CLUSTER DEVELOPMENT BASED AGRICULTURE TRANSFORMATION PLAN VISION-2025

Barley Cluster Feasibility and Transformation Study

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

February 2020

FOREWORD

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

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

FOREWORD

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

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

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

FOREWORD

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

Dr. Babar Ehsan Bajwa
Regional Director
CAB International

FOREWORD

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

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

ACKNOWLEDGEMENT

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

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

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

Dr. Abid Mahmood
Senior Author

Citation:

Mahmood Abid, Ali Mubarik, and Yasin Aqsa. (2020). Barley Cluster Feasibility And Transformation Study. In Ali Mubarik (ed.) (2020) *Cluster Development Based Agriculture Transformation Plan Vision-2025*. Project No. 131(434)PC/AGR/CDBAT-120/2018. Unpublished Report, Planning Commission of Pakistan, Islamabad, Pakistan and Centre for Agriculture and Biosciences International (CABI), Rawalpindi, Pakistan. Page 79.

DISCLAIMER

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

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LIST OF ACRONYMS

AARI	Ayub Agriculture Research Institute
ADP	Annual Development Plan
AZRI	Arid Zone Research Institute
BT	Bacillus thuringiensis
CBR	Central Board of Revenue
CDF	Community Development Fund
DoA	Department of Agriculture
EU	European Union
FAO	Food & Agriculture Organization
FFS	Farmer Field School
GAP	Good Agriculture Practices
GDP	Grand Domestic Product
GoP	Government of Pakistan
Ha	Hectares
ICM	Integrated Crop Management
IPM	Integrated Pest management
KP	Khyber Pakhtunkhwa
MINFAL	Ministry of Food, Agriculture and Livestock
MNSF&R	Ministry of National Food Security & Research
NARC	National Agricultural Research Centre
NARC	National Agriculture Research Council
NGOs	Non-Governmental Organizations
NPK	Nitrogen, Phosphorus, Potash
PARC	Pakistan Agriculture Research Council
PHDEC	Pakistan Horticulture Development and Export Company
SARC	Southern-zone Agricultural Research Center
SWOT	Strengths, Weaknesses, Opportunities, Threats
TDAP	Trade Development Authority Pakistan
USAID	United States Agency for International Development
US$	United States Dollar
ZTBL	Zarai Traqiyati Bank Limited

EXECUTIVE SUMMARY

Barley is a widely adaptable crop grown in variety of environment and ranked 4th largest grain crop after wheat, rice and maize. Recent statistic revealed that global production of barley was 149 million tonnes and Russia is the top producing country with the share of 14%. The top exporters of barley are France, Australia, Argentina, Germany & Russia. However, barley is imported by Saudi Arabia, China, Netherlands and Belgium.

According to the last latest available statistics, barley was cultivated on an area of 60 thousand ha with a production of 58 thousand tonnes in 2018 in Pakistan, giving less than one third of the world average yield. In the backdrop of international stagnation in barley production, Pakistan's production is on the steep decline suggesting country's consistent deterioration in its relative position in world barley production. Moreover, the continuous decline in barley yield also affected its competitiveness in international market. As a result, the country has turned from an exporter to an importer of barley costing US$11.75 million in 2017, and the imports are on the steep rise. The producers' prices of the barley grains are higher than the world average suggesting that its local production is no more competitive internationally. Moreover, it does not meet the quality standards for processing thus very little production goes into the processing compared to an increasing global trend for barley processing.

To make the country competitive in barley production to meet at least the domestic processing requirements, the Planning Commission of Pakistan (PCP) has initiated the feasibility study on Cluster Development Based Agriculture Transformation (CDBAT) plan. The main purpose of the study is to improve the country's competitiveness in barley by evaluating gaps and potentials in its value chain, prepare a strategy plan to achieve these potentials, and suggest economically viable interventions along the chain to implement the plan. Such analysis was considered more robust if undertaken at cluster level so that regional variations can be incorporated in preparing the barley plan. In this study, macro-data were analysed, several stakeholders along the value chain were consulted and literature were reviewed to analyse the value chain of barley at its cluster level, prepare a plan to harness the potentials, and evaluate the economic and social feasibility of suggested interventions.

Barley production in Pakistan is concentrated in Punjab and Balochistan each contributing over one third of the barley area and production of the country, while Khyber Pakhtunkhwa and Sindh provinces combined have less than one third of the total barley area. Layyah and Muzaffargarh districts in Punjab and Turbat and Awaran districts in Balochistan are identified as two main barley clusters in this study vis a viz 41% (Punjab) and 27% (Balochistan) concentration of barley production in these clusters.

As part of this study, several performance gaps were identified in barley production, market, and processing components of the value chain. These included the lack of improved cultivars specially to meet the processing requirements, the use of primitive production technology and disconnect between barley producers, traders and processors. In order to address multilevel challenges from production to product, benchmarks and performance targets were set, based on global average for yield, quality and export and the interventions were designed to meet these benchmarks over the period of five years. This benchmark includes increasing 100%

yield on 50% of the current barley area, channel 10% of barley production into barley porridge and flour and 90% into barley brewery and improving value chain of barley so that it can fetch the price almost equal to the Pakistani import price. Based on these parameters and keeping in view the gaps and constraints, specific interventions have been proposed for both the clusters. These interventions include introduction of latest high-yielding 2-row barley varieties, improved management practices, incentivizing private sector to invest in barley processing sector and linking barley producers and traders with Murree Brewery.

These interventions are to be initiated by government and executed in collaboration with participation of the private sector including the Farmers' Entrepreneur Groups, traders and their groups/ associations. A time-horizon of five years has been set for realizing the intended outcomes of the cluster development interventions. The total estimated investment of this cluster development/upgradation plan is US$0.89 million for both the clusters central points. Out of the total investment, however, the major investment of 93.5% will come from the public sector in terms of strengthening the R&D system and providing incentives to promote processing technologies in barley clusters.

When the investment will be made, it will improve various value chain operations thus will involve additional operational costs at various segments of the chain estimated at US$0.98 million during the 5th year of the project. This will generate a gross revenue worth of US$1.67 million during the last year of the project. Accounting for all the yearly value chain costs including the production, processing and marketing costs applied over five years and investments made, the estimated net cash flow (undiscounted) would be US$ 0.688 million in the 5th year. The discounted Net Present Value (NPV) over the project period is estimated at US$0.395 million while the average Internal Rate of Return (IRR) is 29% for the central points of both the clusters. The cluster level infrastructure and investment requirements, induced cost and return for various stakeholders along the value chain, IRR and NPV of these interventions at the cluster level can be seen in the attached summary sheet.

To achieve these benefits, however, the research system needs to be strengthened to address the issues of each clusters, and capacity of farmers to adopt new technologies need to be built.

Summary Sheet of Barley Cluster

Information	Punjab	Balochistan	Total
Area under cultivation in barley focal point (ha)	6,400	4,000	10,400
Total barley Production of focal point district (t)	5,600	4,500	10,100
Default yield (t/ha)	0.88	1.13	0.97
Area of the cluster (ha)	14200	7400	21,600
Production of the cluster (tonnes)	11800	9100	20,900
Additional production from improved varieties in 5th year (t)	2,690	1,604	4,293
Additional value from improved varieties in 5th year (US$)	618,609	368,887	987,496
Production through improved value chain in 5th year (t)	3765	2495	6,260
Value of the improved value chain in 5th year (US$)	161,914	107,280	269,194
Percentage of production for processing	10%	10%	10%
Raw production of barley used in processing in 5th year (t)	269.0	160.4	429
Barley porridge production in subsequent years (t)	147.9	88.2	236
Additional value from barley porridge (US$)	164,365	98,014	262,378
Total barley flour production (t)	126.4	75.4	202
Additional value from Barley flour (US$)	93,638	55,838	149,476
Total Value from increased barley flour processing (US$)	258,003	153,852	411,854
Barley Porridge Production Units required	7	5	12
Barley Porridge Production Units investment	47,955	34,253	82,208
Investments			
Investment on R&D establishment (US$)	200000	150000	350000
Investments required on extension services (US$)	100000	70000	170000
Investments required on stakeholder interaction (US$)	140000	140000	280000
Investment on processing	47954	34253	82208
Loans on processing infrastructure	5514	3939	9453
Total investments (US$)	493469	394253	8877237
Source of Investment			
Public Investment (US$ Million)	0.455	0.371	0.826
Private Investment (US$ Million)	0.038	0.027	0.066
Economic Analysis (000 US$0			
Gross revenue of all interventions	1,038.5	630.0	1,668.5
Total operational cost during the 5th year	**634.62**	**345.47**	**980.09**
Net cash flow during the 5th year	403.91	284,55	**688,45**
NPV (US$)	255,82	138.87	394,69
IRR	**33%**	**25%**	**29%**

1. INTRODUCTION

Barley, locally known as '*jao*', is a widely cultivated cereal crop in the world. The crop is the hardiest of all the cereal grains. It is one of the first cultivated grains in history and it remains one of the most widely consumed grains, globally. Barley cultivation extends farther north than any other crop and at the same time it can be cultivated in sub-tropical countries. Barley has a short growing season and is also relatively drought and salinity tolerant. Globally barley is ranked fourth among grains in quantity produced behind maize, rice and wheat.

Barley is being used since ancient times as a food for humans and animals, as well as to make alcoholic beverages. Barley grains are also used for porridge, animal feed, flour and malt drink. In addition, barley water is used for medicinal purposes. Barley is a concentrated source of nearly three dozen vitamins and minerals[1]. It is particularly rich in vitamins A, C, B1, B2, folic acid and B12, calcium, iron, potassium and chlorophyll[2]. Barley-grains have 10-12 percent water, 10-12 percent protein and 60 percent starch. However, it lacks nitrogenous compound called gluten which is present in abundance in wheat. Barley is highly nutritious and the salts it contains have a high proportion of phosphoric acid[3]. Consuming barley might have benefits for the heart, blood pressure, and bones; useful in maintaining a healthy weight and provides a high percentage of an individual's daily requirement of manganese and selenium[4].

Barley is divided into two general types; 2-row and 6-row and the most obvious difference between a head of 2-row barley and a head of 6-row barley is the arrangement of the kernels when the head is viewed down its axis. In general, 6-row malted barley has more protein and enzyme content, is thinner and contains less carbohydrate than 2-row malt. There are also flavor differences between 2-row and 6-row barley.

In Pakistan, mostly cultivated type is 6-row barley, however the demand of the industry like Murree Brewery is 2-row barley which is currently being imported[5]. Ayub Agricultural Research Institute, Faisalabad recently evolved 2-rows barley varieties namely Jau-17 & Sultan-17.

1.1. National scenario of barley production

During 2017-18, total area under barley in Pakistan is about 60 thousand ha with production of 58 thousand tonnes giving an average yield of 0.95 tonnes per ha (Annexure 1). Barley area and yield are continuously on declining trends which have produced a strong downward production trend (Figure 1).

[1] https://www.dawn.com/news/280620
[2] https://www.auroville.com/barley-powder-pack.html
[3] https://pakissan.com/english/news/newsDetail.php?newsid=15873
[4] https://www.medicalnewstoday.com/articles/295268.php
[5] Discussion with Murree Brewery Management.

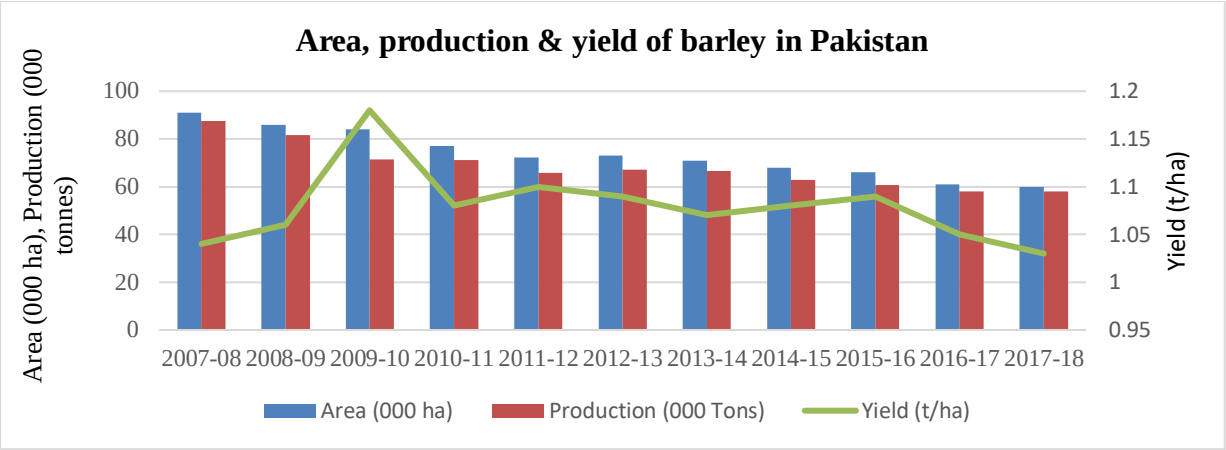


Figure 1: Area, production and yield of barley in Pakistan

Source: MNFS&R (2018), Chapter 2-Agriculture, page 19

Barley covers 0.26% area of total cropped area in Pakistan. Punjab and KP each contributes about one third of the total barley area, while KP and Sindh each have 18% and 12% share in (Table-1).

Table 1: Provincial contribution and share in total cropped area, 2017

Province	Area under barley crop (acres)	Provincial contribution(%)	% of total cropped area
Punjab	8701.3	35%	0.13
Sindh	3075.7	12%	0.24
KP	8377.2	34%	1.12
Balochistan	4492.5	18%	1.05
Total (Pakistan)	24646.7	100%	**0.26**

Source: NFS&R (2017)

Average yield of barley in Pakistan at 0.9 tonnes/ha which is lower than the world average yield of 3.0 t/ha and much lower than in main barley producing countries (Figure 2).

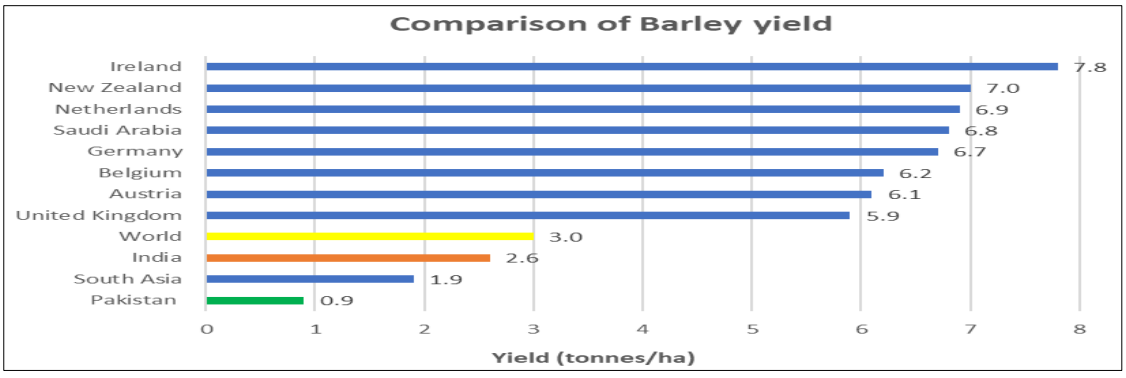


Figure 2: Comparison of barley yield across countries

Source: FAOSTAT Producers Price http://www.fao.org/faostat/en/#data

Area of barley in Pakistan has declined from 113 thousand ha in 2001 to 68 thousand tonnes in 2015 with an average downward trend of 3.5% per annum, while production declined from 99 thousand tonnees to 63 thousand tonnes with an average annual per capita declining rate of 3.7% during the corresponding period (Table 2).

Table 2: Trend in barley area (000 ha) and production (000 tonnes) in Pakistan by province during 2001-15

Year	Punjab		Sindh		KP		Baluchistan		Pakistan	
	Area	Prod	Area	Prod	Area	Prod	Area	Prod	Area	Prod
2001-02	32.0	32.8	16.3	8.9	43.9	32.9	20.8	24.3	113.0	98.9
2002-03	35.2	33.7	14.1	6.4	40.1	34.7	21.2	25.0	110.0	99.8
2003-04	39.9	38.4	13.5	5.8	33.2	30.6	21.1	24.8	107.0	99.6
2004-05	37.6	35.8	10.3	4.4	32.9	32.9	20.8	24.5	101.0	97.6
2005-06	35.9	35.2	7.7	3.4	32.2	32.7	17.5	20.4	93.0	91.7
2006-07	34.8	32.0	6.5	2.9	32.8	33.5	15.8	19.1	89.0	87.5
2007-08	37.0	34.6	7.7	4.2	32.1	32.7	17.2	21.2	94.0	92.7
2008-09	32.8	28.9	8.2	4.4	32.5	31.9	17.6	22.2	91.0	87.4
2009-10	33.0	30.4	6.5	3.6	30.5	27.5	16.0	20.0	86.0	81.5
2010-11	31.4	28.2	7.5	4.3	29.6	26.0	15.6	12.9	84.0	71.4
2011-12	25.6	24.7	11.6	6.9	27.4	23.7	12.5	15.9	77.0	71.2
2012-13	22.9	20.0	9.1	5.4	26.9	23.1	13.3	17.2	72.2	65.7
2013-14	25.1	22.5	8.4	5.1	26.3	22.8	13.3	16.8	73.0	67.2
2014-15	24.0	21.7	8.7	5.3	24.6	21.9	13.6	17.6	71.0	66.5
2015-16	24.1	20.8	8.1	5.0	23.4	21.1	12.1	15.9	68.0	62.8
Annual growth (%)	-3.5	-4.3	-3.3	-0.7	-3.5	-3.7	-3.7	-3.5	-3.5	-3.7

Source: NFS&R (2018)

This suggests that yield also declined with an average annual rate of 0.2%. The decline in barley area perpetuates in every province of the country although production decline was highest in Punjab implying that yield decline was also highest in Punjab (Table 2).

The existing demand of barley in Pakistan is around one hundred thousand tonnes (Pakistan Economic Survey 2017-18, Chapter 2-Agriculture, page 19), of which around 63 thousand tonnes is locally produced, and rest is imported. Pakistan imports of barley is on a steep rise from 0.11 thousand tonnes in 2001 to 42.8 thousand tonnes in 2016 worth of US$27 thousand to US$11.75 million in the corresponding period.

However, Pakistan has been a barley exporting countries in early 1970s. During 1974, for example, Pakistan exported 94.6 thousand tonne of barley worth of US$10.5 million which, due to laxity of policy makers towards the crop, has dwindled to almost nil during 2016. It indicates the potential of barley production in the country to expand production and at least reduce its imports.

The production and demand of beer of barley has also declined in the country from 10.9 thousand tonnes in 2001 to 4.5 thousand tonnes in 2014 (FAOSTAT data downloaded on April 28, 2019). Pakistan also imports beer of barley but the quantity was only few tonnes during the latest years.

Producer price of barley in Pakistan has been higher as compared to other main barley exporting countries (Table 3) suggesting that it has become an uncompetitive crop for the country. The cost of production is also higher which is mainly due to lower yield. During 2016, the local market price was US$335 compared to world average of US$ 152 per tonne. Even higher difference can be seen during 2010 (Table 3).

Table 3: Producer Prices of Pakistan (US$/tonne) compared with other main barley producers

Country	Year 2010	Year 2016
Pakistan	265	199*
France	203	139
Germany	166	139
Australia	158	188
Ukraine	120	118
Russian Federation	112	115
Kazakhstan	92	77
World Average	165	155

Source: FAOSTAT Producers Price http://www.fao.org/faostat/en/#data

There are fewer barley processing and value addition activities in the country. Limited buyers and processing facilities exist in the country. A fewer barley products are available in the markets as per customer demand. Currently, Murree Brewery, Fauji Cereals, Gourmet Foods, Nestle Pakistan and Pakistan Army are the main buyers of barley from local as well as international markets.

There is need to enhance R&D for development of new varieties for processing purpose and production/protection technology. Moreover, emphasis may be given on quality like low husk, more starch, protein contents ranging from 11-12%, and low moisture percentage. Farmers may be encouraged and supported to cultivate barley and establish proper markets. Contract farming may be promoted to facilitate both farmer and processor. Value addition & customer awareness campaign should be initiated. The new/organic barley products should be introduced like alcoholic & non-alcoholic beverages, bakery products, baby foods, porridges, cosmetics, medicines, animal feed etc.

1.2. Global scenario of barley

On a global scale, the annual production of barley during 2016 accounts for approximately 147.4 million tonnes. However, more than a quarter of production are grown for the processing industry, which makes barley the world's leading crop for processing. Pakistan performs very low in terms of per ha yield, export-production ratio, and export price in the international barley

sector. Its yield is only 30% of the world average yield. It contributes only 0.04% in world production (Table4).

Table 4: Comparison of world vs. Pakistani barley sector 2016-17

Parameter	World	Pakistan	Share (%)
Area (000 ha)	47009	61.0	0.13
Production (000) tonne-dry	147404	58.1	0.04
Value of production (Million US$)	22906	19.47212	0.09
Yield (tonne/ha)-dry	3.14	0.95	30
Farm gate price (US$/tonne)	155	335	216
Quantity of international trade (000 tonne)	31869	0.0	0.00
Value of international trade (Million US$)	5751	0.006	0.00
Export quantity as % of production	22%	0%	-
Export value as % of production value	25%	0%	-
Average export prices (US$/tonne)	180	273	151

Source: FAOSTAT 2018, Production, Crops http://www.fao.org/faostat/en/#data/QC

FAOSTAT 2018, Trade, Crop and Livestock Products http://www.fao.org/faostat/en/#data/TP

In 2016, barley was cultivated on 48 million ha worldwide producing 146 million tonnes. In contrast to Pakistan where production is on a steep declining trend, the barley production at the global level remained almost stagnant during 2001-16. While barley area declined at a rate of 1.30% per annum which was compensated with a higher increase in yield at 1.32% per annum during the period (Table 5). Despite the global stagnating production of barley grain, the production of bear of barley has increased at a rate of 2.49% per annum during the period suggesting that higher percentage of barley grain is used in bear production and the consumption of raw grain has declined over the period.

Table 5: Trend in international dry grain and beer of barley production during 2001-16

Year	Dry grain			Beer of barley (million tonnes)
	Area (million ha)	Production (million tonne)	Yield (tonne/ha)	
2001	55.8	140.6	2.52	140.1
2002	55.1	141.0	2.56	140.5
2003	57.5	136.5	2.37	142.8
2004	57.4	156.3	2.72	151.3
2005	55.6	136.7	2.46	155.7
2006	56.6	144.5	2.55	164.6
2007	54.9	131.1	2.39	172.9
2008	55.1	153.8	2.79	176.8
2009	54.4	150.8	2.77	174.5

Year	Dry grain			Beer of barley (million tonnes)
	Area (million ha)	Production (million tonne)	Yield (tonne/ha)	
2010	47.4	123.3	2.6	178.6
2011	48.4	132.7	2.74	185.8
2012	49.8	132.2	2.65	188.3
2013	49.8	143.5	2.88	188.6
2014	49.7	145.1	2.92	180.3
2015	48.7	147.4	3.03	-
2016	47.7	145.8	3.06	-
Growth rate (%)	-1.30	0.02	1.33	2.49

Source: FAOSTAT 2018, Production, Crops http://www.fao.org/faostat/en/#data/QC

FAOSTAT 2018, Production, Crop Processed http://www.fao.org/faostat/en/#data/QD

Barley grain trade has expanded at the rate of 8.3% per annum. The quantity and value of bear of barley trade also expanded at a rate of 4.5% and 6.1% per annum.

Despite the stagnation in barley production, the trade in barley is increasing at a rate of 3.3% per annum in terms of traded quantity and 8.3% in terms of its value. (Table 6) This implies that increasing more barley production is utilized somewhere else from where it is produced. Moreover, barley prices are increasing over time as production lags behind its utilization

Table 6: International trade in barley products (Quantity in million tonnes and value in billion US$) during 2001-2016

Year	Barley-grain		Pearled barley		Bear of barley		Total Value
	Quantity	Value	Quantity	Value	Quantity	Value	
2001	19.7	2.3	17.872	5.0	7.5	5.1	7.5
2002	22.7	2.4	57.343	38.1	8.2	6.0	8.5
2003	21.9	2.9	17.954	5.2	8.4	6.7	9.7
2004	23.0	3.3	13.061	4.6	9.0	7.5	10.8
2005	25.8	3.6	69.017	11.5	9.9	8.1	11.7
2006	24.0	3.5	21.401	6.7	11.1	9.2	12.6
2007	23.2	5.5	12.278	7.2	11.8	10.1	15.5
2008	27.2	7.7	12.054	9.6	12.1	11.0	18.7
2009	25.7	4.5	19.081	9.2	11.0	10.3	14.8
2010	26.5	4.9	22.490	9.5	11.7	10.9	15.8
2011	25.4	7.1	29.596	14.3	12.6	11.8	19.0
2012	28.5	7.9	33.264	17.1	14.0	12.7	20.7
2013	31.1	8.7	35.071	19.0	14.0	13.4	22.0
2014	33.5	7.8	35.550	16.6	13.9	13.5	21.3
2015	38.3	7.8	48.491	17.7	14.4	12.8	20.7
2016	31.9	5.8	46.662	16.2	15.2	13.2	18.9
Growth rate (%)	3.3	8.3	4.0	6.0	4.5	6.1	6.8

Source: FOSTAT, Trade Data http://www.fao.org/faostat/en/#data/TP

Russia is the leader of barley production remotely followed by Australia, and Germany. Pakistan ranks at 57th position among barley producing countries of the world. The highest per ha yield producing country are Germany, France, and United Kingdom (Table 7).

Table 7: Production of barley in main barley producing countries of the world, 2016

Sr. No.	Country	Production (million tonnes)	Country	Area (million ha)	Country	Yield (Tonne/ha)
1.	Russian F.	20.6	Russian F.	7.85	Germany	6.94
2.	Australia	13.5	Australia	4.83	France	6.29
3.	Germany	10.9	Spain	2.60	United Kingdom	6.10
4.	France	10.5	Ukraine	2.50	Canada	3.59
5.	Ukraine	8.3	Turkey	2.42	Ukraine	3.32
6.	Canada	7.9	Canada	2.20	Turkey	2.93
7.	United Kingdom	7.2	Kazakhstan	2.07	Australia	2.80
8.	Turkey	7.1	Morocco	2.00	Russian F.	2.62

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

France and Australia are the major exporters of barley-dry grain, while Mexico is the major exporter of beer of barley. In pearled barley, Belgium, Netherland, and Czechia are the lead exporter (Table 8).

Table 8: Main exporters of barley & its products in year 2016 (quantity in tonnes)

S.No	Barley-dry grain		Beer of barley		Pearled barley	
	Country	Quantity (million t)	Country	Quantity	Country	Quantity
1	France	5.87	Mexico	3.22	Belgium	9.73
2	Australia	5.81	Netherlands	1.87	Netherlands	9.22
3	Argentina	3.23	Germany	1.65	Czechia	7.22
4	Germany	2.90	Belgium	0.83	USA	5.88
5	Russia	2.86	France	0.65	Germany	4.55
6	USA	1.76	USA	0.62	Italy	4.12
7	Ukraine	1.57	UK	0.60	UK	2.09
8	Romania	1.31	Czechia	0.45	Russia	1.37
9	Canada	1.21	Ireland	0.43	Denmark	0.90
10	Kazakhstan	0.78	Russia	0.38	Latvia	0.59

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

Saudi Arabia and China are the major importer of barley grain, while USA is the lead importer of Beer of barley. In Pearled barley, UK and Netherlands are the lead importer (Table 9).

Table 9: Main importers of barley & its products during 2016

Sr. No.	Barley-grain dry		Beer of barley		Pearled barley	
	Country	Quantity (million t)	Country	Quantity (million t)	Country	Quantity (000 t)
1	Saudi Arabia	6.33	USA	3.91	UK	9.4
2	China	5.00	UK	1.06	Netherlands	5.3
3	Netherlands	1.86	France	0.78	Germany	4.1
4	Belgium	1.71	Germany	0.73	Viet Nam	3.2
5	Iran	1.45	Italy	0.69	Spain	2.7
6	Germany	1.28	China	0.65	Italy	2.1
7	Japan	1.16	Spain	0.49	USA	1.7
8	Spain	1.07	Australia	0.40	Slovakia	1.6
9	Morocco	0.98	Canada	0.38	Portugal	1.5
10	Jordan	0.96	Netherlands	0.37	Canada	1.0

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

Form the analysis of the macro data, it can be concluded that Pakistan's performance in the barley sector has been poor during the 2000s. The area, production, and per ha yields of the crop in the country are on a steep decline, while imports of barley grain and its products are on the rise to meet the domestic demands. Pakistan now gets only 30% of the world average yield and its producers' prices are far higher than the world average mainly because of low yield. Although barley markets like Saudi Arabia and China exist in the neighborhood of Pakistan but the country did not benefit from this proximity.

Pakistan has a potential to become competitive in the domestic and international barley markets as once it was. But for this, the country has to carefully identify the gaps and potential and make careful investments decisions on economically viable interventions along barley value chain. This study attempts to do this in the regional context by identifying the major barley growing clusters in the country and suggesting upgradation plan and economically viable interventions along the value chain for the major barley growing clusters.

2. OBJECTIVES

The prime objective of this study is to suggest interventions for the purpose of improving the value chain of barley so that the competitiveness of barley production can be improved in the national and international markets and thus contributes to *the Cluster Development Based Agriculture Transformation Plan -V2025.* Specific objectives of the study are:

- To identify the major clusters of barley production in Pakistan,
- To conduct a detailed diagnosis and SWOT of the barley value chain in each cluster,
- To identify technological, institutional, infrastructure and policy gaps in each cluster,
- Assess the potential of barley production in each barley producing cluster,
- Prepare an upgradation plan and strategies to harness the cluster potentials,
- Suggest technological interventions to implement the plan,
- Conduct economic and social feasibility of the suggested interventions, and
- Make suggestions to improve the competitiveness of the barley sector in Pakistan.

3. METHODOLOGY

3.1. Collection of Macro data:

Relevant macro data were collected from various published and unpublished reports of government and non-governmental organizations and internet search on barley value chain. Stakeholders discussions especially with farmers also provided basic information on production and value chain costs. Long-term statistics on production, prices, trade, etc. were obtained from the FAOSTAT, and national and provincial statistics.

3.2. Literature review:

The literature related to the functioning, gaps, and interventions in Banana value chain is reviewed and synthesized in Section-4. The literature reviewed in this study is listed in Annexure 2.

3.3. Stakeholders consulted:

Primary information was collected through meetings, consultations, key informant interviews, surveys and focus group discussions using structured tools and open-end questionnaires. List of stakeholders consulted are given in Annexure 3.

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

- Global and Pakistan context of barley sector;
- Production potential and review of barley sector;
- Cost of production, harvesting and processing and marketing margins of barley;
- Issues and constraints relating to production, marketing and processing;
- Stakeholders suggestions and benchmarks;

4. LITERATURE REVIEW

Barley (*Hordeum vulgare* L.) is the most widely grown cereal crop over broad environmental conditions and is the world's fourth important cereal crop after wheat, maize and rice *(USAID, 2014).* Food barley is principally cultivated in the highland where it is highest consumption in the form of various traditional foods and local beverages takes place. *Ceccarelli et al. (1999)* indicated that barley grain accounts for over 60% of food for the highlands in Ethiopia.

According to *Berhanu et al. (2005),* barley is used in diversity of recipes and deep rooted in the culture of people's diets. In Ethiopia, annual national average grain yield of barley at about 1 t ha-1 is quite low when compared with the yield potential of some of the released food-barley varieties. These varieties, if used in conjunction with the suggested efficient practices in their appropriate niches, have shown the possibility of boosting the production and productivity of the crop. Some of the major food-barley production constraints are low-yield capacity of farmers' varieties; inadequate number of improved varieties; lack of appropriate production practices; biotic stresses such as disease; weeds; abiotic stresses such as poor soil fertility, low soil pH, drought, waterlogging, and frost and loose linkage between research and extension services.

Malt barley, due to its limited usage and high-quality requirements, is a unique niche product in international grain market representing only about 1.5% of the total world grain production *(USAID, 2014).* It is particularly interesting in the context of smallholder commercialization and food security since it has high value as both cash and food crop. It is also the major raw material (about 90% of the total raw material cost) used in beer production and mainly produced in south eastern parts of Ethiopia particularly in east and west Arsi, west Shewa and Bale administrative zones of Oromia region *(Legesse et al., 2007).*

Value chain analysis is a better alternative approach to conventional marketing to understand the determinants of malt barley producers' market orientation. It also enables researchers to analyze the different actors and their roles; benefit and shares among the actors and the need for upgrading the chain (Watabaji, et. al., 2016). A barley value chain research conducted by *Rashid et al.* (2014) in Ethiopia focused on production and productivity, determinants of quantity supplied and some value chain aspects of barley in general on selected zones using focus group discussion and key informant interview.

In South Africa barley is planted mainly for malting purposes, as there is no significant feed market for barley due to the large volumes of maize produced in the country that serve as a main ingredient in animal feed production. Barley varies from most other agricultural commodities in that producers are mainly limited to only one major barley buyer in South Africa, namely South African Breweries Malting (Pty) Ltd. Barley producers in the country have a guaranteed market for their produce as well as fixed price contracts with the buyer *(*Department of Agriculture, Forestry & Fisheries, 2014*)*.

5. CLUSTER IDENTIFICATION AND CHARACTERISTICS

5.1. Geographical Identification of Clusters

The district level data of barley (Table 10 and Annexure 4) suggest that the following barley clusters can be identified:

i. **South Eastern Punjab** (for simplicity this will be referred as Punjab cluster). This cluster comprises of five districts in the south eastern Punjab with Layyah as a focal point. The cluster contributes 59% of total barley area and 57% of production of the whole Punjab (Tablem9). It has an average yield of 0.83 t/ha. Layyah is selected as focal point because it alone contributes 27% of the total area and production of the province. This cluster has a potential to produce exportable quality of barley. The connectivity of the cluster with airport in Bhawalpur and Multan further improve the potential of the cluster for export. Layyah also has a big barley market and well connected with other districts of the cluster as well as with other parts of the country.

ii. **Central Balochistan Cluster** (for simplicity, this will be called as Balochistan cluster). This cluster comprises of five districts of Baluchistan. The cluster contributes 61% of Balohistan's barley area and 57% of its production (Table 10). Awaran and Turbat are selected as the focal points of the cluster because its contribution in both barley area and production is highest in the province. The average yield of the cluster is 1.23 t/ha while average yield of the focal point is 1.1 t/ha. This cluster is scarce of irrigation water and mostly depends on rains, which favors the development of barley. Besides this cluster also lack the provision of any nearby airport.

iii. Weak clusters which and can be potentially invigorated are:

- Punjab (Attock, Rawalpindi districts).
- Sindh (Larkana & Thatha districts)

The farmers in these clusters are scattered over a big area. The researchers did not find much interaction among barley growing farmers and processers. Therefore, we will not explore further these clusters.

Table 10: Major Barley Producing Districts and barley clusters of Pakistan during 2013-14

District/	Area in 000 Ha	Share in the total punjab area (%)	Production in 000Tonnenes	Share in the total punjab production (%)
Cluster 1, South Eastern Punjab				
Layyah	6.4	27	5.6	27
Muzzafargarh	4.1	17	4.1	20
Bahawalnagar	1.5	6	0.4	2
Bhakkar	1.3	5	1.0	5
Mianwali	0.9	4	0.7	3
Cluster total	14.2	59	11.8	57
Punjab	**24.1**	59	**20.8**	57
Cluster 2, Balochistan				
Awaran	2.2	18	2.4	15
Turbat	1.8	15	2.1	13
Khuzdar	1.7	14	2.3	14
Kalat	0.9	7	1.2	8
Kachhi	0.8	7	1.1	7
Cluster total	7.4	61	9.1	57
Balochistan	**12.1**		**15.9**	

Source: Agriculture Marketing Information Service (AMIS), http://www.amis.pk/Agristatistics/DistrictWise/2012-2014/Barley.html

These geographical location of clusters are shown in Figure 3

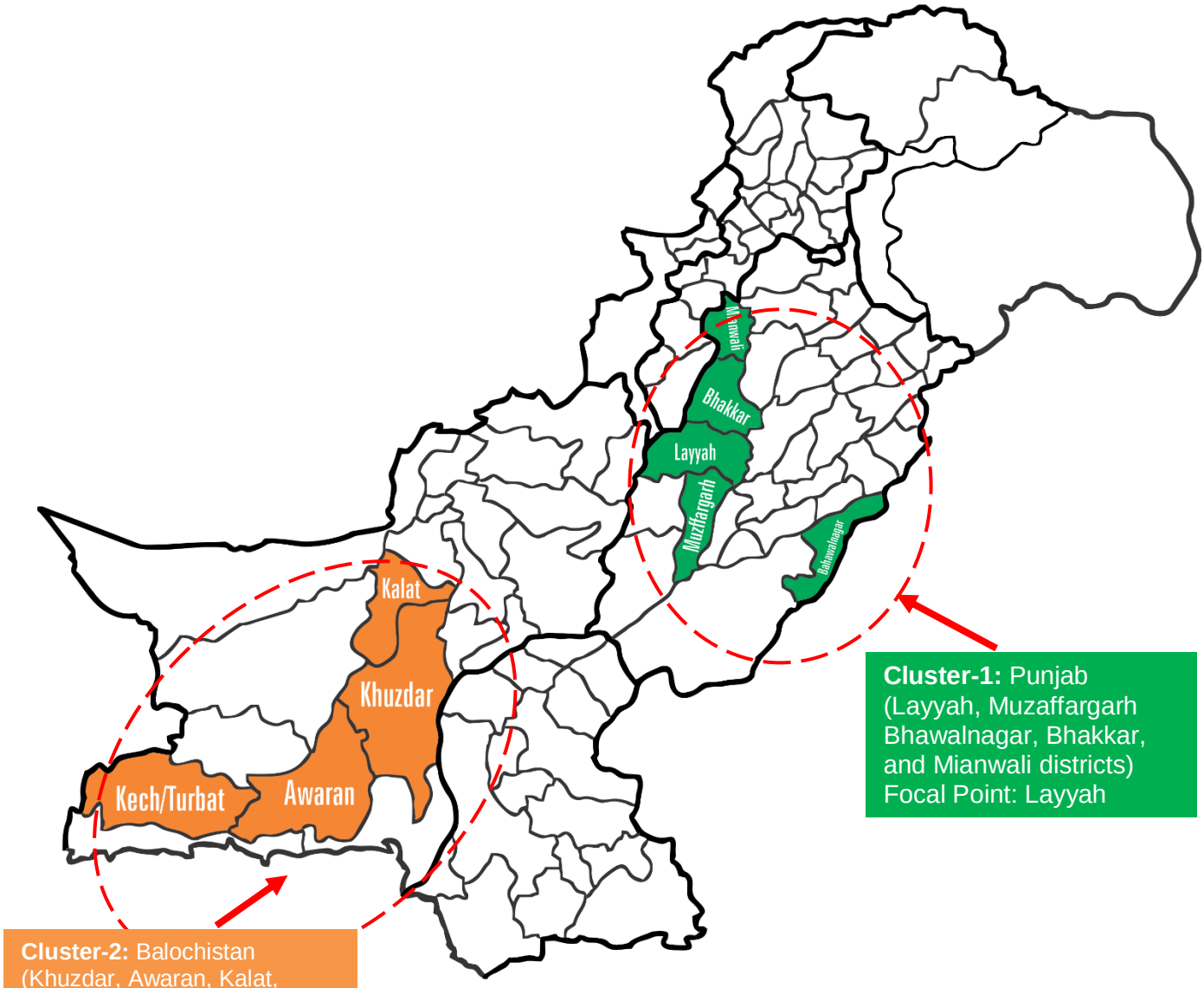


Figure 3: Map of selected clusters

5.2. Comparison of cluster characteristics

The comparison of selected clusters is given in below Table 11.

Table 11: Comparison of characteristics across selected clusters

Characteristics	Punjab Cluster	Balochistan Cluster
Districts	Layyah, Muzaffargarh, Bahawalnagar, Bhakkar, Mianwali (Punjab)	Khuzdar, Awaran, Turbat, Kalat & Kachhi districts (Balochistan)
Area of the cluster (000 ha)	14.2	7.4
Production of the cluster (000 tonnes)	11.8	9.1
Average yield of the cluster (t/ha)	0.83	1.23
Focal point	Layyah	Khuzdar
Focal point area (000 ha)	6.4	4.0
Focal point production (000 tonnes)	5.6	4.5
Focal point yield (tonne/ha)	0.88	1.13
Percentage of the barley area that lies in the cluster (barley area of the cluster/Barley area in the country)	20%	10.4%
Percentage of total cropped area in the cluster (barley area in the cluster/total cropped area in the cluster)	1.6%	4.2%
Geographical and environmental factors	Loam/clay loam soils in Muzaffargarh and Sandy Loam/Loam in Layyah, OM is less than 0.5%	Silt loam to clay soils
	Flat lands	Flat soils, locked with rocky hills in Khuzdar district
	Winter climate is mild for barley production	Winter climate is mild for barley production
	Barley is grown through artificial irrigation system	Barley is grown through artificial irrigation system
	Climate classified as BWh by the Köppen-Geiger system	Climate classified as BWh by the Köppen-Geiger system
	Arid climate, very low and erratic rainfall, average rainfall is 195 & 157 mm in Layyah & Muzaffargarh, respectively.	Arid climate, very low and erratic rainfall, average rainfall is 125 & 225 mm in Awaran & Khuzdar, respectively.
	Precipitation mostly in monsoon, winter months are almost dry	Precipitation mostly in monsoon, winter months are almost dry

Characteristics	Punjab Cluster	Balochistan Cluster
	Highest average in June (35°C), reaches up to 44°C in June. Lowest in January, when it is around 12°C, reaches up to 3°C in January.	Highest average in June (30°C), reaches up to 40°C in June. Lowest in January, when it is around 10°C, reaches up to 1.3°C in Khuzdar and 6°C in Awaran.
	Frost and high temperature in March & April impact grain formation	Frost and high temperature in March & April impact grain formation
Barley growers	Small to medium land holders, 1000s of farmers are involved in barley cultivation	Small to medium land holders, 1000s of farmers are involved in barley cultivation, poor farmers
	No barley grower association	No barley grower association
	Household labor for sowing and harvesting	Household labor for sowing and harvesting
Product features	Cultivated for grain purpose	Cultivated both for fodder & grain purpose. 2-3 cutting for fodder/grazing of sheep & goats
Variety features	Mostly 6 row old & low yielding varieties of barley are cultivated	Mostly 6 row old & low yielding varieties of barley are cultivated
	Old varieties (6-row): Jau-87 & Haider-93 2-row Sultan-2017 & Jau-2017 are recently approved in Punjab but not disseminated on farmers field	Main cultivars are Surab-96 and Awaran-2002
	Salt & drought tolerant varieties	Salt& drought tolerant & lodging resistant varieties
	No certified seed is available	No certified seed is available
	6-row varieties have more husk & less starch and 2-row have more starch & less husk	Better quality due to long duration and mild weather
	Hay is not liked by Animals	Fresh fodder or grazing
Supply Cycle	Sowing: November Harvesting: April	Sowing: October 1st & 2nd week cuts for fodder: November & December Harvesting for grains: Last fortnight of April to first fortnight of May
Planting Input/management practices	Farmers retain their own seed or purchase from local markets, certified seed is not available. The land is prepared by 2-3 ploughing with planking and planting is usually with broadcast	Farmers retain their own seed or purchase from local markets, certified seed is not available. The land is prepared by 2-3 ploughing with planking and planting is usually with

Characteristics	Punjab Cluster	Balochistan Cluster
	method with 50-60kg seed rate per ha.	broadcast method with 50-60kg seed rate per ha.
	Less input (water & fertilizer) requiring crop	Less input (water & fertilizer) requiring crop
	Low fertilizer application by split application	Low fertilizer application
	No pesticides application	No pesticides application
	No weedicides are used	No weedicides are used
	2-3 irrigations by flooding	2-3 irrigations
Plant protection measures	Crop lodging is problem due to weak stem	No crop lodging
Plant protection measures Harvesting & threshing	Generally, no plant protection & weed control measures are in practice	Generally, no plant protection & weed control measures are in practice
	Manual harvesting & threshing by wheat thresher, grain shattering is problem	Manual harvesting & threshing by wheat thresher
Product Type	Yield is 0.83 t/ha, less than potential	Yield is 1.23 t/ha, less than potential
Product Type Marketing	Grain & straw	Grain, fodder & straw
	No proper marketing	No proper marketing
	Mainly few middle men are involved in the business	Farmers sell barley grain to commission agents in local markets
	Farmers sell their produce in local markets to commission agents. About 5-10% is retained by the farmer for future planting and home consumption.	Farmers sell barley grain to commission agents in local markets
Storage/processing/ value addition Storage/processing/ value addition	Fluctuating price, Local market price varies from Rs. 9600-15100 per tonne, which is very less, even less than wheat but competitive to international price	Fluctuating price, Local market price varies from Rs. 9600-15100 per tonne, which is very less, even less than wheat but competitive to international price
	Less profitable	
	No modern storage facilities are available	
Certification	A fewer barley products are available in the markets as per customer demand, like porridge, pearled barley, flour, malt drink, beer, animal feeds. Barley porridge is available on some stores including supermarkets.	

Characteristics	Punjab Cluster	Balochistan Cluster
	Murree Brewery, Fauji cereals, Gourmet Foods, Nestle Pakistan and Military are the main buyers of barley from local as well as international markets.	
Certification	Barley crop and its products are not certified under organic category, though no pesticide and weedicides are being sprayed	Barley crop and its products are not certified under organic category, though no pesticide and weedicides are being sprayed
	No awareness of farmers about organic certification Certification is costly and not affordable	No awareness to farmers about on organic certification, it is costly and not affordable
Barley profitability	Barley is not a profitable crop for the farmers, as its yield and price in very low	Barley is not a profitable crop for the farmers, as its yield and price in very low. However, first 2 cuts are used as fodder or the grazing of sheep/goats.
Source: Feedback from different stakeholders and survey of secondary sources		

5.3. Value Chain Analysis

In existing value chain, the barley grains are used for porridge, beer, animal feed, flour & malt drink at the plant. Barley straw is used in animal feed, paper industry and as fuel purpose. Barley growers sell their produce to commission agents or pre-harvest contract and sometime directly to private processers. The barley purchased by the processor are then processed into different by-products of barley which reaches to consumers through wholesalers and retailers as depicted below.

Figure 4: Existing barley value chain

There are limited number of buyers and processing facilities in the country and farmers get less price of their produce due to lack of proper marketing. Further, the farm storage facilities are inadequate. A fewer barley products are available in the markets as per customer demand. Currently, Murree Brewery, Fauji cereals, Gourmet Foods, Nestle Pakistan and Military are the main buyers of barley from local as well as international markets. The new/organic barley products should be introduced as depicted below:

Figure 5: Barley products diversification

As illustrated in Figure 6, several by-products of barley are available. There is a need to diversify the value chain of barley to promote some of these products such as baby foods, pearled barley, malt, drinks, powder, bakery products and mixing barley flour in wheat flour. The organic products of barley (Figure 7) should also be emphasized like pearled barley, porridge and malt etc.

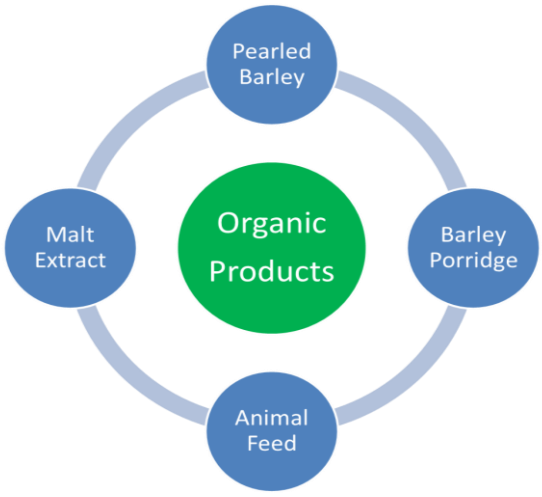


Figure 6: Organic barley products

5.4. SWOT Analysis

5.4.1 Overview of SWOT Analysis

The SWOT analysis is carried out in focus group consultation conducted in major barley producing areas with the participation of different barley stakeholders along the value chain.

The results are organized around the value chain functions, including inputs, production, storage, and marketing.

The SWOT analyses for Punjab and Baluchistan barley clusters in in Table 12 and Table 13 suggest that extensive canal and tube well irrigation system, presence of progressive farmers, strong input supply systems are few of the strengths for south Punjab cluster but opposite is the case for Balochistan which is lacking canal irrigation and developed road infrastructure. On the other hand, poor planning, policy and priority neglect, nonexistence of a barley research institute, inadequate investment in R&D, weak extension, poor marketing infrastructure etc. are the major constraints in barley development in both the clusters. Threats include diseases and natural disasters, such as, climate change, sudden shortage of irrigation in Punjab and severe scarcity of irrigation water in Balochistan and occurrence of floods, energy shortages, lack of processing facilities, high transport cost specially for Balochistan cluster and non-transparent trading practices in local market systems. These factors generally hold back investment into the value chain and inhibit its development. Table 7 presents the SWOT analysis for barley Central Balochistan & South Punjab clusters.

Table 12: SWOT Analysis of Punjab Barley Clusters

Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
Environment, climate, soil	- Favorable environment - mild climate - Sandy loam soils - Fit in existing cropping pattern - Drought & salt tolerant crop	- Frost & terminal heat - Soil fertility status & less organic matter	- Can be grown on marginal lands - Suitable soil and climate	- Climate change - Depleting groundwater resources
Varieties/ technologies/ Quality	- Recently evolved 2-row varieties i.e., Sultan-2017 and Jau-2017 by AARI are high yielding subject to adoption of recommended production technology	- Limited availability of certified seed - Low yielding varieties - Grain shattering - Obsolete production & protection technology - Farmers' unawareness - Lack of R&D - Low quality (more husk, less starch) - Crop lodging - Hay is not liked by animal and due to husk stiffness	- Germplasm acquisition from barley growing countries - Evolution of high yielding varieties - Improvement in quality - Seed regulation under Seed (Amendment) Act, 2015 - Malt varieties	- Low yielding varieties
Input supplies	Less input requirement Low water requirement Production technology as of wheat	- Low fertilizer application - Lodging - No weed control	- Contract farming - Poor man can grow	

Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
Marketing & industry	- Grain & straw both can be used - Can be grown for fodder purpose and grain for animal feed - Many Products are available worldwide	Price instability No proper marketing Limited purchasers Lack of industry and processing Non-availability of local consumption data Farmers prefer wheat as compared to barley due to marketing issue of barley	- Huge potential of export & for local industry - Customer acceptance in local markets - Can replace wheat due to surplus wheat & same growing season - Value addition	Improper marketing strategies Lack of procurement Week linkages of industries-markets-farmers
Social aspects	Religious emphasis on barley for the Muslims	Wheat is staple food in Pakistan which suppress other cereals	- Organic farming & certification - Public awareness for its benefits and importance	- Pakistan is Muslim country, the acceptance of barley for brewery industry may be a threat

Table 13: SWOT Analysis of Balochistan Barley Cluster

Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
Environment, climate, soil	Favorable environment mild climate Silt loam to clay soils Fit in existing cropping pattern Drought & salt tolerant crop	- Frost & terminal heat - Soil fertility status & less organic matter	- Can be grown on marginal lands - Can be grown in rain-fed areas - Suitable soil and climate	- Climate change - Depleting groundwater resources
Varieties/ technologies/ Quality	- Existing germplasm and varieties (Surab-96 and Awaran-2002) - Salt & drought tolerant varieties - Lodging resistant varieties	No availability of certified seed Low yielding varieties Grain shattering Obsolete production & protection technology Farmers' awareness Lack of R&D Low quality (more husk, less starch) Crop lodging	- Germplasm acquisition from barley growing countries - Evolution of high yielding varieties - Improvement in quality - Seed regulation under Seed (Amendment) Act, 2015 - Malt varieties	- Low yielding varieties
Input supplies	Less input requirement Low water requirement Production technology as of wheat	- Low fertilizer application - No weed control	- Contract farming - Poor man can grow	

Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
Marketing & industry	- Grain & straw both can be used - Can be grown for fodder purpose and grain for animal feed - Many Products are available worldwide - Profitable as first two cuts are used for fodder & animal grazing	Price instability No proper marketing Limited purchasers Lack of industry and processing Non-availability of local consumption data	- Huge potential of export & for local industry - Customer acceptance in local markets - Can replace wheat due to surplus wheat & same growing season - Value addition	Improper marketing strategies Lack of procurement Week linkages of industries-markets-farmers
Social aspects	Religious emphasis on barley for the Muslims	Wheat is staple food in Pakistan which suppress other cereals	- Organic farming & certification - Public awareness for its benefits and importance	- Pakistan is Muslim country, the acceptance of barley for brewery industry may be a threat

5.5. International Best Practices

International best practices in production, logistics, marketing, trade, etc[6].

- Forward marketing/contract growing by industry
- Quality seed
- Fertilizer management
- Disease, pest & weed management
- Specialized equipment to harvest
- Adherence to industry standards, these are reviewed regularly considering any changes in market requirements. The standards are an important market signal to farmers of the quality required by the market.
- Sampling & testing
- Stock selection & proper storage
- Quarantine measures
- Export Control Act

[6] The Australian Grain Export Supply Chain Market Focused and Responsive, Industry Management Plan for Wheat and Barley Exports to China (Grains Industry Market Access Forum, November 2017)

6. CHALLENGES FACED BY THE CLUSTER

Barley clusters face numerous challenges which are discussed below:

6.1. Climate Change and Increasing Shortages of Water

Pakistan is amongst the most vulnerable countries to climate change impacts. Both the clusters in Punjab and Balochistan face water shortage particularly Balochistan. Another issue is the frost in winter months which hampers the crop growth & development. The terminal heat stress in March & April also effects the grain development. The winter months are almost dry and receive no rainfall, due to which ground water recharging is an issue. The depleting ground water resources and lack of water storage will adversely affect the crop production in Pakistan. The soil fertility is depleting at an alarming rate and according to soil analysis reports of Soil & Water Testing Labs in Punjab, the organic matter content in soils is found low.

6.2. Constraints at Production Level

Mostly barley growers are small famers and barley is considered the poor man crop. Though barley requires less water, fertilizer and plant protection, yet it is mostly grown on marginal lands and no/very fewer inputs are being supplied to barley crop due to which yield of barley is very low in Pakistan compared to world (Table 14).

Table 14: Constraints at production level

S.#	Parameter	Punjab	Baluchistan
1	Competition with other crops	Competitive only in marginal areas	Competitive only in marginal areas
2	Germplasm	Narrow germplasm	Narrow germplasm
3	Locally evolved high yielding Varieties	2-row Sultan-2017 & Jau-2017	Main cultivars are Surab-96 and Awaran-2002
4	Certified Seed	Not available, seed system is weak	Not availability, seed system is weak
5	Commercial inputs	Limited use	Limited use
6	Extension services	Adequate	Poor
7	Labor input	Family labor	Family labor
8	Credit	Not demanded	Not available
9	Research system	Inadequate	Poor

Farmers use their own seed and barley seed system is very weak. No seed company or agency is producing certified barley seed in Pakistan. Due to which, the certified seed is unavailable in both the clusters. Moreover, the varieties are low yielding. The quality of

produce is another threat this need to be addressed. The production technology and extension services are not up to the mark in both the clusters. In Punjab, yield is significantly reduced by crop lodging.

Another issue of barley promotion is competition with other Rabi crops like wheat, oilseed crops and winter vegetable, which give more economic returns per unit area and marketing is better than the barley (Table 14). Its hay is not liked by the animals, so farmers prefer wheat. So unless high-yielding barley varieties and technologies are not available, the crop will remain a marginal land crop.

6.3. Constraints at Post-Harvest and Processing Level

There are fewer processing facilities in the country and farm storage facilities are inadequate. There is no cleaning, grading and proper packing of barley grains. The major constraints at the processing level is that appropriate grain quality to be used in processing such as beer of barley is not available in both the clusters (Table 15).

Table 15: Constraints at post-harvest and processing level

S.#	Parameter	Central Punjab	Balochistan
1	Post-harvest operation	Not adequate	Not adequate
2	Appropriate type of barley grain for processing	Not available	Not available
3	Value addition technologies in use	Not available, not in use	Not available, not in use
4	Access to energy for processing	Available	Limited
5	Legal framework for processing	Not favorable	Not favorable

A fewer barley products are available in the markets as per customer demand. Currently, Murree Brewery, Fauji cereals, Gourmet Foods, Nestle Pakistan and Military are the main buyers of barley from local as well as international markets. The representative of Murree brewery explained that they are importing barley as locally produced barley is of low quality. It contains more husk and less starch percentage. The R&D institute should focus on quality improvement, research on value addition, processing and product development.

6.4. Constraints at Marketing/Trading Level

Poor marketing of the produce is a major factor in less cultivation of barley. The price instability and lack of marketing facilities are serious constraint on barley production. (Table 16).

To renter into export, Pakistan first has to see the supply and quality of barley produced with in the county, compare the supply with what the world and domestic processing sector requires, and then accordingly change its cultivation as per national and international quality

standards. Branding and certifications have become increasing important in modern days marketing of agricultural commodities, Pakistan has special advantage of producing barley with little inputs. So certification and branding of the produce as 'organic' can help in a great way to promote the product.

Table 16: Constraints at Marketing and Trading Level

S#.	Parameter	Central Punjab	Balochistan
1.	Marketing channels	Traditional	Traditional
2.	Marketing infrastructure	Available	Poor
3.	Price volatility	Poor	Poor
3.	Market information about prices and quality	Lacking	Lacking
2.	E-commerce platforms	Not available	Not available
3.	Contract farming	Not reported	Not reported
4.	Export readiness	Lacking, but can be possible with appropriate effort	Lacking, but can be possible with appropriate effort
6.	Branding	Lacking	Lacking

7. CLUSTER DEVELOPMENT POTENTIAL

7.1. Production

Pakistan's average yield is 0.9 t/ha as compared to world average i.e., 3 t/ha. It is 3 times less the world average. There is no reason that Pakistan cannot achieve this potential in the long-run. The Ayub Agriculture Research Institute has developed varieties which can give the yield

almost equal to the world average. These varieties include 2-row Sultan-2017 & Jau-2017. Achieving this potential in the whole barley producing areas means that Pakistan can produce 144 thousand tonnes of additional production which is more than double the current level. This will not only substitute all the imports and meet all the domestic barley industry needs even if it operates at full potential, but Pakistan can also be able to export barley as it was the case before.

This intervention will generate an additional income of US$16.29 million to the whole barley producing farmers. Focusing just on the two clusters, it will generate US$1.0 million in the focal point of Punjab cluster and US$0.33 million in the Balochistan cluster at the existing barley prices. If there are 2000 farmers in the focal point of Punjab cluster (data from Pakistan Agriculture Census, 2011), it will generate US$500 additional income to each barley growing families in the cluster. Similarly, if there are 300 barley growing farmers in Balochistan cluster, it will increase an average income of about US$1100 to each barley growing families. These are lots of incomes for the poor barley growing farmers and will invigorate the life of poor farmers in marginal areas.

7.2. Demand of barley

The question is where to sell the huge amount of additional barley produced through the above intervention. As we have noticed earlier that Pakistan's imports are increasing overtime. In addition, domestic barley-based industry is in doldrums because of non-available of enough and quality local barley as raw material. It is estimated that 60% of the barley beer is underutilized. Similar is the case of other barley-based industry. So most of the additional barley supply will substitute imports and consumed by the domestic industry as it will become in its full operation.

We have also observed that international demand of barley grain has been increasing at a rate of 3.3% per annum, while its value is increasing by 8.3% per annum indicating high increase in barley prices. Overall, the exports of barley-based products are increasing at a rate of 6.1% and 6.8% per annum, respectively. Pakistan can easily enter in international market if it increases its per ha yield and reduces the farmgate prices to at least equal or lower to the level of average international prices. It has to pay special attention to meet the quality standards in the national and international markets.

7.3. Quality Improvement and Value Addition

One of the concerns of barley stakeholders is that the quality of barley produced in the country does not meet the processing requirements of the industry. For example, as noted earlier, Pakistan produces 6-row barley compared to the 2-row barley as demanded by the industry. This deteriorates the prices the produce can get in national and international markets. For example, Pakistan imports barley at a price of round US$180 per tonne while domestically produced barley hardly fetches US$130 per tonne. Moreover, handling in the value chain further deteriorates barley quality. Most of the value chain processes like grading, proper packaging, and storing are missing. This situation creates a big potential for quality improvement. It is estimated that if the quality of only 20% of the total domestic production is improved at par to international level so that it can fetch price equal to the import price, it will generate US$0.6 million to various stakeholders in the value chain.

7.4. Value chain processing

In the past, barley was used for flour and sattu making (local preparations) and also used as animal feed. The grain as well as straw or the green ripe crop is used as fodder for feeding the dairy animals. But the other most important use of barley is for malt used in chocolate, infant food, weaning baby food, milk-based beverages, for beer and spirits. The medicinal properties of barley include for diuretics and kidney stonnee ailments. As noted earlier, the international trade for beer of barley is booming so the malt requirement has shot up. In Pakistan, current industrial requirement of barley is about 3.5 to 4.0 hundred thousand metric tonne and it is growing at annually the rate of 10 percent.

A substantial progress in enhancing yield by reducing the losses from biotic stress, increasing seed size, lodging resistance and tolerance to salinity stress has been made by adopting the appropriate breeding approaches in the form of new cultivar developed by AARI i.e. 2-row Sultan-2017 & Jau-2017 is recently approved in Punjab, while for Balochistan cluster they are using the same traditional varieties i.e. Surab-96 and Awaran-2002.

Barley can be processed into dozens of products. Pearled barley, barley porridge, beer of barley, barley flour and barley powder are more common. It can also be used in various health products and medicines. The technologies for many of these products are readily available, which can be introduced at small scale level as cottage industry. The demand of these products are on a rise in urban and peri-urban areas of Pakistan as well as in international markets. The barley processing will not only add values in barley produce but also create jobs in rural areas and stabilize barley prices.

8. PLAN, POLICIES, AND STRATEGIES

8.1. Plan

The purpose of the whole exercise is to develop a research-based cluster development plan. Looking at the gaps and potential and in view of the consultation with stakeholders, following plan with fixed physical targets is made to improve the whole value chain of barley and make it nationally and internationally competitive. Initially focus will be to enhanced productivity and value chain in the *Focal Points* of each clusters to substitute the barley imports, but we hope a strong trickledown effect in the whole cluster which will make barley as an exportable commodity in table 17.

Table 17 The upgradation plan for barley value chain

S#.	Targets
1.	Replace at least 50% and 40% of the current barley area under 6-row varieties in Punjab and Baluchistan cluster, respectively with 2-row varieties with 100% increase in yield on the adopter farms in five years.
2.	Increase yields by 40% from the current base with improved management practices on the one half of the non-adopters fields in each cluster.
3.	Improve the quality of all the 2-row barley produced and 20% of the other variety production at par to the world average quality through proper value chain processes like grading, packing, branding, etc..
.	Converting 10% additional production of 2-row variety into barley porridge and barley flour processed products
4.	Gradually decrease the import to meet the demand of local industry.

8.2. Policies

Realizing the importance of barley for poor farmers in marginal areas, government will try to overcome the policy neglect for the crop in the past and pay special attention to strengthen research and development activities for the crop.

Clear incentives and programs will be design to promote 2-row barley existing varieties, such as 2-row Sultan-2017 & Jau-2017 in each cluster and provincial research institute in collaboration with PARC should continue developing new high-yielding 2-row varieties. The technical, advisory, and financial supports shall be focused more specifically on cluster-specific issues. This will create a big enough market, reduce market and transaction cost, and encourage private sector for the private sector to invest on market and quality infrastructure such as grading, packaging, and storage, etc. and facilitate the sector to trade more widely nationally and internationally.

To stabilize the barley prices, e-markets and future markets will be encouraged in cluster areas. Specific barley grades will be clearly defined and farmers will be trained to identify and produce according to the specification of these grades.

Farmers Entrepreneur Groups (FEGs) will be organized in major barley growing areas at union council level. All the incentives will be channeled through FEGs. The farmers will be trained and value chain infrastructure will be established through these groups.

8.3. Production Level Strategies

8.3.1. Strengthening barley R&D

Barley Sections under the provincial wheat program in Punjab, Baluchistan, and Sindh provinces will be established and strengthened. Barley grades will be developed and farmers will be trained on how to produce according to these grades. The extension department will start a crash program to introduce 2-row varieties to the farmers. Demonstration plots will be established, information campaign will be started, and farmers training about Good Agricultural Practices (GAP) will be initiated to spread 2-row high yielding varieties in the shortest possible time. Demonstrations plots on the demand and with the help of FEGs will be established on balance use of fertilizer, optimum irrigation, and other management practices specific to each cluster.

8.3.2. Enriching germplasm

For the sustainability of the barley production, new varieties need to be continuously developed and disseminated. For this purpose, the research institutes should have rich germplasm. Researchers links with international organization such as CIMMYT and ICARDA will be strengthened by inviting scientists from these centers and allowing national scientists to visit these and other related international centers and universities.

Moreover, barley germplasm, hybrids, and varieties of high-yielding with special characteristics for each cluster such as drought resistant for Baluchistan cluster and salinity tolerance for Punjab cluster will be imported from private companies. The demand of the industry will be kept in mind in the import of such breeding material. Private sector will be encouraged to import, test, and introduce 2-row hybrid materials and varieties.

8.3.3. Organization of Farmers Entrepreneur Group

Farmers Entrepreneur Groups (FEGs) in major barley growing areas will be established at union council levels. All technical, financial, training, information, and advisory services will be linked with the formulation and functioning of these groups. These groups will be linked with the industry such as Murree Brewery, Fauji Foods, etc. They will also be trained to maintain the quality standards so that they can ensure quality to the industry as they demand as a group.

8.3.4. Improving the supply of quality seed

Interested farmers in the FEGs will be selected to produce quality seeds. They will be provided special training on how to produce and store the barley seed. Special incentives will be provided to the private companies to supply improved barley seed as per need of farmers to meet the industry demand.

8.4. Value Chain Strategies

Research institute will be formulated various barley grades keeping in view industry and market demand and farmers will be trained to maintain the grade they choose to produce. Farmers will be advised to properly grade their produce before selling. The barley porridge and flour will be produced after proper cleaning and will be packed properly. The storage will be at processing level.

8.5. Processing

- As a part of major intervention, farmers would be made realize that the 6-row barley lacks the desired quality of malt.
- Quality and quantity-based contracts with pre-determined prices and input supply for 2-row barley cultivation will be facilitated between farmers and malting industry. The private sector barley processing companies will also be facilitated to make contract with farmers to produce and supply quality seeds of their own needs.
- Small barley porridge making and barley powder making units along with packaging machines will be supplied to interested FEGs on cost sharing basis to established cottage industry of barley processing in rural areas.
- Farmers will be trained on the selection of appropriate raw material and the processing of various barley products.
- Sanitary and phto-sanitary training will be provided to the barley processors in rural areas.
- Branding will be introduced for various barley products.

8.6. Information sharing

An information cell will be created at the provincial level to continuously get and disseminate information related to technology, supply, demand, prices, and quality demanded in the national and international markets t various stakeholders including FEGs, trader's associations, researchers, policy planners, etc.

9. BENEFIT AND COST OF CLUSTERING

9.1. Punjab Barley Cluster

9.1.1. Proposed Interventions

Following three interventions have been proposed for transformation of the two Barley clusters of Pakistan.

i) improvement in Barley yield by introducing new 2-row variety
ii) production of value added products from Barley
iii) improvement in value chain

The expected benefits by implementing the proposed interventions have been based on certain assumptions which have been decided in discussion with Barley sector experts. Expected benefits have been calculated with reference to the baseline situation of each of the two clusters. 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 Barley 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 Barley porridge production unit is separately estimated and explained in Appendix. For each cluster, the number of Barley porridge production units required was estimated based on the estimated Barley quantities that will be processed and the average capacity of the production unit. Total investment and operational costs of processing in each cluster were incorporated in the main feasibility model. In the following section, we have explained the feasibility of the whole package of interventions.

9.1.2. Baseline Status or Prevailing Situation

The study has considered 6,400 ha of area under Barley production in the focal point of Punjab Barley cluster which is currently producing 5,600 tonnes of Barleys per year. Current yield in the cluster is 0.88 tonnes/ha; showing a negative growth of -0.8% (Table 18).

Table 18: Punjab Cluster – Yearly baseline status

Item	
Area under cultivation in cluster (ha)	6,400
Total Production (tonnes)	5,600
Production yield (tonnes/ha)	0.88
Annual yield growth without intervention	-0.8%
Farm gate price of Barley (US$/tonne)	230

Barley production and its value at the current farm gate price in the next five years in a no-intervention scenario is shown in 19.

Table 19: Punjab Cluster – Barley Production in No-Intervention Scenario

	Year 2	Year 3	Year 4	Year 5
Default yield (tonnes/ha)	0.86	0.85	0.85	0.84
Annual expected production without intervention (Tonnes)	5,510	5,466	5,423	5,379
Total value of production at farm gate (US$)	**1,267,392**	**1,257,253**	**1,247,195**	**1,237,217**

9.1.3. Benefits of the Proposed Interventions

9.1.3.1. Intervention 1 – Introduction of New Varieties and Improved Practices

Farmers would be made to realize that the 6-row barley lacks the desired quality of malt. Quality and quantity-based contracts with pre-determined prices and input supply for 2-row barley cultivation will be facilitated between farmers and malting industry. Quality seed will be provided to farmers along with training on how to produce and store the barley seed. The extension department will start a crash program to introduce 2-row varieties to the farmers. It is estimated that these efforts in Punjab cluster will increase the Barley yield by 100% 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 be gradual at a rate of 25% per year starting from the second year. It is assumed that 50% of the total area in the cluster will be adopting the new variety at a rate of 12.5% per year. It is also assumed that with these new practices, the farmers will be able to increase the farm gate price of Barley up to the import price of US$ 280 per tonne. Based on these assumptions, the value of increased Barley production is shown in the following table 20.

Table 20: Punjab Cluster - Increased Barley Value by Increased Production Yield

	Year 2	Year 3	Year 4	Year 5
Current Yield without interventions	0.86	0.85	0.85	0.84
Yield increase over five years	25.00%	50.00%	75.00%	100.00%
Increase in yield (tonnes/ha)	0.22	0.43	0.64	0.84
Adoption Rate (area adopting 2-row variety)	12.5%	25.0%	37.5%	50.0%
Additional production from enhanced yield (tonnes)	172	683	1,525	2,690
Expected additional value (US$)	48,216	191,321	427,029	753,089

9.1.3.2. Intervention 2– Enhance Processing

Barley can be processed into different value added products like Barley porridge, barley flour, alcoholic beverages. It has been estimated that 10% of the additional production from the cluster will be processed into Barley porridge and barley flour which can be currently sold to the consumers in the local market. It is assumed that 10% processing into Barley porridge will be achieved in four years at a linear rate of 2.5% per year. Yield of Barley into porridge has been considered to be 55% and that into flour has been assumed to be 47%. It is estimated that 7 small processing units will be required in the whole cluster to process 10% Barley production into porridge and flour by fifth year. Barley 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 government will incentivize Barley processing. This intervention will add value to the Barley production from the cluster. Projected values of this value addition activity at a Barley porridge price of US$ 1,111 per tonne and barley flour price of US$ 741 per tonne is shown in Error! Reference source not found.21. The e conomic feasibility of small scale barley porridge unit is given in Annexure 6.

Table 21: Punjab Cluster - Value Addition by Barley Porridge and Flour Production

	Year 2	Year 3	Year 4	Year 5
Increased Processing %	2.5%	5.0%	7.5%	10.0%
Additional Production (tonnes)	4.3	34.2	114.4	269.0
Total Barley Porridge production @55% yield	2.4	18.8	62.9	147.9
Expected additional value from barley porridge (US$) (A)	**2,631**	**20,878**	**69,901**	**164,365**
Total Barley Flour production @47% yield	**2.0**	**16.1**	**53.8**	**126.4**
Expected additional value from barley flour (US$) (B)	1,499	11,894	39,822	93,638
Total Additional Value from Increased Processing (US$) (A+B)	4,130	32,773	109,723	258,003

9.1.3.3. Intervention 3 – Improved Value Chain

The improved value chain activities as highlighted in previous sections of the report will improve the quality and price of Barley to be marketed in the local markets. It is assumed that

20% of the total production from the cluster will be pass through these activities and sold at higher price than the current price. This will be achieved in four years with the addition of 5.0% each year. Benefits from this intervention at an increased price of US$ 270 per tonne over four years are shown in the following table 22.

Table 22: Punjab Cluster – Additional Value by Price Increase in Local Markets

	Year 1	Year 2	Year 3	Year 4	Year 5
Percent production to be passed through improved value chain		5%	10%	15%	20%
Total production through improved value chain (Tonnes)		276	547	813	1076
Additional Value (US$)		**11,021**	**21,865**	**32,536**	**43,034**

9.1.4. Total Benefits Summary

Summary of the value of the benefits of the proposed interventions is shown in Table 23.

Table 23: Punjab Cluster - Summary of the Value of Benefits of Interventions

Benefits Value (US$)	Year 1	Year 2	Year 3	Year 4	Year 5
Value of Increased Yield	-	48,216	191,321	427,029	753,089
Value of Processed Products	-	4,130	32,773	109,723	258,003
Value of Improved Value Chain	-	11,021	21,865	32,536	43,034
Total Value	**-**	**63,366**	**245,959**	**569,287**	**1,054,125**

9.1.5. Enhanced Costs of the Proposed Interventions

The above proposed interventions will add cost of producing, processing, and value addition of Barley. The costs of the proposed interventions involve two types of costs i) value chain improvement costs and ii) sector support interventions costs.

9.1.5.1. Value Chain Improvement Operational Costs

The proposed sector transformation plan includes interventions both for on-farm and off-farm activities. Improvement entails 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 the following table 24.

Table 24: Punjab Cluster – Value Chain Costs and Proposed Incremental Increases Cost Head

	Cost	Incremental (%)
Production Inputs and Harvest (land preparation, inputs, labor, etc.) (US$/ha)	181	94.4%
Grading Transportation and Storage (US$/tonne)	46	50%
Processing (US$/tonne Barley)	527	0%

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. It is assumed that cost increase will gradual and will be completed in four years; starting from the second year. Total planned increase in cost was distributed over four years as per the interventions in those years. Value chain costs projections are shown in the following table 25.

Table 25: Punjab Cluster – Value Chain Improvement Costs

	Year 2	Year 3	Year 4	Year 5
Production Inputs and Harvest (land preparation, inputs, labor, etc.) (US$/ha)	34,200	136,800	307,800	547,200
Grading Transportation and Storage (US$)	1,582	6,276	14,008	24,704
Processing (US$/tonne dried Barley)	2,269	18,007	60,287	141,760
Total Costs (US$)	**38,051**	**161,083**	**382,096**	**713,664**

9.1.5.2. Cluster Development Investment Costs

Punjab Barley cluster has huge growth potential by virtue of its diverse agro ecological conditions. A mega program will be launched that will include strengthening of R&D infrastructure for varietal development program, production technology development, processing and value addition. High yielding 2-row variety will be evolved that will have characteristics like non-shattering, bold grain, low husk and more starch. Production technology will be developed for weed control. Pre-basic barley seed will be provided to provincial and private seed companies. Provision of certified seeds to farmers will be ensured in the cluster. Seed regulation will be implemented in the selected districts. Farmers will be organized at Markaz level for better crop management (Annexure 5) and awareness. Advisory services will be provided during the barley season.

The proposed budget for cluster development interventions in Punjab will be US$ 488,011. About 70% of this investment should be provided by the federal government, by establishing

a Cluster Development Fund (CDF) under PSDP. The remaining 30% should come from the provincial budgets. Details are provided in Table 26.

Table 26: Punjab Cluster - Inputs and Infrastructure Needs for Cluster Development

S#	Cluster Strategy	Interventions	Implementing Agency
	Strengthening of R&D	Develop a cluster development project	DoA Punjab
		Strengthening of R&D infrastructure having HR, infrastructure and other facilities for varietal development program, production technology development, processing and value addition	DoA Punjab/ AARI
		Evolve one high yielding 2 row barley variety having characteristics like non-shattering, bold grain, low husk, more starch, Protein contents 11-12%.	
		For this, scientists may acquire international germplasm and visit major barley producing countries for training/germplasm purpose.	
		A specific Production technology development for selected districts particularly weed control	
		Research on processing & value addition	
		Production of pre-basic seed of barley for provision to provincial & private seed corporations	
2		Training of master trainers of Agri. Extension	DoA Punjab
3.	Availability of certified seed of barley to farmers & seed regulation	Ensure the certified seed availability to farmers in selected districts of both the clusters	Punjab Seed Corporations/ private seed companies
		Seed regulation in the selected districts	FSC&RD
4.	Extension services	Organize farmers days on Markaz level for better crop management and awareness in selected districts of clusters	DoA Punjab through Agriculture Extension Wing
		Advisory services throughout the barley season	
5.	Stakeholders interaction	Organize seminar covering all aspects & whole value chain by involving all stakeholders	DoA Punjab
65.	Forward marketing	Policy intervention for industries/processors to procure barley locally by forward marketing from selected clusters	MNFSR/DoA Punjab
7	Processing into value added products	Investment on Barley porridge and flour making units	Private sector, subsidy on the units and interest free loans by the government

Note: The costs of these activities have been included in Table 27.

This proposed cluster development investment cost will be spent in four years starting from year 1. 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 Barley porridge & flour making units that will be required each year to meet the set production target. For production

level strategies, it is assumed that 40% of this cost of production level strategies and marketing/trading level strategies will be spent in year 1, 30% in year 2 and 15% each in year 3 and year 4. With these assumptions, the cost distribution is shown in Error! Reference s ource not found.27.

Table 27:Punjab Cluster – Cluster Development Investments Cost Projections

Investment Head	Year 1	Year 2	Year 3	Year 4	Total
R&D Establishment (US$)	200,000				200,000
Investments in Extension Services (US$)	40,000	30,000	15,000	15,000	100,000
Investment on Stakeholder Interaction (US$)	56,000	42,000	21,000	21,000	140,000
Investment on Processing (US$)	6851	6851	13701	20552	47955
Total investments (US$)	**303639**	**79639**	**51272**	**58916**	**487955**

9.1.6. Economic Viability of 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 the following table 28.

Table 28: Punjab cluster - Economic Viability of Proposed Interventions Package

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Benefits of the Interventions (US$)	-	216408	462126	736410	1038525
Total operational costs of the Interventions (US$)	-	(132835)	(283166)	(450566)	(634612)
Total investment costs of the interventions (US$)	(303639)	(79639)	(51277)	(58916)	-
Net Cash Flows (US$)	(303639)	3935	127684	226928	403907
NPV (US$)			**255818**		
IRR			**33%**		

A positive NPV of US$ 255818 indicates that the interventions package proposed for uplift and transformation of Punjab Barley cluster is an economically viable proposition.

9.2. Balochistan Barley Cluster

9.2.1. Proposed Interventions

Following three interventions have been proposed for transformation of the two Barley clusters of Pakistan.

iv) improvement in Barley yield by introducing new 2-row variety
v) production of value added products from Barley
vi) improvement in value chain

The expected benefits by implementing the proposed interventions have been based on certain assumptions which have been decided in discussion with Barley sector experts. Expected benefits have been calculated with reference to the baseline situation of each of the two clusters. 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 Barley 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 Barley porridge production unit is separately estimated and explained in Appendix. For each cluster, the number of Barley porridge production units required was estimated based on the estimated Barley quantities that will be processed and the average capacity of the production unit. Total investment and operational costs of processing in each cluster were incorporated in the main feasibility model. In the following section, we have explained the feasibility of the whole package of interventions.

9.2.2. Baseline Status or Prevailing Situation

The study has considered 4,000 ha of area under Barley production in the focal point of Balochistan Barley cluster which is currently producing 4,500 tonnes of Barley per year. Current yield in the cluster is 1.13 tonnes/ha; showing a negative growth of -0.2%. Following table shows the cluster's current production performance table 29.

Table 29: Balochistan Cluster – Current Production Situation

Area under cultivation in cluster (ha)	4,000
Total Production (tonnes)	4,500
Production yield (tonnes/ha)	1.13
Annual yield growth without intervention	-0.2%
Farm gate price of Barley (US$/tonne)	230

Barley production and its value at the current farm gate price in the next five years in a no-intervention scenario is shown in Table 30.

Table 30: Balochistan Cluster – Barley Production in No-Intervention Scenario

	Year 1	Year 2	Year 3	Year 4	Year 5
Default yield (tonnes/ha)		1.12	1.12	1.12	1.11
Annual expected production without intervention (Tonnes)		4,482	4,473	4,464	4,455
Total value of production at farm gate (US$)		**1,030,860**	**1,028,798**	**1,026,741**	**1,024,687**

9.2.3. Benefits of the Proposed Interventions

9.2.3.1. Intervention 1 – Introduction of New Varieties and Improved Practices

Farmers would be made to realize that the 6-row barley lacks the desired quality of malt. Quality and quantity-based contracts with pre-determined prices and input supply for 2-row barley cultivation will be facilitated between farmers and malting industry. Quality seed will be provided to farmers along with training on how to produce and store the barley seed. The extension department will start a crash program to introduce 2-row varieties to the farmers. It is estimated that these efforts in Balochistan cluster will increase the Barley yield by 100% 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 be gradual at a rate of 25% per year starting from the second year. It is assumed that 40% of the total area in the cluster will be adopting the new variety at a rate of 10% per year. It is also assumed that with these new practices, the farmers will be able to increase the farm gate price of Barley up to the import price of US$ 280 per tonne. Based on these assumptions, the value of increased Barley production is shown in the following table 31.

Table 31: Balochistan Cluster - Increased Barley Value by Increased Production Yield

	Year 1	Year 2	Year 3	Year 4	Year 5
Current Yield without interventions		1.12	1.12	1.12	1.11
Yield increase over five years		25.00%	50.00%	75.00%	100.00%
Increase in yield (tonnes/ha)		0.28	0.56	0.84	1.11
Adoption Rate (area adopting 2-row variety)		10%	20%	30%	40%
Additional production from enhanced yield (tonnes)		112	447	1,004	1,782
Expected additional value (US$)		**31,374**	**125,245**	**281,238**	**498,978**

9.2.3.2. Intervention 2 – Improve Processing

Barley can be processed into different value added products like Barley porridge, barley flour, alcoholic beverages. It has been estimated that 7% of the additional production from the cluster will be processed into Barley porridge and barley flour which can be currently sold to the consumers in the local market. It is assumed that 7% processing into Barley porridge will

be achieved in four years at a linear rate of 1.75% per year. Yield of Barley into porridge has been considered to be 55% and that into flour has been assumed to be 47%. It is estimated that 5 small processing units will be required in the whole cluster to process 10% barley

production into porridge and flour by fifth year. Barley 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 government will incentivize Barley processing. This intervention will add value to the Barley production from the cluster. Projected values of this value addition activity at a Barley porridge price of US$ 1,111 per tonne and

barley flour price of US$ 741 per tonne is shown in Error! Reference source not found.32. The e conomic feasibility of small scale barley porridge unit is given in Annexure 6.

Table 32: Balochistan Cluster - Value Addition by Barley Porridge and Flour Production

	Year 2	Year 3	Year 4	Year 5
Increased Processing %	1.75%	3.50%	5.25%	7.00%
Additional Production (tonnes)	2.0	15.7	52.7	124.7
Total Barley Porridge production @55% yield	1.1	8.6	29.0	68.6
Expected additional value from barley porridge (US$) (A)	1,198	9,567	32,225	76,233
Total Barley Flour production @47% yield	0.9	7.4	24.8	58.6
Expected additional value from barley flour (US$) (B)	683	5,450	18,359	43,430
Total Additional Value from Processing (US$) (A+B)	1,881	15,018	50,584	119,662

9.2.3.3. Intervention 3 – Improved Value Chain

The improved value chain activities as highlighted in previous sections of the report will improve the quality and price of Barley to be marketed in the local markets. It is assumed that 20% of the total production from the cluster will be sold at higher price than the current price. This will be achieved in four years with the addition of 5.0% each year. Benefits from this intervention at an increased price of US$ 270 per tonne over four years are shown in the following table 33.

Table 33: Balochistan Cluster – Additional Value by Price Increase in Local Markets

	Year 1	Year 2	Year 3	Year 4	Year 5
Percent production to be passed through improved value chain		5%	10%	15%	20%
Total production through improved value chain (Tonnes)		224	447	670	891
Additional Value (US$)		8,964	17,892	26,785	35,641

9.2.4. Total Benefits Summary

Summary of the value of the benefits of the proposed interventions is shown in Table 34.

Table 34: Balochistan Cluster - Summary of the Value of Benefits of Interventions

Benefits Value (US$)	Year 1	Year 2	Year 3	Year 4	Year 5
Value of Increased Yield	-	31,374	125,245	281,238	498,978
Value of Processed Products	-	1,881	15,018	50,584	119,662
Value of Improved Value Chain	-	8,964	17,892	26,785	35,641
Total Value	**-**	**42,219**	**158,155**	**358,606**	**654,282**

9.3. Costs of the Proposed Interventions

The above proposed interventions will add the operational costs of producing, processing, and value addition of Barley. The costs of the proposed interventions involve two types of costs i) value chain improvement costs and ii) sector support interventions costs.

9.3.1. Value Chain Improvement Operational Costs

The proposed sector transformation plan includes interventions both for on-farm and off-farm activities. Improvement entails 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 the following table 35.

Table 35: Balochistan Cluster – Proposed Incremental Increase in Cost

	Cost	Incremental Increase
Production Inputs and Harvest (land preparation, inputs, labor, etc.) (US$/ha)	181	94.4%
Grading Transportation and Storage (US$/tonne)	46	50%
Processing (US$/tonne Barley)	527	0%

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. It is assumed that cost increase will gradual and will be completed in four years; starting from the second year. Total planned increase in cost was distributed over four years as per the interventions in those years. Value chain costs projections are shown in the following table 36.

Table 36: Balochistan Cluster – Value Chain Improvement Costs

	Year 1	Year 2	Year 3	Year 4	Year 5
Production Inputs and Harvest (land preparation, inputs, labor, etc.) (US$/ha)		17,100	68,400	153,900	273,600
Grading Transportation and Storage (US$)		1,287	5,136	11,532	20,461
Processing (US$/tonne dried Barley)		568	4,538	15,286	36,162
Total Costs (US$)		**18,955**	**78,074**	**180,719**	**330,223**

9.3.2. Cluster Development Investment Costs

Balochistan Barley cluster has huge growth potential by virtue of its diverse agro ecological conditions. A mega program will be launched that will include strengthening of R&D infrastructure for varietal development program, production technology development, processing and value addition. High yielding 2-row variety will be evolved that will have characteristics like non-shattering, bold grain, low husk and more starch. Production technology will be developed for weed control. Pre-basic barley seed will be provided to provincial and private seed companies. Provision of certified seeds to farmers will be ensured

in the cluster. Seed regulation will be implemented in the selected districts. Farmers will be organized at Markaz level for better crop management and awareness. Advisory services will be provided during the barley season.

The proposed budget for cluster development interventions in Balochistan will be US$ 394,294. About 70% of this investment should be provided by the federal government, by establishing a Cluster Development Fund (CDF) under PSDP. The remaining 30% should come from the provincial budgets. Details are provided in Error! Reference source not found.

Table 37:Balochistan Cluster - Inputs and Infrastructure Needs for Cluster Development

S#	Cluster Strategy	Interventions	Implementing Agency
1.	Strengthening of R&D	Develop a cluster development project	DoA Balochistan
		Strengthening of R&D infrastructure having HR, infrastructure and other facilities for varietal development program, production technology development, processing and value addition	DoA Balochistan/ AARI
		Evolve one high yielding 2 row barley variety having characteristics like non-shattering, bold grain, low husk, more starch, Protein contents 11-12%.	
		For this, scientists may acquire international germplasm and visit major barley producing countries for training/germplasm purpose.	
		A specific Production technology development for selected districts particularly weed control	
		Research on processing & value addition	
		Production of pre-basic seed of barley for provision to provincial & private seed corporations	
2		Training of master trainers of Agri. Extension	DoA Balochistan
3.	Availability of certified seed of barley to farmers & seed regulation	Ensure the certified seed availability to farmers in selected districts of both the clusters	Balochistan Seed Corporations/ private seed companies
		Seed regulation in the selected districts	FSC&RD
4.	Extension services	Organize farmers days on Markaz level for better crop management and awareness in selected districts of clusters	DoA Balochistan through Agriculture Extension Wing
		Advisory services throughout the barley season	
5.	Stakeholders interaction	Organize seminar covering all aspects & whole value chain by involving all stakeholders	DoA Balochistan
6.	Forward marketing	Policy intervention for industries/processors to procure barley locally by forward marketing from selected clusters	MNFSR/DoA Balochistan
7	Processing into value added products	Investment on Barley porridge and flour making units	Private sector, subsidy on the units and interest free loans by the government

Note: The costs of these activities have been included in Table 38.

This proposed cluster development cost will be spent in a period of four years starting from year 1. 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 Barley porridge & flour making units that will be required each year to meet the set production target. For production level strategies, it is assumed that 40% of this cost of production level strategies and marketing/trading level strategies will be spent in year 1, 30% in year 2 and 15% each in year 3 and year 4. With these assumptions, the cost distribution is shown in Error! Reference s ource not found.38.

Table 38: Balochistan Cluster – Cluster Development Investments Cost Projections

Investment Head	Year 1	Year 2	Year 3	Year 4	Total
R&D Establishment (US$)	150,000				150,000
Investments in Extension Services (US$)	28,000	21,000	10,500	10,500	70,000
Investment on Stakeholder Interaction (US$)	56,000	42,000	21,000	21,000	140,000
Investment on Processing (US$)	6,859	6,859	6,859	13,717	34,294
Total investments (US$)	**240,851**	**69,851**	**38,351**	**45,201**	**394,253**

9.4. 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 the following table 39. A positive NPV of US$ 138869 indicates that the interventions package proposed for uplift and transformation of Balochistan Barley cluster is an economically viable proposition.

Table 39: Balochistan cluster - Economic Viability of Proposed Interventions Package

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Benefits of the Interventions (US$)	-	129433	277656	444556	630019
Total operational costs of the Interventions (US$)	-	(70639)	(151807)	(242439)	(345474)
Total investment costs of the interventions (US$)	(240851)	(69,851)	(38,351)	(45,201)	-
Net Cash Flows (US$)	**(240,851)**	**(11057)**	**87499**	**155916**	**284546**
NPV (US$)			**138869**		
IRR			**25%**		

9.5. Conclusion

In conclusion, the overall economic, social and environmental impact of the cluster development program shall be positive, sustainable and long lasting. The IRR of Punjab & Balochistan clusters is 33% & 25%, respectively. Pakistan is potential barley producing country; in 1974 it exported about 94 thousand tonnes of barley, but currently is importing. This is due to the weak linkage between the researchers, farmers, industry and other stakeholders. Contract farming between farmers and industry is suggested along with other program like improvement in R&D system, promotion of barley value chain activities, and

incentivizing the processing infrastructure. The network once established will benefit both the farmers and processor. The 2-row varieties are available in Pakistan, further strengthening R&D, particularly in varietal improvement and production and processing technology development, is necessary to meet the quality requirement for barley in national and international market. Improving farmers' capacity to produce high-quality barley and organizing hem in FEGs are the most important components of the upgradation plan for barley.

10. PROGRAMS AND PLANS

10.1. Program for Research Reforms

The following programs are proposed for both the barley clusters i.e., Punjab & Balochistan

Table 40: Program for research reforms

S#.	Area of Action	Purpose	Institutions to be involved	Priority
1. Cluster-1: Punjab (Layyah & Muzaffargarh districts)				
1.1	Establishment of Barley Research Centre	To strengthen R&D infrastructure	DoA Punjab/AARI	Short to Medium (1-2 years)
1.2	Acquisition of barley germplasm from national & international sources	To enrich barley germplasm	DoA Punjab/AARI	Short to Medium (1-2 years)
1.3	Programs for varietal development program	To evolve high yield variety as per industry demand	DoA Punjab/AARI	Medium (2-4 years)
1.4	Development of production technology of barley	To increase the yield by better management practices	DoA Punjab/AARI	Short to Medium (1-2 years)
1.5	Research on processing and value addition	To promote barley as food	DoA Punjab/AARI	Medium (2-4 years)
2. Custer-2: Balochistan (Khuzdar & Awaran districts)				
2.1	Establishment of Barley Research Centre	To strengthen R&D infrastructure	DoA Balochistan	Short to Medium (1-2 years)
2.2	Acquisition of barley germplasm from national & international sources	To enrich barley germplasm	DoA Balochistan	Short to Medium (1-2 years)
2.3	Programs for varietal development program	To evolve high yield variety as per industry demand	DoA Balochistan	Medium (2-4 years)
2.4	Development of production technology of barley	To increase the yield by better management practices	DoA Balochistan	Short to Medium (1-2 years)
2.5	Research on processing and value addition	To promote barley as food	DoA Balochistan	Medium (2-4 years)

10.2. Programs for HR development/capacity building

The following programs are proposed for both the barley clusters i.e., Punjab & Balochistan.

Table 41: Programs for HR development/capacity building

S#.	Area of Action	Purpose	Institutions to be involved	Priority
1. Cluster-1: Punjab (Layyah & Muzaffargarh districts)				
1.1	Training of scientists on barley breeding and technology improvement	Capacity building of scientists	DoA Punjab/AARI	Short (1 years)
1.2	Training of master trainer of agriculture extension staff on barley production technology	Capacity building of agriculture extension staff	DoA Punjab/AARI/ Agriculture Extension	Short (1 years)
1.3	Advisory services to farmers	Capacity building of farmers	DoA Punjab/ Agriculture Extension	Short to Medium (1-2 years)
1.4	Organizing farmers days on Markaz level for better crop management and awareness	Capacity building of farmers	DoA Punjab/ Agriculture Extension	Short to Medium (1-2 years)
2. Custer-2: Balochistan (Khuzdar & Awaran districts)				
2.1	Training of scientists on barley breeding and technology improvement	Capacity building of scientists	DoA Balochistan/ Agriculture Research	Short (1 years)
2.2	Training of master trainer of agriculture extension staff on barley production technology	Capacity building of agriculture extension staff	DoA Balochistan/ Agriculture Research/ Agriculture Extension	Short (1 years)
2.3	Advisory services to farmers	Capacity building of farmers	DoA Balochistan/ Agriculture Extension	Short to Medium (1-2 years)
2.4	Organizing farmers days on Markaz level for better crop management and awareness	Capacity building of farmers	DoA Balochistan/ Agriculture Extension	Short to Medium (1-2 years)

10.3. Programs for Networking of Stakeholders

The following programs are proposed for both the barley clusters i.e., Punjab & Balochistan

Table 42: Programs for Networking of Stakeholders

S#.	Area of Action	Purpose	Institutions to be involved	Priority
1. Cluster-1: Punjab (Layyah & Muzaffargarh districts)				
1.1	Establish research & development board of barley to develop linkages of R&D-farmers-markets-industries	Organization of barley stakeholders	DoA Punjab/AARI/ Agriculture Extension/Relevant Industries/Processors/ Farmers	Short to Medium (1-2 years)
1.2	Organize seminar covering all aspects & whole value chain by involving all stakeholders	Organization of barley stakeholders	DoA Punjab/AARI/ Agriculture Extension/Relevant Industries/Processors/ Farmers	Short to Medium (1-2 years)

S#.	Area of Action	Purpose	Institutions to be involved	Priority
1.3	Forward marketing of barley involving farmers and processors/industry	To strengthen linkages	DoA Punjab/ Relevant Industries/Processors/ Farmers	Short to Medium (1-2 years)
2. Custer-2: Balochistan (Khuzdar & Awaran districts)				
2.1	Establish research & development board of barley to develop linkages of R&D-farmers-markets-industries	Organization of barley stakeholders	DoA Balochistan/ Agriculture Extension/Relevant Industries/Processors/ Farmers	Short to Medium (1-2 years)
2.2	Organize seminar covering all aspects & whole value chain by involving all stakeholders	Organization of barley stakeholders	DoA Balochistan/ Agriculture Extension/Relevant Industries/Processors/ Farmers	Short to Medium (1-2 years)
2.3	Forward marketing of barley involving farmers and processors/industry	To strengthen linkages	DoA Punjab/ Relevant Industries/Processors/ Farmers	Short to Medium (1-2 years)

10.4. Programs for value addition

The following programs are proposed for both the barley clusters i.e., Punjab & Balochistan

Table 43: Programs for value addition

S#.	Area of Action	Purpose	Institutions to be involved	Priority
1. Cluster-1: Punjab (Layyah district)				
1.1	Provision of 30 processing plants for converting 10% of additional produce to barley porridge (on 30 % subsidy)	To enhance value addition in barley	DoA Punjab Industries/Processors	Short to Medium (1-2 years)
2. Custer-2: Balochistan (Khuzdar district)				
2.1	Provision of 12 processing plants for converting 10% of additional produce to barley porridge (on 30 % subsidy)	To enhance value addition in barley	DoA Punjab Industries/Processors	Short to Medium (1-2 years)

ANNEXURES

Annexure 1A: Province & district wise area of Barley in Pakistan

YEAR	Punjab	Sindh	KP	Balochistan	PAKISTAN
2007-08	32.8	8.2	32.5	17.6	91.1
2008-09	33.0	6.5	30.5	16.0	86.0
2009-10	31.4	7.5	29.6	15.6	84.1
2010-11	25.6	11.6	27.4	12.5	77.1
2011-12	22.9	9.1	26.9	13.3	72.2
2012-13	25.1	8.4	26.3	13.3	73.1
2013-14	24.0	8.7	24.6	13.6	70.9
2014-15	24.2	8.2	23.4	12.1	67.9
2015-16	23.1	8.3	23.3	11.4	66.1
2016-17	21.5	7.6	20.7	11.1	60.9
2017-18	-	-	-	-	60.0

Annexure 1B: National and province wise production of barley crop (000 tonnes)

YEAR	Punjab	Sindh	KP	Balochistan	PAKISTAN
2007-08	28.90	4.40	31.90	22.20	**87.40**
2008-09	30.40	3.60	27.50	20.00	**81.50**
2009-10	28.20	4.30	26.00	12.90	**71.40**
2010-11	24.70	6.90	23.70	15.90	**71.20**
2011-12	20.00	5.40	23.10	17.20	**65.70**
2012-13	22.50	5.10	22.80	16.80	**67.20**
2013-14	21.70	5.30	21.90	17.60	**66.50**
2014-15	20.80	5.00	21.10	15.90	**62.80**
2015-16	20.10	5.20	20.30	15.00	**60.60**
2016-17	20.10	4.70	18.50	14.70	**58.00**
2017-18	-	-	-	-	**58.00**

Annexure 1C. National and province wise yield of barley crop (tonnes/ha)

YEAR	Punjab	Sindh	KP	Balochistan	PAKISTAN
2007-08	1.13	1.86	1.02	0.79	1.04
2008-09	1.09	1.81	1.11	0.80	1.06
2009-10	1.11	1.74	1.14	1.21	1.18
2010-11	1.04	1.68	1.16	0.79	1.08
2011-12	1.15	1.69	1.16	0.77	1.10
2012-13	1.12	1.65	1.15	0.79	1.09
2013-14	1.11	1.64	1.12	0.77	1.07
2014-15	1.16	1.64	1.11	0.76	1.08
2015-16	1.15	1.60	1.15	0.76	1.09
2016-17	1.07	1.62	1.12	0.76	1.05
Annual Growth rate %	-0.5	-1.3	1.0	-0.4	0.1

Source: Agricultural Statistics of Pakistan, Ministry of National Food Security & Research Islamabad

Annexure 2. LIST OF DATA AND LITRETURE REVIEWED:

1. Barley Fact Sheet – US Grain Council
   https://grains.org/buying-selling/barley/
2. Barley Trade Year Exports by Country
   https://www.indexmundi.com/agriculture/?commodity=barley&graph=ty-exports
3. Barley Trade
   https://atlas.media.mit.edu/en/profile/hs92/1003/
4. Barley Trade Quarterly
   https://www.fas.usda.gov/search/barley
5. FAOSTAT, Production, Crops: http://www.fao.org/faostat/en/#data/QC
6. FAOSTAT, Trade Crop and Livestock Products:http://www.fao.org/faostat/en/#data/TP
7. FAOSTAT, Price, Producers' Prices-Annual: http://www.fao.org/faostat/en/#data/PP
8. https://www.dawn.com/news/280620
9. https://www.auroville.com/barley-powder-pack.html
10. https://pakissan.com/english/news/newsDetail.php?newsid=15873
11. https://www.medicalnewstoday.com/articles/295268.php
12. MNFS&R (Ministry of National Food Security and Research). 2018. Pakistan Economic Survey 2017-18, Chapter 2-Agriculture, page 19, Economic Wing, MNFS&R, Islamabad.
13. Data provided by Wheat Research Institute, Faisalabad
14. Grains Industry Market Access Forum. 2017. The Australian Grain Export Supply Chain Market Focused and Responsive, Industry Management Plan for Wheat and Barley Exports to China, Grains Industry Market Access Forum, November 2017 [https://www.graintrade.org.au/sites/default/files/file/Trade%20%26%20Market%20Access/IMP-Wheat-Barley-to-China-Update-Nov17-FINAL.pdf]
15. Department of Agriculture, Forestry & Fisheries. 2014. Barley Market Value Chain Profile, 2014, Department of Agriculture, Forestry & Fisheries, South Africa. [https://www.nda.agric.za/doaDev/sideMenu/Marketing/Annual%20Publications/Commodity%20Profiles/field%20crops/Barley%20Market%20Value%20Chain%20Profile%202014.pdf]
16. Berhanu, B. Fekadu, A., and Berhane, L. 2005. Food barley in Ethiopia. pp 53–82, in: S. Grando and H. Gomez Macpherson (eds.). Food barley: Importance, use and local knowledge. Proceedings of the International Workshop on Food Barley Improvement, 14–17 January 2002, Hammamet, Tunisia. ICARDA, Aleppo, Syria. https://www.researchgate.net/publication/242783214_Food_Barley_Importance_Uses_and_Local_Knowledge

17. Ceccarelli, S., Acevedo, E. and Grando, S. 1991. Breeding for yield stability in unpredictable environments: single traits, interaction between traits, and architecture of genotypes. Euphytica, 56: 169-185. https://link.springer.com/article/10.1007/BF00042061

18. Legesse, G., Debebe, S. and Alemu, T. 2007. Assessing the comparative advantage of malt barley production in Ethiopia. Application of a Policy Analysis Matrix. In African Crop Science Conference Proceedings, 8 (1), pp. 1227-1230. https://www.cabdirect.org/cabdirect/abstract/20103268542

19. USAID (United States Agency for International Development). 2014. Agricultural Growth Program Agribusiness and Market Development (AGP-AMDe). Addis Ababa, Ethiopia. https://www.agri-learning-ethiopia.org/wp-content/uploads/2015/08/AGP-AMDe_MTE-final.pdf

20. Mulugeta D. Watabaji, Adrienn M., Manoj K.D., and Xavier G. 2016. The influence of value chain integration on performance: an empirical study of the malt barley value chain in Ethiopia. Int. Food Agribusiness Manage. Review. 19(4): 79-94. DOI: 10.22434/IFAMR2015.0201. https://www.wageningenacademic.com/doi/pdf/10.22434/IFAMR2015.0201

21. Rashid, S., Gashaw, A, Solomon, L., James, W., Leulsegged, k., and Nicholas M. 2014. Barley value chain in Ethiopia. Research for Ethiopia's Agriculture Policy (REAP): analytical support for the Agricultural Transformation Agency (ATA). https://www.researchgate.net/publication/303075299_The_Barley_Value_Chain_in_Ethiopia

Annexure 3: List of Stakeholders consulted:

A. Researchers:

1. Dr. Muhammad Imtiaz, country head of CIMMYT, Pakistan, at NARC, Islamabad
2. Dr. Attiq-ur-Rehman Rattu, National Coordinator, Wheat at PARC, Islamabad
3. Dr. Javed Tareen, Director General Agri. Research, Balochistan
4. Dr. Ahfaq Ahmad Chatha, Professor, Department of Agronomy, UAF
5. Dr. Zaffar Iqbal, Director, Agri. Biotechnology Research Institute, AARI, Faisalabad
6. Dr. Shahzada Munawar Mehdi, Director, Rapid Soil Fertility Survey & Soil Testing Inst., Lahore
7. Dr. Manzoor Ahmad, Regional Agricultural Research Institute, Bahawalpur
8. Dr. Muhammad Azeem Tariq, Director, Barani Agricultural Research Institute, Chakwal
9. Dr. Muhammad Yaqub Mujahid, country manager harvest plus
10. Dr. Javed Ahmad, Director, Wheat Research Institute, Faisalabad
11. Dr. Ghulam Mahboob Subhani, Director/Barley expert, AARI, Faisalabad
12. Director, Cereal Crops, ARI, Quetta
13. Mr. Muhammad Sharif Kakar, Director Agriculture Research Institute, Qila Saif ullah
14. Dr. Fazal-e-Subhan, head Wheat division NIFA, Tarnab, Peshawar
15. Mr. Shah sawar Khan, Breeder, Agriculture Research Farm, Tarnab, Peshawar
16. Dr. Abdul Bari, Director Agriculture Research Institute, Mangora, Sawat
17. Dr. Gulzar Ahmad, head Agriculture research Station, Sawabi
18. Dr. Muhammad Noor, Assistant Prof. PBG University of Sawabi
19. Dr. Muhammad Amin, Prof. Soil & Environmental Sciences, Shaheed Benazir Bhutto, University, Sharingle upper Dir
20. Dr. Masud Jan, Director, CCRI, Pir-Sabak, KP
21. Dr. Gulzar, Wheat Botanist, CCRI, Pir-Sabak, KP
22. Dr. Karim Bux laghari, Director Wheat Research Institute, Sakrand
23. Dr. Khalid Ansari, Wheat Breeder, Wheat Research Institute, Sakrand
24. Dr. Mehboob Ali Sial, PSO, NIA Tando jam.
25. Dr. Muhammad Yousaf Mamon, NIA Tando jam.
26. Roshan Ali Jonajo, Wheat Botanist, Wheat Research station, Tando jam.
27. Dr. Ahmad Din, Food technologist, AARI, Faisalabad
28. Dr. Ijaz Tabassum, Assistant Botanist, AARI, Faisalabad
29. Deputy Director Agriculture Extension, Layyah
30. Deputy Director Agriculture Extension, Muzaffargarh

B. Industrialist/processors/commission agents

1. Isphanyar M. Bhandara, Chief Executive, Murree Brewery, Rawalpindi
2. Mr. Fakhar-e-Mahmood, Technical Manager, Murree Brewery, Rawalpindi
3. Mr. Yaseen, Project Manager, Murree Brewery
4. Mr. Riaz, New Riaz Commission Shop, Grain Market, Faisalabad
5. Al-Hafiz Wanda, Small Industrial Estate, Faisalabad
6. Zaman Traders, Tarar Commission Agent, Chowk Munda, Kot Addu, District Muzaffargarh 0307-7840153
7. Mr. Asif Ali, Chowk Munda, Kot Addu, District Muzaffargarh
8. Mr. Ghulam Nabi, Muhammad Wala, Chowk Munda, Kot Addu, District Muzaffargarh
9. Jullundur seed, Bahawalnager road, Arif wala

10. Rasham Seed Sadiq abad
11. Abad Seed, Chiniot Road Jhang
12. Lashkar Seed, Jhang Road Faisalabad

C. Barley Growers

1. Mr. Khrsheed Zaman Qureshi (0300-8681100)
2. Mian Munir (0300-4100741)
3. Saeed Ahmad, Chak No. 168 TDA Peer Jaggi, Layyah Supplies barley to military
4. Mr. Liaqat, Chak No. 168 TDA Peer Jaggi, Layyah
5. Mr. Muhammad Mahmood, Chak No. 168 TDA Peer Jaggi, Layyah
6. Shar Zaman Khan, Bajour Agency
7. Muhammad Zada Khan, Bajour Agency
8. Saoud Jan Khan, Bajour Agency
9. Muhammad Ibrahim Khan, Bajour Agency
10. Haji Mukarrum Khan, Bajour Agency
11. Muhammad Shehzad Khan, Bajour Agency
12. Salah-ud-Din, Manki Sharif
13. Zafar Ali Khan, Talash Dhari Chak. Lower Dir
14. Taj Burr Khan, Kumrat Upper Dir

Annexure 4. Major Barley Producing Districts of Pakistan [Area (000 ha), Prod. (000 Tonnes)]

Sr. No	District	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod	Area	Prod.	Area	Prod.	Area	Prod.
		2007-08		2008-09		2010-11		2011-12		2012-13		2013-14		2014-15		2015-16		2016-17	
Punjab																			
1	Attock	2.3	1.8	2.5	1.9	1.7	1.3	1.7	1.1	2.0	1.2	2.1	1.1	2.0	1.1	2.0	1.1	1.6	0.8
2	Sargodha	1.3	1.8	1.1	1.7	1.1	1.7	0.9	1.3	1.0	1.6	1.1	1.6	1.0	1.3	1.1	1.3	0.8	0.9
3	Bakkar	1.6	1.1	1.8	1.5	1.3	1.0	1.1	0.7	2.0	1.4	1.3	1.0	1.2	1.0	1.6	0.7	1.3	1.2
4	Jhang	1.0	1.1	1.0	1.1	0.4	0.5	0.3	0.3	0.4	0.4	0.4	0.5	0.4	0.6	0.3	0.4	0.4	0.5
5	M. Garh	5.6	5.1	5.9	6.1	3.9	3.9	3.4	3.0	3.4	3.1	4.1	4.1	5.5	5.1	4.2	4.6	4.4	5.2
6	Layyah	8.3	8.0	8.2	8.2	6.9	6.6	6.6	6.3	6.9	6.3	6.4	5.6	6.1	5.4	5.7	5.1	4.3	4.1
7	Bahawalnagar	3.5	2.1	3.8	2.2	2.5	2.2	2.1	1.2	1.7	1.3	1.5	1.2	1.3	0.9	0.8	0.6	0.7	0.6
KP																			
8	Mardan	2.5	2.9	2.5	3.0	2.2	2.0	1.6	1.5	1.6	1.3	1.4	1.2	1.4	1.2	1.3	1.1	1.2	0.9
9	Swabi	1.9	1.8	1.8	2.2	1.7	2.2	1.6	1.9	1.6	2.1	1.6	2.1	1.2	1.6	0.9	1.2	1.1	1.4
10	Dir Lower	1.9	1.9	1.9	1.4	1.8	1.6	1.7	1.6	1.4	1.3	1.4	1.2	1.2	1.1	1.2	1	1.2	1
11	Bajore	12.5	12.3	11.8	10.2	11.3	8.3	10.0	8.1	10.1	8.2	10.1	8.2						
12	Dir Upper	1.6	2.3	1.6	1.1	1.4	1.2	1.3	1.1	1.3	1	1.2	1	0.8	0.7	0.8	0.7	0.7	0.7
13	Chitral	2.3	2.6	2.1	2.4	1.8	2.6	1.8	2.6	1.8	2.8	1.7	2.7	1.7	2.8	1.7	2.6	1.7	2.6
Balochistan																			
14	Chagi	1.3	1.6	1.3	1.7	1.0	1.3	1.4	2.0	0.4	0.5	0.3	0.5	0.3	0.5	0.3	0.4		
15	Killa Saif Ullah	1.6	2.2	1.7	2.2	1.7	2.2	1.7	2.2	0.8	1	0.7	1	0.7	1.0	0.7	0.9		
16	Kalat	2.4	3.7	1.0	1.2	0.7	0.9	0.7	1.0	0.8	1	0.9	1.2	0.7	1.0	0.7	0.9		
17	Khuzdar	3.5	4.3	3.4	4.4	1.6	2.1	1.7	2.2	1.6	2.1	1.7	2.3	1.7	2.3	1.7	2.3		
18	Awaran	2.0	2.4	2.2	2.2	2.5	2.7	2.3	2.6	2.3	2.5	2.2	2.4	1.7	2.0	1.5	1.7		
19	Kharan	1.0	1.3	1.0	1.2	0.5	0.7	0.9	1.2	0.5	0.7	0.5	0.7	0.5	0.6	0.5	0.6		
Sindh																			
20	Larkana	2.6	1.3	1.6	0.9	3.8	2.3	2.5	1.4	2.9	1.9	3	2	2.6	1.7	2.7	1.8		
21	Badin	1.2	0.7	1.2	0.7	1.3	0.8	1.1	0.6	1.1	0.6	1.1	0.6	1	0.6	1	0.6		
22	Thatta	1.5	0.8	1.2	0.7	4.7	2.7	3.6	2.2	2.5	1.5	2.6	1.5	2.5	1.5	2.4	1.4		

Annexure 5: Recommended Production Technology of barley

Production Technology of barley	Existing/currently used by farmers	Recommended
Land preparation	2-3 Ploughing with planking.	2-3 Ploughing with planking.

		To remove the stubbles, use rotavator or disc harrow
Time of sowing	Mid Oct. to Dec.	Rainfed areas 15 Oct. – 10 Nov. Irrigated areas 1st Nov. – 25 Nov.
Seed rate	50-60 kg/ha	Rainfed areas: 50-60 Kg/ha Irrigated areas: 70-80 Kg/ha
Method of Sowing	Broadcast	Line sowing with automatic Rabi drill with row to row distance 20-30 cm
Irrigation	Generally, 1-2 irrigations	2-3 irrigations. 1st irrigation is after 12- 18 days of Germination 2nd irrigation at Tillering stage 3rd irrigation at Grain development stage
Fertilizer	1 bag of urea	1 bag of DAP at sowing 1 bag of urea at 1st irrigation
Approved Varieties	Generally, farmers use unapproved seed available at local market	Sultan-17, Jau-17, Haider-93, Jau-87
Diseases	No disease control is in practice.	Loose smut, Bunt attack & Powdery mildew Seed treatment with fungicide and use of approved varieties seed
Insects	No insect control is in practice.	Army worms Aphid In case of sever attack of Army worm proper insecticide may be used to control aphid, predators and parasites should be encouraged. Planting at proper time is helpful to minimized damaged by aphid.
Harvesting and threshing	Manual harvesting followed by threshing with tractor driven thresher	Harvesting with combined harvester be preferred. Harvesting of barley at full maturity. Maximum moisture 13.5%. Moisture >16% reduces malting quality. Mechanical harvesting with some part of awns retaining on grain. Harvesting early morning or late evening reduces shattering. Store plump kernels after grading.

Annexure- 6: Feasibility Study of Barley Porridge Production Unit

Project Concept

Barley is a healthy high-fiber, high-protein whole grain offering numerous health benefits; being an exceptional source of dietary fiber; containing both insoluble and soluble fibers. It is a rich source of phytochemicals, the plant based compounds which decrease the risk of diabetes, cancer and heart disease. It is good source of antioxidants which can effectively slow down the rate of oxidative damage to the human body.

Major part of barley is consumed for malt production which is further processed into alcoholic beverages. However, it is commonly used in breads, soups, stews, and health products. The simplest value added product of barley which can be produced with simple and low cost equipment is Barley Porridge (*Jau ka Dalia*). Barley Porridge is the main cereal grain popular for breakfast meal valued for its nutrients and rich flavor. It is rich in dietary fiber and proteins for an energetic and healthy metabolism. It is a highly nutritious breakfast cereal made from raw, broken coarse grains which cook quickly and are very easy to digest. Its crucial benefits are derived from its nutritional value that helps in lowering cholesterol and hence helps weight loss. The indigestible fiber in and around Barley porridge lingers making feel full and is supportive in controlling diabetes.

Potential Market

Barley porridge is value added nutritious product with increasing demand in the local market. Major share of 'Jau ka Dalia' is sold in the local market in unbranded form. Small *Chakkis* in urban and rural areas grind Barley to make this product. It is packed in smaller consumer packs and is sold on those *Chakkis* as well as on the local general stores. In addition to these unbranded products, some branded products are also available in the local market. Fauji Cereals is the leading market player which sells Barley Porridge in branded packs. These are sold at higher price compared to unbranded products. Increasing health consciousness in urban population is leading to increase demand for Barley porridge. It is mostly eaten as a popular breakfast item along with other products.

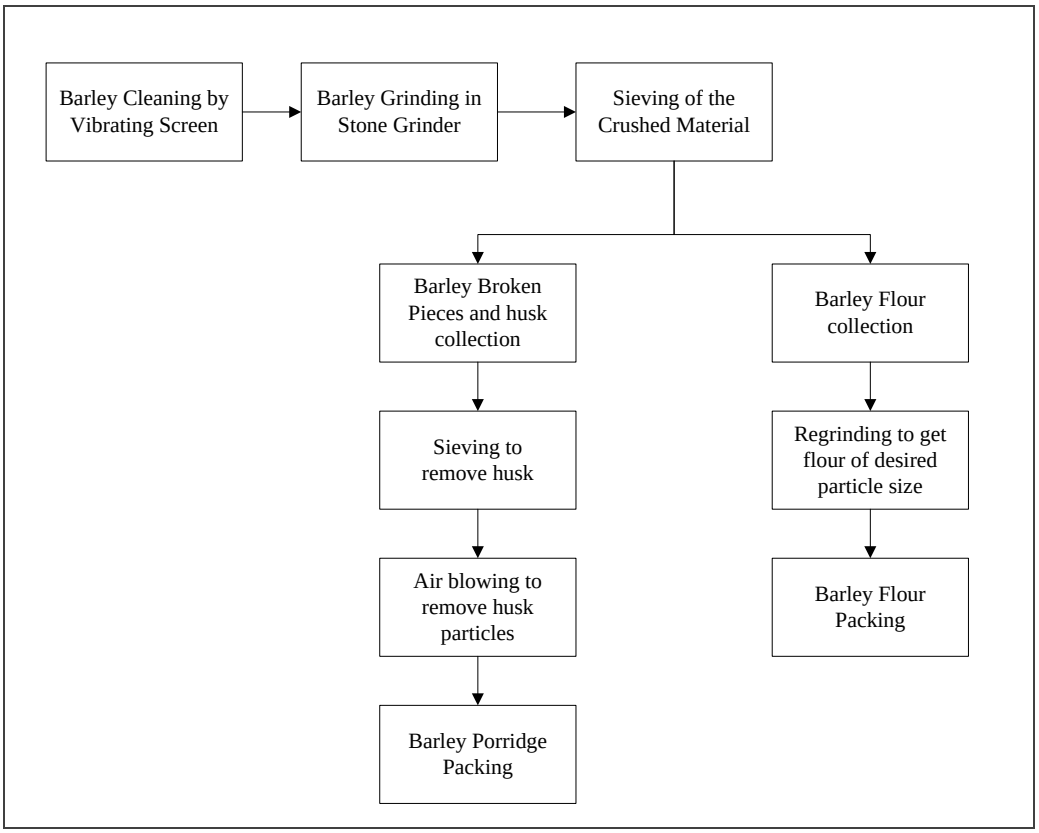
In addition to Barley porridge, Barley flour is also a popular product; easily available at local general stores. It is used as an additive to wheat flour to increase the overall nutritional value. It is also used due to some of its medicinal benefits. Barley flour is also consumed along with syrup of *'Gur'.* This product is commonly known as '*Sattu'* in the local language. It is a popular drink consumed by local people during summers. The proposed Barley processing unit will produce both barley porridge and flour which will be sold in large packing of 5 kg in wholesale markets.

Barley Porridge Production Process Flow

Barley is first cleaned by passing it through vibrating screen where dust and unwanted particles are separated. Cleaned barley is fed to the motorized stonnee grinder which crushes the grains into broken pieces, coarse barley flour and the husk (hard cellulose covering of the grains). Broken pieces (*Dalia*) of barley, flour and husk are separated by multiple-mesh sieving machine. After first sieving stage, flour produced during grinding process is recovered (which can be further ground to achieve barley flour of desired particle size). Mixture of husk and broken pieces of barley grains porridge (D*alia*) are separated by sieving. Finally, the recovered Porridge is passed through the air blowing machine to blow off the left over husk particles if any. Yield of porridge and flour is 55% and 47% respectively.

Process flow chart of Barley porridge production is shown in figure.

Barley Porridge Production Process Flow



Project Cost

Total project cost of the proposed Barley porridge production unit is PKR 1.356 million. Major items of project cost are listed in.

Project Cost Details

Cost Item	Cost (PKR)
Machinery & Equipment	107,000
Office Equipment & Furniture	33,000
Pre-operating expenses	132,140
Capital Investment	**272,140**
Working Capital	653,790
Total Project Cost	925,930

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

Land and Building

The proposed project will be established in a rented building with a covered area of around 500 sq. ft. 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 connected 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 two utilities will have to be added in the project cost.

Machinery and Equipment

The feasibility study of Barley porridge production unit has been based on locally manufactured machinery. This has been done to keep the capital cost of the project lower to keep it within the reach of smaller investors in the rural areas. Total cost of the required machinery and equipment is PKR 107,000.

Machinery and Equipment Cost

Sr.No	Name of the Machine	No.	Unit Cost (PKR)	Total Cost (PKR)
1	Barley Cleaning Machine (Vibrating screen)	1	20,000	20,000
2	Stonnee Grinding Machine (Amri Chakki) 12 in.	1	25,000	25,000
3	Multiple Mesh Sieving Machine	1	20,000	20,000
4	Air Blower	1	10,000	10,000
5	Weigh Scale	1	5,000	5,000
6	Packing Machine	1	7,000	7,000
7	Miscellaneous	1	20,000	20,000
	Total			**107,000**

Other Project Cost Items

- Office equipment and furniture has been included at a total cost of PKR 33,000.

- Pre-operating expenses include those expenses which have to be incurred before the business becomes operational. The costs included under this head are 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 132,140.

- Working Capital calculation includes the cost of one-month supply of Barley, electricity bill, packing material and the staff salaries. Machinery spares equal to 1% of machinery cost and petty cash of PKR 100,000 have also been included in the working capital. With these assumptions, total working capital requirement has been calculated to be PKR 653,790.

Revenues and Costs

Revenues

Revenues will be generated by selling Barley porridge and Barley flour, the two products produced during processing. The products will be sold in wholesale market in 5 kilogram bags to traders who will sell the product in retail market in smaller packing. The grinding capacity of the suggested stonnee grinder is 150 kg per hour. It has been assumed that the machine will process barley for 4 hours per day for 90 days during a year. At 600 kg per day, total quantity of Barley that will be processed during the year will be 54 tonnes. The yield of Barley porridge will be 55% whereas the yield of Barley flour will be 47%. It is assumed that the project will operate at this capacity from the first year.

At a selling price of PKR 150 per kilogram of Barley porridge and PKR 100 per kilogram of Barley flour, total revenues of the project will be PKR 6.453 million. No growth in selling price has been assumed over the five-year period.

Revenue Calculations

	Year 1	Year 2	Year 3	Year 4	Year 5
Barley Porridge Production (kg)	29,700	29,700	29,700	29,700	29,700
Price (PKR/kg)	150	150	150	150	150
Revenues from Porridge (PKR)	**4,455,000**	**4,455,000**	**4,455,000**	**4,455,000**	**4,455,000**
Barley Flour Production (kg)	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Price (PKR/kg)	19,980	19,980	19,980	19,980	19,980
Revenues from Flour (PKR)	100	100	100	100	100
	1,998,000	**1,998,000**	**1,998,000**	**1,998,000**	**1,998,000**
Total Revenues (PKR)					

Costs

Barley Cost

Barley is the major cost of Barley porridge production unit. Barley's cost has been assumed considered to be PKR 32 per kg. At this rate, total cost of Barley will be PKR 1.728 million. No growth has been assumed in the cost of Barley.

Barley Cost Calculations

	Year 1	Year 2	Year 3	Year 4	Year 5
Barley Processing Per year	54,000	54,000	54,000	54,000	54,000
Barley Cost (PKR/kg)	32.0	32.0	32.0	32.0	32.0
Barley Cost (PKR)	**1,728,000**	**1,728,000**	**1,728,000**	**1,728,000**	**1,728,000**

Other Costs

- Processing cost includes the cost of electricity which has been worked out on the basis of an electricity connection of 6 KVA. Electricity cost for the first year has been calculated to be PKR 140,038.

- Barley porridge and flour will be packed in 5 kg bags. The cost of this pack has been assumed to be PKR 20.0 per pack. At this rate, total cost of bags was calculated to be PKR 0.994 million. Packing cost has been assumed to remain constant for five years.

- Building Lease cost has been assumed to be PKR 25,000 per month. Annual cost comes out to be PKR 300,000.

- Plant maintenance cost has been assumed to be PKR 2,000 per month. Maintenance cost during three months of operations during the first year has been calculated to be PKR 6,000.

- Marketing cost includes the cost of transporting the Barley products to wholesale markets and the cost of creating products awareness and promotion. It has been assumed to be PKR 15,000 per month or PKR 180,000 per annum.

- Administration cost includes the cost of travelling, office stationery, telephone and refreshment. Administration cost during first year of operations is calculated as PKR 144,000. 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 Barley porridge production unit will need small workforce; including a machine operator, machine helper and a security guard. The activities of production management, administration, bookkeeping and marketing will be carried out by the entrepreneur himself/herself.

Human Resource Cost

Designation	No.	Salary (PKR/month)	Total (PKR/month)	No. of Months	Salary per Year (PKR)
Machine Worker	1	25,000	25,000	3	75,000
Machine Helper	1	20,000	20,000	3	60,000
Security Guard	1	15,000	15,000	12	180,000
Total Staff	**3**		**60,000**		**315,000**

Projected Financial Statements

Projected Profit & Loss Statement

Projected Income Statement

	Year 1	Year 2	Year 3	Year 4	Year 5
Revenues	**6,453,000**	**6,453,000**	**6,453,000**	**6,453,000**	**6,453,000**
Direct Costs					
Barley	1,728,000	1,728,000	1,728,000	1,728,000	1,728,000
Packing Cost	993,600	993,600	993,600	993,600	993,600
Direct Labor	135,000	135,000	135,000	135,000	135,000
Direct Electricity	111,238	111,238	111,238	111,238	111,238
Maintenance	6,000	6,000	6,000	6,000	6,000
Total Direct Cost	**2,973,838**	**2,973,838**	**2,973,838**	**2,973,838**	**2,973,838**
Gross Profit	**3,479,162**	**3,479,162**	**3,479,162**	**3,479,162**	**3,479,162**
Indirect Costs					
Building Lease	300,000	300,000	300,000	300,000	300,000
Indirect Labor	180,000	180,000	180,000	180,000	180,000
Fixed Electricity	28,800	28,800	28,800	28,800	28,800
Depreciation	17,300	17,300	17,300	17,300	17,300
Amortization	26,428	26,428	26,428	26,428	26,428
Marketing	180,000	180,000	180,000	180,000	180,000
Office Administration	144,000	146,400	146,400	146,400	146,400
Licensing/Regulatory Fee	5,000	5,000	5,000	5,000	5,000
Total Indirect Costs	**881,528**	**883,928**	**883,928**	**883,928**	**883,928**
Net Profit	**2,597,634**	**2,595,234**	**2,595,234**	**2,595,234**	**2,595,234**

Projected Balance Sheet

ASSETS	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Current Assets						
Cash	100,000	2,850,748	5,489,653	8,128,556	10,767,456	13,406,352
Raw material	514,800					
Advance Processing Charges	37,920					
Accounts Receivables		537,750	537,750	537,750	537,750	537,750
Spare Parts inventory	1,070	1,124	1,180	1,239	1,301	1,366
Total Current Assets	**653,790**	**3,389,621**	**6,028,583**	**8,667,545**	**11,306,506**	**13,945,468**
Fixed Assets						
Land	-	-	-	-	-	-
Building & Civil Works	-	-	-	-	-	-
Processing Machinery	107,000	96,300	85,600	74,900	64,200	53,500
Utility Machinery	-	-	-	-	-	-
Laboratory Equipment	-	-	-	-	-	-
Office Equipment & Furniture	33,000	26,400	19,800	13,200	6,600	-
Net Fixed Assets	**140,000**	**122,700**	**105,400**	**88,100**	**70,800**	**53,500**
Other Assets						
Pre-operating Expenses	132,140	105,712	79,284	52,856	26,428	-
Contingencies						
Total Other Assets	**132,140**	**105,712**	**79,284**	**52,856**	**26,428**	**-**
TOTAL ASSETS	**925,930**	**3,618,033**	**6,213,267**	**8,808,501**	**11,403,734**	**13,998,968**

LIABILITIES	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Current Liabilities						
Accounts Payables		94,470	94,470	94,470	94,470	94,470
Short term loan						
Other Current Liabilities						
Total Current Liabilities	**-**	**94,470**	**94,470**	**94,470**	**94,470**	**94,470**
Long Term Liabilities						
Lease payable						
Long term debt	-	-	-	-	-	-
Long term debt	**-**	**-**	**-**	**-**	**-**	**-**
Equity						
Paid up Capital	925,930	925,930	925,930	925,930	925,930	925,930
Retained Earnings		2,597,634	5,192,867	7,788,101	10,383,334	12,978,568
Total Equity	**925,930**	**3,523,563**	**6,118,797**	**8,714,031**	**11,309,264**	**13,904,498**
TOTAL LIABILITIES	**925,930**	**3,618,033**	**6,213,267**	**8,808,501**	**11,403,734**	**13,998,968**

Projected Cash Flow Statement

Projected Cash Flow Statement

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Operating Activities						
Net Income		**2,597,634**	**2,595,234**	**2,595,234**	**2,595,234**	**2,595,234**
Depreciation		17,300	17,300	17,300	17,300	17,300
Amortization		26,428	26,428	26,428	26,428	26,428
Change in raw material inventories	(514,800)	514,800	-	-	-	-
Change in advance processing charges	(37,920)	37,920				
Change in spares inventory	(1,070)	(54)	(56)	(59)	(62)	(65)
Change in Accounts Receivables		(537,750)	-	-	-	-
Change in Accounts Payables		94,470	-	-	-	-
Cash from operations	**(553,790)**	**2,750,748**	**2,638,905**	**2,638,903**	**2,638,900**	**2,638,897**
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	925,930					
Net cash from financing activities	**925,930**	-	-	-	-	-
Investing Activities						
Capital Expenditure	(272,140)					
Cash from investing activities	**(272,140)**	-	-	-	-	-
Net Cash	**100,000**	**2,750,748**	**2,638,905**	**2,638,903**	**2,638,900**	**2,638,897**
Cash balance brought forward	-	100,000	2,850,748	5,489,653	8,128,556	10,767,456
Cash investment in securities		-	-	-	-	-
Cash available for appropriation	100,000	2,850,748	5,489,653	8,128,556	10,767,456	13,406,352
Dividend	-	-	-	-	-	-
Cash carried forward	**100,000**	**2,850,748**	**5,489,653**	**8,128,556**	**10,767,456**	**13,406,352**

Financial Feasibility

The proposed project of Barley porridge production unit is found to be financially viable with a positive NPV of PKR 6.972 million.

Financial Feasibility Indicators

NPV (PKR)	**6,971,596**
IRR	**294%**

Profitability Ratios

	Amount (PKR)	Percent
Sales	6,453,000	100.0%
Direct Costs	2,973,838	46.1%
Gross Profit	3,479,162	53.9%
Indirect Costs	881,528	13.7%
Net Profit	2,597,634	40.3%

Interventions are being proposed here to increase Barley yield, improve value chain, and convert basic crop production into high value added products; so as to increase the overall value of the produce for the farmers and for other sector stakeholders. Cost and benefit analysis has been done separately for each of the two clusters.

The economic and financial analysis of Barley clusters has been carried out by identifying the benefits of the proposed interventions and their associated costs. Cost and benefit analysis has been done in a five-year timeframe; separately for each of the two clusters. Discounted cash flow analysis has been carried out to work out the economic viability of the proposed interventions in terms of NPV and IRR.