindh Cluster – Additional values by Improving Quality for Export and Local Markets

	Year 2	Year 3	Year 4	Year 5
Improved export price (US$/tonne)	1,933	2,074	2,214	2,355
Expected additional value from exports (US$) (A)	145,028	654,975	1,654,782	3,287,206
% of domestic production to be evaluated at international prices	1.25%	2.50%	3.75%	5.00%
Expected additional value from exports (US$) (B)	686,977	1,735,868	3,234,690	5,282,506
Total expected additional value (US$) (A+B)	832,005	2,390,843	4,889,472	8,569,712

9.3.3. Total Benefits Summary

Summary of the value of the benefits of the proposed interventions is shown in Table 21. All benefits start from the second year.

Table 20: Sindh Cluster - Summary of the Value of Benefits of Interventions

Benefits Value (US$)	Year 2	Year 3	Year 4	Year 5
Value of Increased Yield	2,343,502	4,774,181	7,294,472	9,906,865
Value of Reduced Post-Harvest Losses	1,259,632	2,745,154	4,467,864	6,439,462
Value of Processed Products	968,244	2,186,393	3,682,587	5,486,565
Value of Increased Exports	1,457,187	3,290,476	5,542,216	8,257,165
Value of Improved Prices	832,005	2,390,843	4,889,472	8,569,712
Total Value	**6,829,995**	**15,248,964**	**25,527,745**	**37,966,751**

9.3.4. Enhanced of the Proposed Interventions

The proposed sector transformation plan includes interventions both for on-farm and off-farm activities, which involve two types of costs i) value chain improvement operational costs and ii) sector support interventions costs.

9.3.4.1. Value Chain Improvement Operational Cost

Operational costs entail spending more money for carrying out those activities on modern lines. Existing costs and the proposed incremental increases for different cost heads are shown in table 21.

Table 21: Sindh Cluster – Value Chain Costs and Proposed Incremental Increases Cost Head

	Cost	Incremental Increase
Production Inputs and Harvest (land preparation, inputs, labor, etc.) (US$/ha)	1,182	114%
Transportation and Storage (US$/tonne)	163	68%
Grading and packaging (US$/tonne)	37	0%
Processing (US$/tonne dried chili)	1,400	0%
Cost of Shelving and Retailing (US$/tonne)	15	250%

Based on the above unit costs, total value chain costs for the entire cluster were calculated. It was assumed that costs will be incurred from the second year of implementation. Total planned increase in cost was distributed over four years as per the interventions in those years. Value chain costs projections are shown in **Error! Reference source not found.**22.

Table 22: Sindh Cluster – Value Chain Improvement Operational Costs

	Year 2	Year 3	Year 4	Year 5
Production Inputs and Harvest (land preparation, inputs, labor, etc.) (US$/ha)	4,721,658	9,443,316	14,164973	18,886,631
Transportation and Storage (US$/ha)	150,586	380,842	710,188	1,160,4801
Grading and packaging (US$/ha)	30,117	68,008	114,546	170,659
Processing (US$/tonne dried chili)	754,972	1,704,803	2,871,434	4,278,054
Cost of Shelving and Retailing (US$/ha)	7,529	34,004	85,910	170,659
Total Costs (US$)	5,664,862	11,630,972	17,947,052	24,666,485

9.3.4.2. Cluster Development Interventions Costs

Sindh chili cluster has huge growth potential that can be tapped by focused developmental interventions. A mega program will be launched that will include developing and supplying certified seed to the farmers and providing help to establishing healthy nurseries. 10 demonstration plots will be established at farmer's fields every year. Hands on training will be provided to those farmers for scientific crop management. These blocks will be certified using IPCC protocols and other certifications like' Organic', 'Fair Trade, etc. Post-harvest losses will be reduced by introducing latest technologies from China, Thailand and other countries. Groups of farmers and scientists will be sent to these countries; Tax incentives will be provided for establishing commercial storage facilities at Karachi port to avoid damage during customs checking. Discounted cargo services will be provided at discounted rates (Table 23).

Table 23: Sindh Cluster - Inputs and Infrastructure Needs for Cluster Development

S#.	Cluster Strategy	Interventions	Implementing Agency
1.	Increase yields by 10% over 5 years	Develop a Cluster Development Project	PARC/DoA
		Develop & supply of certified seed	
		Supply 2000 acres seed every year @ 50% discount rate	
		A minimum of 3 acres seed per farmer for establishing healthy nursery	
2.	Improve quality based on international standards	PARC and DoA to develop 10 demo plots at farmers field every year	PARC/ DoA
		Establish model filed blocks of one acre and use them for hands on training for scientific crop management	PARC/DoA
		Certify these blocks, using IPPC protocols and	PARC

S#.	Cluster Strategy	Interventions	Implementing Agency
		other certifications, including organic, Fair-trade, and others	
		Invite experts from China to integrate their specific phytosanitary requirements needed for export to China	PARC
3.	Reduce Post-harvest losses from 20% to 10% in five years	Identify latest post-harvest technologies used in China, Thailand and other friendly countries. Send groups of farmers, traders and scientists from Sindh to these countries to learn post-harvest techniques from them	P&DD/ DoA/ PARC CBR
		Training and certification in processing and food safety and quality management systems	MoD
		Provide tax incentives to investors for establishing commercial storage facility at Karachi port is needed for avoiding the damage during custom checking	
		Require public sectors transporters to offer discounted cargo services.	
4.	Create market Linkages for quality Processed Chilies (Domestic and Export)	Revive the Chili Growers Association of Kunri (CGA) and build its institutional capacity	FAO/Cabi- Bio sciences
		Develop Chili Product Brands, and organize a national competition for designing attractive packaging that follow international specifications	PARC-AZRI/ SARC
		Sponsor/ cost-share CGA members to attend international exhibitions and trade fairs, and summits	TDAP
		Include chilies in bilateral/ multilateral trade agreements with friendly countries (OIC, Arab League, China)	MNFS&R
		Promote Umerkot as a health food destination through national and international events	TDAP/ Pakistan's Missions overseas/ MoT/ MNFS&R/MoAgri-Sindh
6.	Undertake Research & Development	Undertake high quality research on all aspects of the chili cluster	DoA/ PARC
7	Develop control seed bank	Ensure availability of good quality seed for farmers	DoA/PARC

The costs of these activities is included in Table 24.

In addition, it will also include promotion of grading/packing facilities and processing units to promote the production of chili value added products to meet the domestic and export demand. To improve chili marketing, farmers will be provided information on standards, process and market segments. International buyers will be sponsored for high potential exporters. Competition and rewards will be announced for exporters. To organize chili sector stakeholders, Chili Growers Association of Kunri will be revived. A national competition for designing attractive packaging will be organized as per international standards. Members of Chili Growers association will be sponsored to attend international exhibitions and trade fairs. Chilies will be included in bilateral/multilateral trade agreements with friendly countries. Umerkot will be promoted as health food destination through national and international events (Table 24).

The proposed budget for cluster development interventions in Sindh Chilies cluster will be US$ 15.721 million. About 57% of this investment will be provided by the federal government by establishing a Cluster Development Fund (CDF) under federal and provincial PSDP. The remaining 43% should come from the provincial budgets. Details are provided in table 24

This proposed cluster development cost will be spent in a period of four years starting from year Yearly distribution of these costs will be driven by the interventions planned for that year. For example, the processing cost will be driven by the number of chili processing units that will be required each year to meet the set production target. For research. First two years' budget will be used for establishing research infrastructure while remaining three years will be used as operational cost of these additional infrastructure. It is assumed that the investment on capacity building, improved seed production and marketing/trading level strategies will be spent 40% in year 1, 30% in year 2 and 15% each in year 3 and year 4. With these assumptions, the cost distribution

Table 24: Sindh Cluster – Cluster Development Investments Cost Projections

Investment Head	Total	Year 1	Year 2	Year 3	Year 4
Investments required on chili research center (000 US$)	4,000.0	2,500.0	500.0	500.0	500.0
Investment required on capacity building/ stakeholders training (000 US$)	2,250.8	562.7	562.7	562.7	562.7
Investment on improved seed	3,274.0	-	818.5	818.5	818.5
Investments required on processing level interventions (US$)	3,750.3	625.1	833.4	1,041.8	1,250.1
Investment required on value chain infrastructure (one pack-house each year)	1,000.0	250.0	250.0	250.0	250.0
Investments required on Marketing/Export level interventions (US$)	400.0	160.0	120.0	60.0	60.0
Loans on value chain infrastructures	546.3	100.6	124.6	148.6	172.5
Total investments (US$)	15,221.4	4,198.4	3,209.2	3,381.5	3,613.8

9.3.5. Economic Viability of Cluster Development Plan

Based on the benefits and the costs of the proposed interventions package in the above paragraphs, the economic viability of the proposition has been calculated in terms of project's NPV and IRR. Discounted cash flow analysis has been carried out using an annual discount rate of 8.5%. Calculations and results are shown in Table 26. The package of interventions suggested in above paragraphs produced a positive NPV of US$ 5.50 million and an Internal Rate of Return (IRR) of 33%.

Table 25.Sindh cluster - Economic Viability of Proposed Interventions Package

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Benefits of the Interventions (US$)	-	6,829,995	15,248,964	25,527,745	37,966,751
Total operational costs of the Interventions (US$)	-	-5,664,862	-11,630,972	-17,947,052	-24,666,485
Total investment costs of the interventions (US$)	-4,198,395	-3,209,196	-3,381,507	-3,613,819	-818489
Net Cash Flows (US$)	**-4,198,395**	**-2,044,063**	**236,485**	**3,966,875**	**12,481,777**
NPV (US$)	5,742,661				
IRR	**34%**				

9.3.6. Environmental Impacts

Any environmental degradation is unlikely to happen from promotion of chili clusters; rather the increase in chili cultivation shall contribute towards plant diversification and soil stabilization. With the climate change impact manifesting in fluctuating temperatures, variable precipitation, and more frequent and intense climate events, the improved climate resistant varieties are likely to reduce the risks to make the communities more self-reliant and climate resilient.

Chili contributes to an improvement of microclimate and helps in biodiversity conservation and carbon sequestration in mitigation of greenhouse gases. It provides habitat to diversity of wildlife and adds to the scenic view. Due to a difficult terrain and problems of accessibility, communities living in remote areas of Sindh in particular have developed a self-reliant and self-sustaining way of life in which they rely more on locally available resources. The temperate climate and availability of irrigation water in the area have created an environment that is suitable for growing different varieties of chilies that not only produce cash in the form of fresh and dry chilies but also from other products such as chili powder and spices produced by farmers for diverse consumption.

9.3.7. Conclusion

In conclusion, the overall economic, social and environmental impact of the cluster development program shall be positive, sustainable and long lasting. Accounting for all the fixed costs and variable costs including the production, processing and marketing cost, the estimated Internal Rate of Return (IRR) for chili cluster is 115%; based on respective investment costs in each region and the present value of resulting revenues over the period of five years. This estimated IRRs signifies the fact that cluster development interventions are likely to produce significant positively impact on the existing output of chili cluster, and on the welfare of all stakeholders in the chili value chain. To achieve these benefits, however, chili research system has to be strengthened, value chain infrastructures have to be incentivized, and capacities of all stakeholders along the value chain have to be built to produce, handle and trade quality chili produce.

10. PROGRAMS AND PLANS

This report presented an overview of the potential of chili sector in Pakistan. Identified the chili cluster as part of V2025 of GoP, Discussed the gaps and constraints in identified chili cluster. Give recommendations for cluster development in Kunri-Sindh; and estimated the economic and social impact of the cluster development interventions that shall set new frame conditions at production, processing, and marketing level of chili value chain. In support of the findings and recommendations presented in previous sections, the following plans and programs are proposed for further value addition.

In support of the strategies and interventions proposed in section 8 of this report, the following programs/plans are recommended to further strengthen the interventions and to creating greater opportunities for participation and learning.

10.1. Program for Organization and Networking of Stakeholders

The following program is proposed for organization of stakeholders at different levels of value chain.

Table 26: Program for Organization and Networking of Stakeholders.

S#.	Area of Action	Purpose	Institutions to be involved	Priority
Umerkot-Sindh				
1.1	• Develop Chili Farmer Enterprise Groups (CFEGs) at grassroots level. 4 CFEGs in total with each having a membership of at least 25 farmers. Mirpurkas division has 6 major chili producing tehsils each should have at least 1 FEGs per tehsil	Organization of Chilies farming community for collective action	Village Organizations (VOs), LSOs, NGOs (FAo/Cabi), DoA Sindh, PARC.	Short to medium term (2 to 3 years)
1.2	• Form Chilies Processors and Traders Association at market/business level. At least 5 processors should be initially involved.	Improve coordination between the stakeholders of Chilies value chain	DoA Sindh, PARC, NGOs, Private Sector	Short to medium term (2 to 3 years)

10.2. Program for Research Reform

The following program indicative areas for further research to strengthen the chilies cluster in the two regions are proposed along with the estimated costs

Table 27: Program for Research Reform

S #	Identification of Areas for Further Research	Research Purpose/ Priority	Indicative Research Institutions
1.1	• Develop high yielding and virus resistant hybrids suitable under local conditions. • Identify suitable cultivars for export demand • Develop strategy for quickly distribution of improved seeds	Chilies production improvement (Short to medium term (2 to 3 years)	NARC, PARC, DoA Sindh, Cabi
1.2	• Develop training modules • Develop formats for Farmer Field Schools (FFS) for on-farm training of Chilies producers	Improve field Management and On-farm Processing Skills (Short to medium term (2 to 3 years)	PARC, DoA Sindh, Cabi
1.3	• Survey for identification of target group of 5 processors	Product Diversification from Processed Chilies (Short to medium term (2 to 3 years)	Private businesses, DoA Sindh, PARC, Cabi
1.4	• Consultation with processors to assess interest in establishing a Chilies Processor Association • Scoping survey to identify new products and potential buyers	Create market Linkages for quality Processed Chilies (Domestic and Export) Medium to long Term (2 to 5 years)	Private businesses, DoA Sindh Govt, PARC, Export promotion board, Embassies
1.5	• Identify suitable Chilies traders to support the cluster • Identify suitable Chilies buyers to link with in premium markets through a market survey • Consultation to decide on implementation strategy – wholesale market or individual traders • Identify most suitable cold storage and Chilies trading technology	Develop Cold-Chain Infrastructure for Chilies Trading Medium to long Term (2 to 5 years)	CFEG clusters; Farmer Associations; Business associations and cooperatives.
1.6	• Research into Climate change related negative impacts such as new diseases and shifts in crop	Investigate into climate related	PARC, DoA Sindh, Research institutions

	cycle	negative impacts on horticulture Medium to Long term (2 to 5 years)	
1.7	• Construction hall as chili seed bank	Insure availability of good quality seed for the farmers	PARC. DoA Sindh Cabi

Note: The estimated costs for research plan mentioned in the above table have already been counted as part of the cluster investments given in Section 9)

11. Annexures

Annex 1: Macro Data Sources

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Annex-3 List of traders

List of Fruit & Vegetable Exporters of Pakistan

Sr.No	Firm	Address	Tel	Fax	Email Address
1	SJ Sourcing	45/5 Habib Road, Lahore Cantt	(042) 6664340	(042) 6664340	adnansj@lhr.comsats.net.pk
2	Allianz Trading	B7, 2nd floor, block 12D, G-8 Markaz, Islamabad	(051) 2262350	(051) 2262350	allianztrading@gmail.com
3	AL Zia Enterprises	A-5 Row 1,Block 10A. Gulshan E Iqbal, Karachi	0300 9225775	(021) 4968072	alzia786@yahoo.com
4	Asia MegaFoods	2 & 3, Karachi Market, New Sabzi Mandi, Super Highway, Karachi	(021) 6870453	(021) 4985942	asia_megafoods@yahoo.com
5	Import World	Chowk Katchary Bazar. Faisalabad, Pakistan	(041) 2412804	(041) 2412809	info@importworld.com.pk
6	Biz-knock Enterprises	Noorani Masjid Road, Agra Taj Colony, Karachi	(021) 2528339	(021) 2528339	bizknockenterprises@yahoo.co
7	Shariq Associates	22-Mughal Arcade Civic Centre, Johar Town, Lahore	0300 4838481		hassanshariq@gmail.com
8	Indus Valley Trading	186 Ahmed Block, New Garden Town, Lahore	0321 4766407		fatimahh@gmail.com
9	Ortec Corporation Private Limited	3050-8M, AKBAR ROAD, CHOWK SHAHIDAN, Multan	(061) 4515590	(061) 4580240	ocpl@gespak.com.pk
10	Impact Apparel	K-456 Gulistan Colony # 1, Faisalabad	(041) 8758096	(041) 5095972	eishauruj@yahoo.com
11	Sabir Rice Mill	Garhi Kharo Road, Near Al Abbass Petroleum, Jacobabad	(021) 5867224		mir82pk@yahoo.com
12	Ahtsham Traders	25 Gulshan Hayat Colony, Factory Area, Sargodha	(048) 3721958		aashi54@yahoo.com
13	110 Exporters	Karachi, Pakistan	0345 2125548		abbas404@hotmail.com
14	Mekotex Private Limited	495 Deh Landhi, Main National Highway, Karachi	(021) 5015592	(021) 5018298	wahab@mekotex.com
15	Abdul Salam & Co.	B-97 Sector X-2 Gulshan e Maymar Karachi	0300 8636196	(021) 6833342	abdulsalamcompany@yahoo.c
16	Abdul Sattar Sons	Banglow No.24, Street No, Al-Mustafa Colony, Khanewal Road, Multan	(061) 6210907		sajid@abdulsattarsons.com
17	M/s Ghufran Enterprises	Flat No.603/Arfat Arcade, Fatima Jinnah Colony, Jamshed Road No.3, Karachi	0301 2167854		ghufran_enterprises@hotmail.c
18	Ajaz and Brothers	12/p/z. p/c, Gujranwala	0333 8102027		iabhatti51@gmail.com
19	A-Babar Imran Tentage	Ghosia Park Gajju Mattah,22Km Ferozepur Road Lahore Pakistan	(042) 5273116	(042) 5273117	info@abitentage.com
20	Al-Siraj Export Company	West Circular Road, D.I. Khan	(0961) 810967, 716310	(0961) 811354	anees771@hotmail.com
		Establishment C 1, 3rd Floor, Jumani	(021) 4931980,	(021) 4945805,	
21	M/S Al Mahmood	Arcade. St. 10/D/14, Main University	4934382, 4945805	4944147	
22	Roshan Enterprises	B 51, Rizwan Society, University Road, Karachi	(021) 8144519, 8145717	(021) 81455818	
23	M/s Ali International	E 37/1, Gulshan e Iqbal, Block 7, Karachi	(021) 4988881 5(5 Line)	(021) 8110518, 4988885	aligoc@digicom.net.pk
24	M/s Pirzada Enterprises	16 C, Suit 6, 10th Commercial Lane, Zam Zama Phase 5, Karachi	(021) 5838825, 0300 8238296	(021) 5838823, 4550397	opiz@yahoo.com
25	M/s Arif Overseas Traders	408, Fortune Centre, Block 6, P.E.C.H. Society, Karachi	(021) 4549810 10	(021) 4536100	
26	M/s Rishad Mateen & Company	22, 3rd Floor, Mian Chambers, Sha rah e Liaquat, Karachi	(021) 242889	(021) 2421764	
27	M/s Questpak Pakistan (Pvt.) Ltd.	606, 6th Floor, Japan Plaza, M.A. Jinnah Road, Karachi	(021) 7770661-3	(021) 7770664	poll@super.net.pk
28	M/s Iftikhar Ahmed & Company	5K 28C, Translayari (Fruit & Vegetable Market) Off: University Road Karachi	49449590, 4944976	4932879	

29	M/s Mohd Din Mohd. Shariff	1058 P.LB. Colony Karachi	494379, 4946754	4936276		
30	M/s Sarah Fruit Trading Co. (Pvt.) Ltd.	1 A, Sector No. 16, Korangi, Industrial Area, Karachi	5054372, 5066272	5054371		
31	M/s Union Fruit Exports (Pvt.) Ltd.	56 G, Gulzar Chowk, Manzoor Colony, Karachi	5891509, 5891067	5887526		
32	M/s Durrani Associates	720, business Centre, Mumtaz Hussain Road, :: Chundrigur Road, Karachi	(021) 2416574, 2429481	(021) 2433663		
33	M/s U.C. Corporation	1240m Sagar Road, Lahore Cantt.	(042) 6661498	(042) 6661498		
34	M/s Al Hammad Establishment	7/A, Rehmani Street, Maqbool Road, Icchra Lahore	(042) 7594865			
35	M/s Imtiaz Enterprises	No. 27, New Sabzi Mandi, Super Highway, Karachi		(021) 6380730, 6380660	(021) 4985942	
36	Iqbal Rice Mills	3KM Faisalabad Road, Chiniot	Mr. Masood Iqbal, Managing Partner	(047) 6332734/6331534	(047) 6334534	786irm@fsd.paknet.com.pk
37	M.M. Commodities	M.M. Tower 3-C, Khayaban-e-Ittehad, Phase II EXT D.H.A., Karachi	Mrs. Madiha Mahmood Moulvi, Proprietor	(021) 5891762, 5891765	(021) 5895329, 5899162	pride@cyber.net.pk
38	Zubair Enterprises	Glallah Mandi, JalalPur Bhattian, Hafizabad	Mr. Muhammad Ilyas Chaudhary, Managing Partner	(054) 7500300, 7500400	(054) 7500500	zejpb@gjr.wol.net.pk
39	Mehran Spice & Food Industries	Plot No. 14 & 15, Sector-24, Korangi Industrial Area, Karachi	Mr. Gul Mohammad Memon, Chairman & CEO	(021) 5076841-50	(021) 5064344, 5064355	info@mehrangroup.com
40	Muhammad Din Muhammad Sharif & Co.	1058, P.I.B. Colony, Karachi	Mr. Binyamin Yousuf, Managing Director	(021) 6871222, 333/68710044	(021) 4933649, 6871555	mdskarachi@hotmail.com
41	Pakistan Sesame Mills (Pvt.) Limited	20-B, Sector 19, Korangi Industrial Area, Karachi	Pirzada Nadeem Ahmed Ansari, Chief Executive	(021) 5069243, 5072638	(021) 5071256	paksesame@cyber.net.pk
42	Matco Rice Processing (Pvt.) Limited	L-24/1, Block 21, F.B. Industrial Area, Karachi	Mr. Faizan Ali Ghori, Director	111253545	(021) 6338819	contact@matcorice.com
43	Irfan Noman Bernas (Pvt.) Limited	F-61/D, S.I.T.E., INB Rice Complex, Karachi	Mr. Irfan Ahmed Sheikh, Managing Director	(021) 111762762	(021) 111763763	irfannoman@cyber.net.pk
44	Shan Food Industries	142, Sector 23, Korangi Industrial Area, Karachi	Mr. M. Khalid Idris Malik, Dy. General Manager Export	(021) 5053076-79	(021) 5053080	shan1@cyber.net.pk
45	Rafhan Maize Products Company Limited	Rakh Canal, East Road, P.O. Box, 62, Faisalabad	Mr. Rashid Ali, Chief Executive & Managing Director	(041) 8540121-23	(041) 8711016	rashidrm@fsd.paknet.com.pk
46	Venus Pakistan (Pvt.) Limited	9/1, K-28, Layari, Hawksbay Road, PAF Masroor, Maripur, Karachi	Mr. Adnan Asad, Chief Executive Officer	(021) 111836871	(021) 2350330	asada@venUS$istributors.com
47	Meskay & Femtee Trading Co. (Pvt.) Limited	Saima Trade Tower Tower-B, Room # 1511 & 1512, I.I. Chundrigar Road, Karachi	Mr. Shahid Tawawalla, Chief Executive Officer	(021) 2214981, 2275349-51	(021) 2275352	mft@cyber.net.pk
48	Meskay & Femtee (Pvt.) Limited	708, Prograssive plaza, Beaumout Road, KarachI	Mr. Tekamal, Chief Executive	(0210 5656300, 5656310	(021) 5656410	meskay@cyber.net.pk
49	Barkat Rice Mills (Pvt.) Limited	Plot 220-221, Street 1, Sector 1-10/3, Industrial Area, Islamabad	Mr. Ayaz Aziz Malik, Executive Director	(051) 4440859, 4443569	(051) 4445687, 4436534	sales@barkatrice.com
50	AL-Riaz Rice Mills	Kot Khazri, G.T. Road, Gujranwala	Mr. Muhammad Arshad,	(055) 6587060,	(055) 6587080	alriazpk@brain.net.pk

			Chief Executive	6587090		
51	Reem Rice Mills (Pvt.) Limited	50 E., Main Gulberg, Lahore	Mr. Badar Manzoor Khan, Chief Financial Officer	(042) 5760101-3	(042) 5760104	reem@brain.net.pk
52	Pakistan Sesame Mills (Pvt.) Limited	20-B, Sector 19, Korangi Industrial Area, Karachi	Pirzada Nadeem Ahmed Ansari, Chief Executive	(021) 5069243, 5072638	(021) 5071256	paksesame@cyber.net.pk
53	Quick Food Industries	138-D, P.E.C.H.S. Block-2, Tariq Road, Karachi	Mr. Usama Zaki, Director	(021) 4552287, 4552227	(021) 4555528	info@monsalwa.com
54	Johar Associates (Pvt.) Limited	Plot No. 249, Main Korang Creek, Industrial Area, Karachi	Syed Johar Ali Qandhari	(021) 5090212-15, 5093842	(021) 0211	info@joharassociates.com
74	A.G.S. TRADERS	300-SHADBAGH Lahore	AHMAREEN NAEEM	042-7723510	042-7730906	
75	A.K. CONTRACTOR	BLK-15 HOUSE-6 SEC. 5-D NORTH KARACHI		021-6973120	021-6973120	
76	A.M. FRUIT PRODUCTS	901-C CANAL VIEW H. SOCIETY CANAL BANK Lahore		042-5420086	042-5424658	
77	AAS MOVING SERVICES	9/5 5TH FLOOR SHARJAH TRADE CNTR ALTAF HUSSAIN RD., KARACHI		021-2410643	021-2434606	
78	ABDUL MAJEED & SONS	1ST FLOOR QADRI MANZIL MITHADAR CHOWK KARACHI	ABDUL MAJEED	021-2425741	021-2425741	
79	ABUZER IND	2-D/1 33RD ST. KHY-BNE-SHAMSHEER PHASE 5 DHA KARACHI		021-5859776		
80	AFGHAN TRADERS	SHOP#4 AL FAISAL MARKET CHUHARMAL RD., QUETTA		2822587	2844147	
81	AFZAL SONS	317 SHAD BAGH Lahore	MUHAMMAD MUNIR BHATTI	042-7723510	042- 7724917	
82	AGENTA TRADERS	SHOP NO 112 AGHA QADIRABAD ZARI MARKET SUKKUR	PARO MAL	2007876		
83	AGENTA TRADERS / SILVER HOIESRY MILLS	SHOP#112 AGHA QADIRABAD ZARI MARKET SUKKUR		2007876		
84	AJAY TRADERS	AGHA QADIR DAD MARKET ORHRI SUKKAR	KASO MALL -	5650592		
85	AL-FAISAL EXPORTS	6/8 ARKAY SQUARE EXTENSION, KARACHI	M.A ALI -	4225904		
86	AL-FIRDUSI	B-52 RIZWAN SOCIETY MAIN UNIVERSITY RD., KARACHI		021-4645151	021-4652518	
87	AL-GHANI INTL	AL-GHANI HOUSE 21 SANDA RD., GHAZI ABAD ISLAMPURA Lahore	SYED IRFAN AHMAD	042-7229828	042-7248968	
88	AL-HILAL VEGETABLE GHEE MILLS	PO.BOX:309 SULTAN NAGAR VEHARI RD., MULTAN		061-4550678	061-4550975	
89	AL-HUJJAT INTL	315-A 3RD FLOOR TRADE AVENUE HASRAT MOHANI RD., KARACHI		021-2473660	021- 2473661	
90	ALI OVERSEAS TRADERS	NO 408 FORTUNE CNTR PECHS BLK-6 MAIN SHAHRAH E FAISAL KARACHI		021-2260494	021-4383151	
91	ALI TAREEN FARMS	32-N IND. AREA GULBERG-2 Lahore		042-5761543	042-5761544	
92	ALI TRADER	AGHA QADIR DAD MARKET, SUKKUR		5650227		
93	ALINA INTL. TRADING CO	17-MC.LEOD RD., LAHORE		042-7210080	042-7211654	
94	AL-KARAM KINO TRADERS	10 CHAK SHAMALI IJNALA RD., BHALWAL SARGODHA	SHAHZAD CHEEMA	048-6645136		
95	ALL 2 ONE (PVT)	H/NO.424 ST.NO.36 SEC. 1-8/2			051-2112966	

	LTD	ISLAMABAD			
96	ALLAGRO (PVT) LTD.	504 MARINE HEIGHTS 3 CLIFTON BLK-2, KARACHI	MUHAMMAD ZUBAIR ALI	021-5370237	021-5371022
97	AL-MADANI INTL. SALES	R-799 SEC. 16/A BUFFER ZONE GULSHAN-E-SIR SYED NORTH KARACHI	M.A. QADIR SIDDIQI	021-6981857	
98	AL-MAHMOOD EST.	JUMANI ARCADE C-1 3RD FLOOR UNIVERSITY RD., KARACHI	MAHMOOD RABBANI	021- 4931980	021-4948493
99	AL-MEHMOOD EST	3RD FLOOR JUMANI ARCADE UNIVERSITY RD., KARACHI		021-4934382	021- 2948493
100	AL-MURTAZA	12-B S. M. KASWAR GARDEZI RD Multan	ZAHID H. GARDEZI	061-4541526	061-4253102
101	AL-NASIR TRADERS	HOUSE NO 391 BLK-A ST NO 10 NAZIM ABABD FAISALABAD	NASIR JAVAID	041-2651766	041-2629531
102	AL-RAHEEM ENT	CHAK NO 06 S B BHALWAL SARGODHA	MEHER ASHRAF -	048- 6644132	
103	AL-RIAZ CHILI DATES	NATIONAL HIGHWAY (HABIBABAD) THEIR DISTT:KHAIRPUR		0243-771149	
104	AL-SALIK IMPEX	664/C BLK-2 PECHS TARIQ RD Karachi	SALIK AFTAB	021-4537000	021-4546114
105	AL-SALIK IMPEX IMPORTER & EXPOTER	SUIT#A-102 IST FLOOR MUSTAFA TRADE CENTER 928/C BLK.#2 PECHS KARACHI		021-4521973	021-4546114
106	AL-ZAIN TRADING EST	E-37/1 BLK-7 GULSHAN-E-IQBAL Karachi	SHAHID ALI	021-2412942 , 4988881 , 5013330	021-4988885
107	AMAR TRADIN CO	AGHA QADIR DAD ZARAI MARKET ROHRI DISTRICT,SUKKUR	ALAKH	071-5650436	
108	AMIN & CO	6/40 QADAFI CHAMBER M-FEROZ ST. JODIA BAZAR, KARACHI		021-2416519 , 2446261	021-2437517
109	AMZ CORP	11 REGAL TRADE SQUARE SADDAR KARACHI AND FACTORY AT SAJJAN GOTH BALDIA TOWN KARACHI	ARSHAD MAHMOOD BHUTT	021-2722397	021-2730093
110	ANMOL COMMISSION SHOP	SHOP QADIR DAD MARKET SUKKUR	BAHGO MALL	071-650485	
111	ANSARI & SONS	KARACHI PADIDAN	BADAR-UZ-ZAMAN	021-6374947	021-6374948
112	AQEEL & CO	NEAR GOVT HIGH SCHOOL NO. 1, QILA DEDAR SINGH, GUJRANWALA		055-4712260	055-4217510
113	ARAIN BROS.	SHOP# 10-11 BASEMENT ASLAM CNTR 9-A SHAHALAM MARKET	CH. SHAHID MAHMOOD ARAIN -	042-7726402	042-7631157
114	ARIF FRESH FRUITS CO	408 FORTUNE CNTR PECHS BLK-6 SHAHRAH-E-FAISAL, KARACHI		021-4549810, 4923251	021-4536100
115	ARIF OVERSEAS TRADERS	408 FORTUNE CNTR BLK-6 PECHS SHAHRAH-E-FAISAL Karachi	MUHAMMAD SADIQ	021-4549819	021-4536100
116	AROOJ IND	BILAL NAGAR MANZOOR ABAD ST.NO.10, MULTAN		061-6563745	
117	ARSHED & CO. / ARSHED & SONS	PLOT NO 10 FRUIT MARKET I-11/4 ISLAMABAD		051-4435896	051-4435898
118	AS INTL	ST.#53HOUSE#13 TOHEEDABAD RAVI RD., LAHORE	BABER ABDUL	042-7721358	
119	ASG SYSTEMS / BOBY	8 AGHA QADARDAD ZARI MARKET		071-5650233	

	TRADING CO	SUKKUR			
120	ASIAN FOOD IND. LTD			042-5715118 , 5715126	
121	ASY INTL	120-BABAR BLK-NEW GARDEN TOWN	MUHAMMAD ATIF SALEEM BHATTI	042-7723510	042-7724917
122	AWAM GROUP	1ST & 2ND FLOOR ADAM BLDG. MOHD. FEROZ ST. JODIA BAZAR Karachi		021-2414458	021-2416853
123	AWWAL DARJA BR & MASALA	SMAEL TRADE CENTER RAMBAHARTI ST. JODIA BAZAR G.P.O. 960		021- 2446424	021- 2446425
124	BANBHORE CERAMIC IND	18 SHOP, ANAJ THAKOOR MANDI KHAIRPUR	HARESH MAL -		
125	BA-WAZEER TRADING ENT	RB-3 2ND FLOOR AWAMI COMPLEX NEW GARDEN TOWN LAHORE		042-5857461	042-5857462
126	BHATTI BROS.	10-A NEW SABZI MANDI RAVI LINK RD	MUHAMMAD NAEEM BHATTI -	042-7723410	042-7724917

http://www.amis.pk/ListofStakeholders/OldListOfExporters.html

Annex 4: Photos during the interviews and visits chili cluster

Figure 4: Interview with progressive farmer at T.M Khan

Figure 5: Meeting with chili exporters & processors at Karachi

Figure 6: Healthy immature chili crop

Figure 7: Dried chilies at Kunri chili market

Figure 8: Chili drying plant near Kunri

Figure 9: Chili drying on green sheet at farmers' field

Annex 5 – Feasibility Study of Chilies Processing Unit

Project Concept

Chili (Capsicum Annuum) is one of the most commonly used spices in the world. Almost the entire population of Indo-Pak subcontinent uses it on daily basis in different food recipes. Chilies are valued for their natural color/pigment, hot flavor and are used as dried, powder, pickle and in fresh form as salad. The attractive color is because of presence of a pigment known as 'Capsanthin' and the pungency due to an alkaloid capsaicin. Chilies are rich source of various minerals and vitamins, but are consumed in small amounts so cannot fulfill the daily micronutrient requirements.

Chili is an important cash crop. The fresh chilies are manually picked from the plants and are preserved by drying in the open sun. The current practice of chilies sun drying is leading to serious quality problems, and Pakistani chilies are either rejected in the international market or fetch a very low price. At the time of chilies harvesting and sun drying period (Sep to Dec) environmental temperature ranging from 30-40 C does not favor prompt drying of the produce. It takes 8-15 days to completely dry/dehydrate the chilies. During this prolonged drying time, fungus starts developing inside the chilies producing aflatoxins which are linked to serious health issues including cancer. During open sun drying, the chilies are exposed to dust/dirt and various other contaminants which deteriorate the quality of the valuable exportable horticulture produce.

Chili sector needs support in developing and adopting processes to produce a safe and good quality globally acceptable product. The goal can be achieved by growing the chilies adopting Good Manufacturing Practices; followed by proper processing/dehydration methods. Proper sorting /washing of the freshly harvested chilies, followed by solar drying process involving low capital and operational cost, offers the solution.

Potential Market

Powdered chilies are in extensive demand all over the world. Chilies are available in the local market round the year. It is an important ingredient of local dishes and is thus used by every household. Chilies powder is marketed by numerous known spices brands in the local market. In addition, it is also sold in open unpacked form which is available at cheaper price; since it is generally considered to be of lower quality. There is another market segment where small processors procure whole dried chilies from wholesale market and convert those into powder on smaller grinders installed by them in their facilities (Chakkis). The quality of such products enjoys a higher quality perception by the customers. Along with the household market, another important market of chilies is the food processing industry where it is used as a raw material to produce different types of ready-to-cook recipe masalas and in cooked food products, available in the market in packed form. Along with powdered chilies, there is a smaller market of chilies flakes also which has the perception of higher purity. Chili flakes are used in variety of food recipes.

In addition to the local market, there is a large export market of chilies. In 2015, total global exports of red chilies were US$ 1,433 million which grew from US$ 749 million in 2012; a very high overall growth of 91%; and an average growth rate of 30% per annum. Around half of this export market was accounted for by whole chilies and the other half by chilies powder.

Pakistan is currently not a major supplier of Chilies in the export markets. In 2015, Pakistan's total exports of chilies were 2295 tons with a value of PKR 574 million; which translated into a global market share of around 0.5%. With concerted efforts, it is possible to get a reasonable share of this large growing market. Local supply of raw material at low prices will act as a major comparative advantage for the Pakistani exporters to increase presence in the international markets.

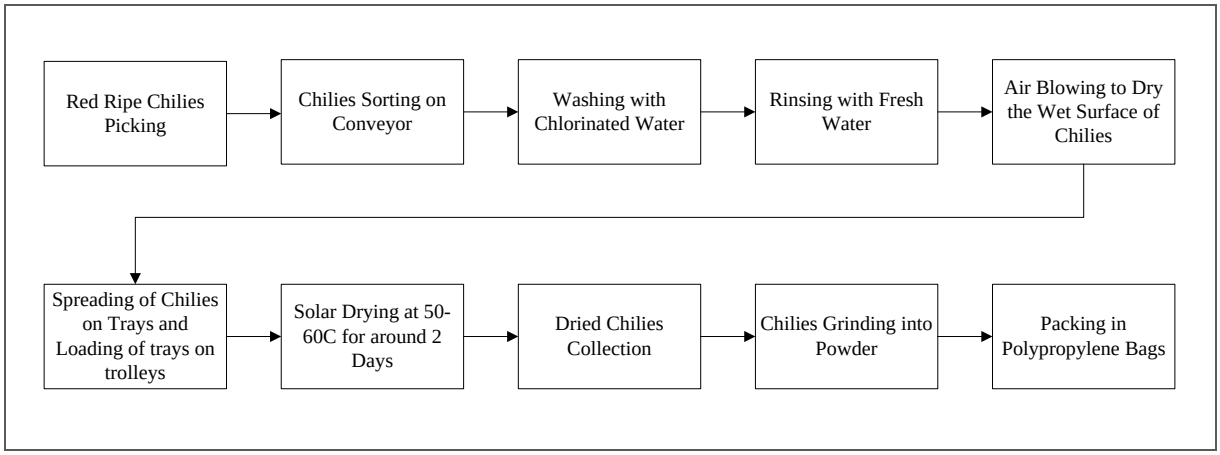
1. Chilies Production Process

1.1. Process Flow

Processed Chili is mainly marketed in powdered form. Small quantities are also marketed as flakes. During the dehydration process, by the application of hot air, free water is removed from the vegetables so that microorganisms cannot survive and reproduce. Removal of water causes concentration of the solids such as sugar and organic acids. The resulting osmotic pressure further inhibits the microorganisms.

Red ripe chilies are picked from the field and transported to the dehydration unit. Chilies are sorted on a conveyor by workers to remove any unripe, decayed chilies. Chilies are washed with chlorinated water to remove any microorganisms. They are then rinsed with fresh water. Air is blown over the washed chilies to dry the wet surface. The chilies are spread on trays which are then loaded on the trollies and placed in the solar dryers. A temperature of 50-60 C, with air blown for around two days in the solar dryers, dehydrates the fresh chilies. Yield of dry chilies from fresh chilies is around 27%. The dried chilies are ground to convert it into chilies powder. The final product is packed in polypropylene bags and marketed. Process flow chart of processed chilies production is shown in Figure 5.

Figure 5 – Processed Chilies Production Process Flow



1.2. Project Cost

Total project cost of the proposed chilies processing unit is PKR 14 million. Major items of project cost are listed in Table 28.

Table 28 – Project Cost Details

Cost Item	Cost (PKR)
Machinery & Equipment	10,775,000
Office Equipment & Furniture	69,500
Pre-operating expenses	419,500
Capital Investment	11,264,000
Working Capital	**2,799,696**
Total Project Cost	**14,063,696**

The project is assumed to be fully financed with shareholder's equity; without any debt financing.

1.1.1. Land and Building

The proposed chili processing unit will be established in a rented building with a covered area of around half acre. It is assumed that electricity and water connections will be available in the space rented for the project. Thus, the costs of electricity and water connections have not been included in the project cost. In case, these facilities are not available at the selected location, the costs of obtaining the connections of these utilities will be added in the project cost. The rental cost has been assumed to PKR60,000 per month.

1.1.2. Machinery and Equipment

The feasibility study of chilies processing unit has been based on locally manufactured machinery and equipment. This has been done to keep the capital cost of the project lower to keep it within the reach of smaller investors in rural areas. Total cost of the required machinery and equipment is PKR10.775 million; comprising of PKR7.8 million of solar dryers. Six solar dryers have been suggested to produce higher volumes of chilies powder to be able to enter into export markets. Machinery & equipment details are shown in table 29.

Table 29 – Processing Machinery and Equipment Cost

Sr. No	Name of the Machine	No.	Unit Cost (PKR)	Total Cost (PKR)
1	Belt conveyor Sorter (2 tons/hr.)	1	700,000	700,000
2	Two-Stage Washer/Rinser (2 tons/hr.)	1	1,400,000	1,400,000
3	Mesh Conveyor (for drainage) (2 tons/hr.)	1	500,000	500,000
4	Water Piping & Waste Water Disposal	1	200,000	200,000
5	Solar Dryer with trays/trolleys (1 ton fresh)	6	1,300,000	7,800,000
6	Grinder	1	50,000	50,000
7	Plastic Baskets	100	1,000	100,000
8	Miscellaneous	1	25,000	25,000
	Total			10,775,000

1.1.3. Other Project Cost Items

- Office equipment and furniture has been included at a total cost of PKR 69,500
- Pre-operating expenses are those expenses which have to be incurred before the business becomes operational. The costs included under this head are those of business registration/licensing, machinery transport, machinery erection and commissioning, personnel, routine administration and project's promotion. Pre-operating costs have been worked out to be PKR 419,500.
- Working capital calculation includes the cost of half month supply of chilies, three months cost of building lease, one-month cost of electricity bill, packing material and staff salaries. Machinery spares equal to 1% of machinery cost and petty cash of PKR 200,000 have also been included in the working capital. With these assumptions, total working capital requirement has been calculated to be PKR 2,259,696.

2. Revenues and Costs

2.1. Revenues

Revenues will be generated by selling processed chilies powder in bulk packaging of polypropylene bags of 25 kg capacity. The capacity of the unit is driven by the capacity of solar dryer which has a loading capacity of one ton of fresh chilies. One batch of chilies will take two days to attain the desired moisture level of 3-5%. This means that the effective capacity of solar dryer will be 500 kg per day or 15,000 kg per month of fresh chilies. With six dryers, total capacity of the unit will be 3000 kg fresh chilies per day. The production will be carried out for four months during the year. It is assumed that the project will operate at this capacity from first year. Operating at 120 days per year, and a dried chilies yield of 27%, the project will produce 97,200 kg of processed chilies per year.

The selling price of processed chilies in the market in the local market ranges from PKR 8000-10,000 per 40 kg. Using an average figure of PKR 9,000 per 40, kg, a selling price of PKR 225 per kg has been used for revenue calculations. This translates into a price of US$ 1667 per tonne which is also in line with the current export market price. At this selling price, project's revenues for the first year will be PKR 21.87 million. No growth in selling price has been assumed over the five-year period. Revenue calculations for five years are shown in Table 3031.

Table 30 – Revenue Calculations

	Year 1	Year 2	Year 3	Year 4	Year 5
Production (kg)	97,200	97,200	97,200	97,200	97,200
Price (PKR/kg)	225	225	225	225	225
Revenues (PKR)	21,870,000	21,870,000	21,870,000	21,870,000	21,870,000

2.2. Costs

2.2.1. Chilies Cost

Fresh chili is the major cost of processed chilies production unit. At 3000 kg per day for 120 days during a year, total requirement of chilies will be 360,000 kg. Chili's price will fluctuate during the year. The calculations have been based on an average cost of PKR 40 per kg (PKR 1600 per 40 kg) of fresh chilies. At this rate, total annual cost of fresh chilies will be PKR 14.4 million. No growth has been assumed in the cost of chilies. With these assumptions, fresh chilies cost for five years is shown in Table 31.

Table 31 – Chilies Cost Calculations

	Year 1	Year 2	Year 3	Year 4	Year 5
Dried Chili Production (kg)	97,200	97,200	97,200	97,200	97,200
Dried Chili yield	27.0%				
Fresh Chili Requirement per year (kg)	360,000	360,000	360,000	360,000	360,000
Fresh Chilies Unit Cost (PKR/kg)	40.0	40.0	40.0	40.0	40.0
Fresh Chilies Cost (PKR)	14,400,000	14,400,000	14,400,000	14,400,000	14,400,000

Other Costs

- Processed chilies powder will be packed in 25 kg polypropylene bags. The cost of one bag pack has been assumed to be PKR 40. At this rate, total cost of packing processed powdered chilies production was calculated to be PKR 155,520. Packing cost has been assumed to remain constant for five years.
- The unit will be established in a rented building with a covered area of around half acre (4 Kanals). Building Lease cost has been assumed to be PKR 60,000 per month.
- Electricity cost has been worked out on the basis of an electricity connection of 10 KVA. Electricity cost for the first year has been calculated to be PKR 186,796.
- Plant maintenance cost has been assumed to be 1% of machinery cost. Maintenance cost during the first year has been calculated to be PKR 107,750.
- Marketing cost includes the cost of product awareness and promotion in the consumer and industrial markets. It has been assumed to be PKR 25,000 per month. Marketing cost during first year is calculated to be PKR 300,000.
- Administration cost includes the cost of travelling, office stationery, telephone and refreshment. Administration cost during first year of operations is calculated as PKR 138,000. No inflationary factor has been considered during five years.
- Depreciation cost has been calculated using straight line method. A life of ten years has been assumed for machinery and equipment and five years for office equipment. Pre-operating expenses have been amortized over a period of five years.

Human Resource Cost

The proposed Chilies processing unit will need small workforce; including a production supervisor, nine workers and a security guard. The activities of production management, administration, bookkeeping and marketing will be carried out by the entrepreneur himself/herself. Human resource requirements and the associated costs are shown in Table 32.

Table 32 – Human Resource Cost

Designation	No.	Salary (PKR/month)	Total (PKR/month)	No. of Months	Salary per Year (PKR)
Production Supervisor	1	30,000	30,000	6	180,000
Workers	9	15,000	135,000	6	810,000
Watchman	1	15,000	15,000	12	180,000
Total Staff	11		180,000		1,170,000

3. Projected Financial Statements

3.1. Projected Profit & Loss Statement

Table 33 – Projected Income Statement

	Year 1	Year 2	Year 3	Year 4	Year 5
Revenues	**21,870,000**	**21,870,000**	**21,870,000**	**21,870,000**	**21,870,000**
Direct Costs					
Fresh Chilies	14,400,000	14,400,000	14,400,000	14,400,000	14,400,000
Packing Cost	155,520	155,520	155,520	155,520	155,520
Direct Labor	990,000	990,000	990,000	990,000	990,000
Direct Electricity	109,252	109,252	109,252	109,252	109,252
Maintenance	107,750	107,750	107,750	107,750	107,750
Total Direct Cost	**15,762,522**	**15,762,522**	**15,762,522**	**15,762,522**	**15,762,522**
Gross Profit	**6,107,478**	**6,107,478**	**6,107,478**	**6,107,478**	**6,107,478**
Indirect Costs					
Building Lease	720,000	720,000	720,000	720,000	720,000
Indirect Labor	180,000	180,000	180,000	180,000	180,000
Fixed Electricity	77,544	77,544	77,544	77,544	77,544
Depreciation	1,091,400	1,091,400	1,091,400	1,091,400	1,091,400
Amortization	83,900	83,900	83,900	83,900	83,900
Marketing	300,000	300,000	300,000	300,000	300,000
Office Administration	138,000	150,000	150,000	150,000	150,000
Licensing/Regulatory Fee	15,000	15,000	15,000	15,000	15,000
Total Indirect Costs	**2,605,844**	**2,617,844**	**2,617,844**	**2,617,844**	**2,617,844**
Net Profit	**3,501,634**	**3,489,634**	**3,489,634**	**3,489,634**	**3,489,634**

4. Projected Balance Sheet

Table 34 – Projected Balance Sheet

ASSETS	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Current Assets						
Cash	200,000	5,626,572	10,285,849	14,944,843	19,603,541	24,261,926
Raw material	1,838,880					
Advance Processing Charges	113,066					
Advance Building Lease	540,000					
Accounts Receivables		1,822,500	1,822,500	1,822,500	1,822,500	1,822,500
Spare Parts inventory	107,750	113,138	118,794	124,734	130,971	137,519
Total Current Assets	**2,799,696**	**7,562,209**	**12,227,143**	**16,892,077**	**21,557,011**	**26,221,945**
Fixed Assets						
Land	-	-	-	-	-	-
Building & Civil Works	-	-	-	-	-	-
Processing Machinery	10,775,000	9,697,500	8,620,000	7,542,500	6,465,000	5,387,500
Utility Machinery	-	-	-	-	-	-
Laboratory Equipment	-	-	-	-	-	-
Office Equipment & Furniture	69,500	55,600	41,700	27,800	13,900	-
Net Fixed Assets	**10,844,500**	**9,753,100**	**8,661,700**	**7,570,300**	**6,478,900**	**5,387,500**
Other Assets						
Pre-operating Expenses	419,500	335,600	251,700	167,800	83,900	-
Contingencies						
Total Other Assets	**419,500**	**335,600**	**251,700**	**167,800**	**83,900**	**-**
TOTAL ASSETS	**14,063,696**	**17,650,909**	**21,140,543**	**24,630,177**	**28,119,811**	**31,609,445**
LIABILITIES	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Current Liabilities						
Accounts Payables		85,579	85,579	85,579	85,579	85,579
Short term loan						
Other Current Liabilities						
Total Current Liabilities	**-**	**85,579**	**85,579**	**85,579**	**85,579**	**85,579**
Long Term Liabilities						
Lease payable						
Long term debt	-	-	-	-	-	-
Long term debt	**-**	**-**	**-**	**-**	**-**	**-**
Equity						
Paid up Capital	14,063,696	14,063,696	14,063,696	14,063,696	14,063,696	14,063,696
Retained Earnings		3,501,634	6,991,268	10,480,902	13,970,536	17,460,170
Total Equity	**14,063,696**	**17,565,330**	**21,054,964**	**24,544,598**	**28,034,232**	**31,523,866**
TOTAL LIABILITIES	**14,063,696**	**17,650,909**	**21,140,543**	**24,630,177**	**28,119,811**	**31,609,445**

5. Projected Cash Flow Statement

Table 35 – Projected Cash Flow Statement

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Operating Activities						
Net Income		**3,501,634**	**3,489,634**	**3,489,634**	**3,489,634**	**3,489,634**
Depreciation		1,091,400	1,091,400	1,091,400	1,091,400	1,091,400
Amortization		83,900	83,900	83,900	83,900	83,900
Change in raw material inventories	(1,838,880)	1,838,880	-	-	-	-
Change in advance processing charges	(113,066)	113,066				
Change in spares inventory	(107,750)	(5,388)	(5,657)	(5,940)	(6,237)	(6,549)
Change in Building Lease	(540,000)	540,000	-	-	-	-
Change in Accounts Receivables		(1,822,500)	-	-	-	-
Change in Accounts Payables		85,579	-	-	-	-
Cash from operations	**(2,599,696)**	**5,426,572**	**4,659,277**	**4,658,994**	**4,658,697**	**4,658,385**
Financing Activities						
Short term debt principle repayment						
Long term debt principle repayment		-	-	-	-	-
Addition to short term debt						
Additions to long term debt	-					
Issuance of shares	14,063,696					
Net cash from financing activities	**14,063,696**	-	-	-	-	-
Investing Activities						
Capital Expenditure	(11,264,000)					
Cash from investing activities	**(11,264,000)**	-	-	-	-	-
Net Cash	**200,000**	**5,426,572**	**4,659,277**	**4,658,994**	**4,658,697**	**4,658,385**
Cash balance brought forward	-	200,000	5,626,572	10,285,849	14,944,843	19,603,541
Cash investment in securities		-	-	-	-	-
Cash available for appropriation	200,000	5,626,572	10,285,849	14,944,843	19,603,541	24,261,926
Dividend	-	-	-	-	-	-
Cash carried forward	**200,000**	**5,626,572**	**10,285,849**	**14,944,843**	**19,603,541**	**24,261,926**

6. Financial Feasibility

The proposed project of chilies processing unit is found to be financially viable with a positive NPV of PKR 1.93 million. NPV, IRR and payback period are shown in Table 36.

Table 36 – Financial Feasibility Indicators

NPV (PKR)	**5742661**
IRR	**34%**
Payback (years)	**2.87**

Profitability ratios are shown in Table 37.

Table 37 – Profitability Ratios

	Amount (PKR)	Percent
Sales	21,870,000	100.0%
Direct Costs	15,762,522	72.1%
Gross Profit	6,107,478	27.9%
Indirect Costs	2,605,844	11.9%
Net Profit	3,501,634	16.0%