Ginger 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. Abedullah

Senior Author

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DISCLAIMER

This report is prepared by using the data from various published and unpublished sources and that obtained during the consultations with stakeholders.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

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

AARI	Ayub Agriculture Research Institute
ABEI	Agricultural and Biological Engineering Institute
AC	Agro-Based Clusters
API	Agriculture Poly-technique Institute
AVRDC	Asian Vegetable Research and Development Corporation
CDF	Cluster Development Fund
CIPM	Cluster Initiative Performance Model
FAO	Food and Agriculture Organization
GAP	Good Agricultural Practices
GFEGs	Ginger Farmer Entrepreneur Groups
Ha	Hectare(s)
HYV	High Yielding Varieties
IFM	Improved Farm Management
IRR	Internal Rate of Return
ITC	International Trade Commission
KP	Khyber Pakhtunkhwa Province
NARC	National Agricultural Research Center
NGO	Non-Governmental Organization
NPV	Net Present Value
PARC	Pakistan Agricultural Research Council
PoP	Persistent Organic Pollutant
R&D	Research and Development
RSP	Rural Support Program
SWOT	Strength, Weakness, Opportunity and Threat
USAID	United States Agency for International Development
VO	Village Organization
ZTBL	Zarai Taraqiati Bank Limited

EXECUTIVE SUMMARY

According to recent statistics, global production of ginger was recorded at 3.0 million tonnes from 327 thousand has with an average yield of 8.2 tonnes per ha. India leads global production; however, China topped the world exports. The world export of ginger has reached US$855.0 million in 2017 which is growing at the rate of 17% per annum. The top importer of ginger is USA and Pakistan.

Due to the negligence of policy makers on the improvement of ginger value chain, the ginger production in Pakistan has dried down, and the country now completely relies on its import by spending over US$70 million per annum. The per ha yield of ginger as reported in Agricultural Statistics of Pakistan is only 5.5% of the world average and 1.5% of the yield in USA which is the top ginger yielding country. Moreover, yield improvement in Pakistan is relatively slow, if any, while world average ginger yield has been improving at the rate of 5.4% per annum. The export of processed ginger from Pakistan which is mainly re-exported does not compensate its high imports. As a result, the trade deficit is ballooning overtime because of the increasing preference of the consumers towards ginger consumption, dwindled ginger supply from domestic source and increase in import prices.

Looking at the growing domestic demand for ginger that is expected to further worsen the trade gap, the Planning commission of Pakistan initiated this study to analyse the ginger value chain, identify its potentials, gaps along the chain and suggest economically viable technological and policy interventions to improve the competitiveness of the ginger value chain in the country. To achieve the objective of the study, a large number of stakeholders along the value chain are consulted, related macro data are analysed, and literature are reviewed.

Currently no ginger producing cluster is found in the country. However, keeping in view the required soil and climatic conditions for the cultivation of ginger in mind, district Mansehra is suggested to be the potential cluster for ginger cultivation where ginger cluster development efforts can be focused. The analysis in this study is focused to identify the constraints and suggest strategies to develop the Mansehra as a potential ginger cluster in the country.

A number of constraints have been identified in the production, processing and marketing of ginger value chain to establish ginger cluster. These include: high soil pH level with low rainfall throughout the production period and unavailability of suitable varieties for these environments. Lack of local level drying facilities at the farm level and marketing mechanism to ensure reasonable prices to ginger producers and unrestricted imports from neighbouring countries which produce ginger under highly input subsidy regime do not allow innovators to start ginger cultivation.

To start from somewhere, the whole Mansehra district should be surveyed by the GIS team to find out the suitable area for ginger cultivation. The team believes that Mansehra district should have enough suitable land for ginger cultivation to at least replace 25% ginger imports in the country. Once this is done, provide incentives to bring ginger area under cultivation in the cluster to reduce imports of ginger by 25%. With an average yield level of 7.0 tonnes per ha, this will require 3548 hectares under ginger cultivation. Interventions, strategies and policies are suggested to achieve the target. These include, capacity building of farmers and other

stakeholders to produce and market quality ginger to the satisfaction of consumers, incentivizing ginger cultivation at the rate of US$300 per ha, establishing collection centres and ensuring guaranteed price, and promotion of ginger drying at the farm-level once its cultivation is established. We also propose to put certain tariff on the import of ginger and use the money to promote ginger cultivation in the country. The estimated cost of investment for these interventions would be around $7.2 million. About 87% of the investment has to be borne by the public sector. The detail of these investments and economic analysis of the plan can be seen in the Summary Sheet given below.

These investments will induce additional cost on production and marketing of ginger to US$5.4 million and generate gross revenue of US$10.6 million during the last year of the project. After deducting all operational costs and investments, the ginger cluster development program will generate a Net Present Value (NPV) of US$1.5 million with a discount rate of 8.5% and it will produce an Internal Rate of Return (IRR) of 29%. The plan will save the foreign exchange to the tune of US$22.1 million in the form of reduced imports during the last year of the project. As ginger is considered more labour intensive crop than the existing crops grown in the area, the ginger cluster development plan will also generate additional employment in rural area.

These benefits of the cluster development plan, however, is highly dependent upon two very strong assumptions: i). availability of the suitable land as a block for the cultivation of ginger in Mansehra district, and ii). availability of suitable variety which can give per ha yield at least equal or higher than the world average. The ginger feasibility (NPV and IRR) in the EXL model is highly sensitive to the yield level that can be attained. Therefore, before starting any ginger cluster development program, the validity of these assumptions should be seriously tested. Once the possibility of expansion in ginger area with enhanced yield exists, the capacity building of stakeholders especially farmers and local ginger marketing mechanism will be the key for the successful establishment of the cluster.

Summary Sheet for Ginger

Item	Value
World average yield (tonnes/ha)	7.0
Current import of ginger (tonne)	79110
Current value of import (Million US$)	74.1
Growth rate in import (% per annum)	4.5%
Future expected demand and import of ginger during the 5th year (tonne)	98782
Value of the future import after 5 years (with constant import price) (M. US$)	88.5
Percentage Demand to be Fulfilled	25%
Additional area required to fulfill the 25% demand in 5th year (ha)	3548
Additional production during the 5th year (tonnes)	24696
Expected economic return from expansion in area (M. US$)	8.1
Percentage of production assumed to be locally dried/processed	10%
Production to be dried during the 5th year (tonne)	1235
Value of the processed ginger (M. US$)	2.47
Total number of drier required (Number)	22
Total collection centers to be established	2
Investments (US$)	
Investment on conducting GIS Survey to identify appropriate area for ginger	100,000
Investment on strengthening of research	814,815
subsidy to promote ginger cultivation @US$300 per ha	5,066,965
Investment on capacity building of stakeholders (Farmers, processors, etc.)	400,000
Establishing Collection Center, guaranteed price, etc.)	266,667
Investment on value addition (drying units)	510,122
Government loans	63,765
Total Investments	**7,222,334**
Total public sector investment (subsidies, research, capacity building, etc	6,600,903
Private sector investment	621,431
Economic Analysis	
Gross revenue of the two suggested interventions during the 5th (M. US$)	10.6
Total operating costs of the interventions during 5th year (M. US$)	5.4
Total investments (M. US$)	7.2
NPV (M. US$)	1.46
Internal Rate of Return (IRR) (%)	29%
Saving in foreign exchange (25% of the expected import value during the 5th year) (M. US$)	22.1

1 INTRODUCTION

Ginger (*Zingiber officinale Rosccoe*) is monocotyledonous, herbaceous, tropical plant belonging to the family Zingiberaceae. It is a perennial plant, but is usually grown as an annual crop for harvesting as a spice. It is one of the oldest spices with a distinct flavor and pungency. Ginger is commercially available in various forms, such as green ginger, dry ginger, ginger powder, ginger oil, ginger oleoresin and preserved ginger (Kizhakkayil & Sasikumar, 2009). The underground rhizome of this crop is also valued throughout the world as a spice of flavoring agent for its two major classes of constituents, such as essential oils and oleoresins.

Ginger produces a hot, fragrant kitchen spice. Young ginger rhizomes are juicy and fleshy with a very mild taste. It is often pickled in vinegar or sherry as a snack or just cooked as an ingredient in many dishes. Some people steep it in boiling water to make ginger tea and then they often add honey to make it sweet or add sliced orange or lemon fruit to improve its taste. It is widely used for culinary purposes in ginger bread, biscuits, sauces, and cakes. Besides, it is used in breweries for the preparation of ginger beer, ginger ale, and ginger wine in different countries. The juice from old ginger roots is extremely potent and is often used as a spice in Indian recipes. It is assumed as a quintessential ingredient of Chinese, Korean and many South Asian cuisines for flavoring dishes such as seafood or goat meat and vegetarian cuisine.

In Pakistan, it is popular by the local name called *Adrak*. In Pakistan, ginger is treated as a minor but important ingredient of food. It is one of the important spices and is frequently used as rhizome and in dried form in majority of the local dishes. Majority of people in Pakistan consume it as a flavoring agent in all kind of curry (vegetables, meat, pulses). It is widely used for culinary purposes in ginger bread, biscuits, sauces, and cakes. It is used in traditional medicines to treat several ailments including nausea, diarrhea, motion sickness, migraine, dyspepsia, heart problems, arthritis, and to reduce flatulence and colic.

The phenolic compounds in ginger are known to help relieve gastrointestinal (GI) irritation, stimulate saliva and bile production, and suppress gastric contractions as food and fluids move through the GI tract. Daily ginger supplementation reduces exercise-induced muscle pain by 25 percent. Other anti-inflammatory and antioxidant compounds found in ginger that are beneficial to health include gingerols, beta-carotene, capsaicin, caffeic acid, curcumin and salicylate (Yashin et al., 2017). Complete breakdowns of the percentage of different components found in ginger are presented in Table 1.

Table 1: Composition of fresh ginger rhizome

Particulars	Fresh ginger rhizome
Dry matter %	92.71
Crude protein %	5.28
Ether extract %	5.54
Crude fiber %	9.74
Ash %	5.97
Total carbohydrate %	66.26
Oxalate mg/g	4.55
Phytin mg/g	28.83
Tannin %	0.26
Phosphorus %	25.70
Sodium %	40.96
Potassium %	37.34
Calcium %	35.66
Manganese %	19.60
Zinc %	4.06
Iron %	1.44

Source: Adanlawo and Dairo (2007)

1.1 Ginger Production in Pakistan

Agricultural Statistics of Pakistan (ASP) (2016-17) indicate that ginger is produced only in Sindh province. The FAOSTAT repeated the country level data of ASP until 2017 (Table 2). These data suggest that during 2017, ginger was grown in Pakistan on 270 ha producing 122 tonnes of ginger with an average yield of 0.45 tonnes per ha.[1] The data suggest high variation in ginger cultivated area (ranging 22 ha in 2011 to 291 in 2015) and corresponding variation in its production, although per ha yield of ginger is shown to vary within a narrow range of 0.388-0.467 during the period.

[1] We however seriously doubt the continued existence of any ginger cultivation in Pakistan. Our team extensively visited Mirpurkhas, Tando Allahyar, T.M. Khan and Badin districts, reported to be the main ginger growing areas in Agriculture Statistics of Pakistan (ASP) and found not a single ginger growing farm in these districts. We explored the source of this data with the concerned data providing authorities (extension and crop reporting departments of Sindh) who admitted that the data of ginger production in these districts are mistakenly reported. Our discussions with vegetable dealers in the main vegetable markets of Karachi and Hyderabad in Sindh also support this conclusion as they categorically indicated that they never received ginger supply from the local sources during the last 20 years. Our conclusion also verified by the vegetable director of Ayub Agricultural Research Institute (AARI) that ginger is not grown anywhere in Pakistan.

Table 2: Area, production and yield of ginger in Pakistan during 2001-17

Year	Area (ha)	Production (tonnes)	Yield (tonnes/ha)
2001	79	30	0.380
2002	94	36	0.383
2003	119	47	0.395
2004	97	41	0.423
2005	109	50	0.459
2006	80	31	0.388
2007	121	57	0.471
2008	195	95	0.487
2009	269	111	0.413
2010	247	115	0.466
2011	22	8	0.364
2012	249	113	0.454
2013	280	124	0.443
2014	282	126	0.447
2015	291	130	0.447
2016	268	120	0.448
2017	270	122	0.452
Growth rate (%)	7.0	8.2	1.2

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

If the data reported in ASP is considered to be true, it indicates some improvement in per ha yield overtime, although it is not clear the technological source of this improvement as no research is being conducted on ginger in the country.

1.2 Import of Ginger in Pakistan

Pakistan imported nearly 79 thousand tonnes of ginger in 2017 costing the country US$71 million. During 2001-17, the quantity of ginger imports grew at a rate of 22%, while imported value increased even at a higher rate of 27% (Table 3). These high growths in ginger imports are partly because of the increasing population, plummeting local production (footnote 1), and partly due to the improved preference of especially the urban population for ginger in Pakistan. It is worth noting that import price of ginger had wide variation in the range of US$802 and US$441 during 2001-17, but no significant trend in export prices was observed during the period (Table 3).

Table 3: Imports of ginger of Pakistan during 2001-17

Year	Import Quantity (000 tonne)	Import Value (Million US$)	Import price (US$/tonne)
2001	1.00	0.75	818.1
2002	0.99	0.79	802.0
2003	12.32	3.38	274.6
2004	43.90	15.28	348.1
2005	32.70	23.35	714.2
2006	48.25	25.26	523.6
2007	56.88	24.54	431.4
2008	60.14	25.12	417.8
2009	58.18	28.86	496.1
2010	62.58	38.44	614.3
2011	60.11	51.03	849.0
2012	74.16	32.76	441.7
2013	62.15	35.33	568.5
2014	69.45	48.09	692.5
2015	89.46	63.90	714.3
2016	77.32	59.34	767.5
2017	79.11	70.92	896.5
Growth rate (%)	**22**	**27**	**2.6^{ns}**

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

^{NS} implies that the trend is not significant at the 5% level of significance.

Pakistan imports ginger mainly from China, Thailand and India. Being a neighboring and friendly country of Pakistan, it is most feasible for Pakistan to import ginger from China. Although India is another important ginger exporter to Pakistan, but our focus group discussion with traders, processors and consumers suggest that Chinese ginger is most popular in Pakistan because of its high quality, cleanliness and uniformity. That is why Chinese share in ginger import, except in 2014, is gradually increasing (Figure 1).

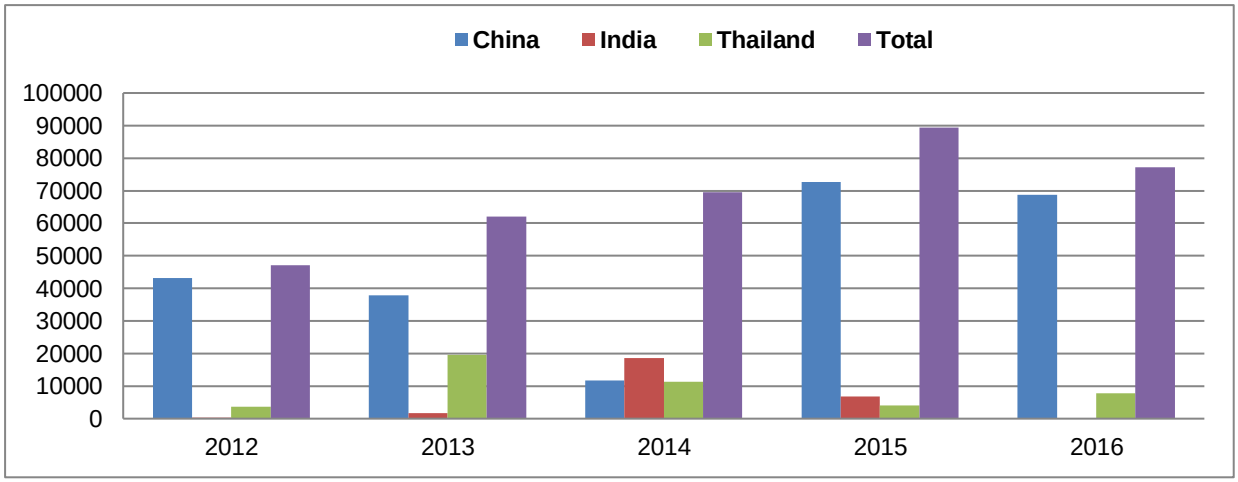

Figure 1: Pakistan's ginger imports by country during 2012-2016

Source: Trade Map (2017)

1.3 Ginger Export from Pakistan

Since Pakistan itself is not a ginger cultivating country, most of our ginger exports actually are re-export after value addition in crushed or powdered form and mixing the produce into spices. This business is undertaken by multinational companies like Shan and National foods which produce and export powdered spices after mixing different ingredients in specific combination.

Pakistan's ginger re-export has gradually increased from 121 tonnes of ginger worth of US$0.288 million in 2007 (the earliest year when data is available) to 406 tonnes, worth of about US$1.0 million in 2017 producing an average annual growth rate of 6.4% and 8.4% in quantity and value of export, respectively over the period (Table 4). These growth rates apparently look large, but are not impressive due to two reasons: first because of very low base to start with, and second these rates are much lower than the growth in ginger imports reported in Table 3 resulting in widening the trade deficit in ginger. Moreover, exports are more than three times higher than the production (as reported in ASP) implying that two third of the exports are prepared from imported ginger.

Pakistan has spent about US$70 million as a trade deficit on ginger during 20017, which was only US$24 million in 2007, implying about three times increase with an average annual growth rate of 10.2% per annum over the period (Table 4).

No significant trend in the export price during the period was observed. It is worth noting that export price of ginger that Pakistani exporters earn is higher than the import price (Table 3) implying that Pakistani export is of much higher value (perhaps because of some value addition before export in Pakistan).

Table 4: Export of processed ginger from Pakistan during 2007-17

Year	Quantity (Tonnes)	Value (000 US$)	Export price (US$/tonne)	Trade deficit (Million US$)
2007	121	288	2380	24.25
2008	193	361	1870	24.76
2009	284	756	2662	28.10
2010	198	489	2470	37.95
2011	349	685	1963	50.35
2012	294	662	2252	32.10
2013	149	377	2530	34.95
2014	184	521	2832	47.57
2015	263	727	2764	63.17
2016	335	857	2558	58.48
2017	406	996	2453	69.92
Growth rate (%)	6.39	8.25	1.86^{ns}	10.23

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

^{NS} implies that the trend is not significant at the 5% level of significance.

Pakistan's biggest export market for ginger is the USA. In 2016, 335 tonne of ginger is exported globally from Pakistan, and 202 tonnes is destined to USA alone, which is about 66% of total export from Pakistan. The remaining export is divided into several countries of Europe

and Canada. The share of USA in the total export of ginger is increasing along with the growth in the total export of ginger (Figure 2).

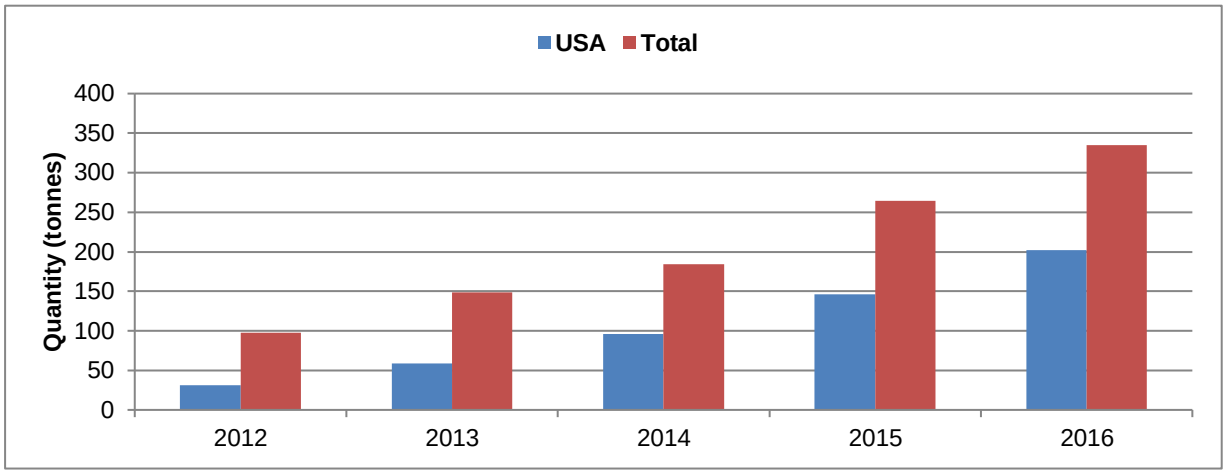

Figure 2: Pakistan's ginger export to USA and other countries during 2012-2016
Source: Trade Map (2017)

1.4 Global Scenario

A comparative picture of Pakistan and the global ginger market is drawn in Table 5 encompassing the various aspects of production, import and export along with international and wholesale prices.

Pakistan's contribution in global area and production of ginger (as reported in the Agricultural Statistics of Pakistan) is insignificant as the country mainly relies on imports to meet its consumption needs. Whatever little area is reported, per ha yield is only 5.5% of the world's average. With such a low yield, competing in the domestic and international ginger markets is almost impossible.

Table 5: Competitiveness of Pakistani ginger with the World in 2016

Particulars	World	Pakistan	Share (%)
Area (000 ha)	372	0.270	0.07
Production (000 tonne)	3038	0.122	0.004
Yield (tonne/ha)	8.17	0.44	5.5
Total Import (000 tonnes)	706	79.1	9.98
Total Export (000 tonne)	728.7	0.41	0.04
Exported-production ratio (%)	23.5	-	-
Wholesale Price (US$/tonne)	1000	2127	228.7
International import Price (US$/tonne)	1268	896	46.6

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

Globally, about 23.8% of the total world's production is traded. Pakistan exports more than 332% of the local production as reported in ASP. Pakistan imports about 10% of world's export, implying that Pakistan is one of the major importers of ginger. However, Pakistan also exports 335 tonnes after processing the raw ginger (Table 5).

The average wholesale price of ginger in Pakistan is observed to be more than double the average wholesale price of the world, indicating some quality differences in the two markets. Perhaps two different commodities are compared in the two markets. While in Pakistan, the wholesale price is for the processed ginger while in international market it is unprocessed ginger products. In any case, the huge difference between wholesale price of ginger in Pakistan and international markets creates big incentive for the importer on one hand and for the farmers to produce ginger in the country on the other.

However, import price of ginger for Pakistan is lower than the world average. One of the reasons for this could be the geographical proximity of the countries from where Pakistan makes its imports, like China and India. Another reason perhaps may be due to some quality difference.

1.5 Global Ginger Production and Trade

Globally, the total area under ginger production is 372 thousand ha with a global production of 3.27 million tonnes with an average yield of 8.2 tonnes per ha. During 2001-17, global ginger production has been increasing at a high rate of 6.5% per annum (Table 6), much higher than the population growth rate of 1.19%, suggesting consumers' high increasing preference for ginger and its increasing per capita consumption.

Most of the increase in production during 2001-17 has originated from the improvement in per ha yield which has been increased at a rate of 5.9% per annum, while the contribution of area expansion is relatively small at 0.6% per annum (Table 6). As noted earlier, Pakistan's yield remained almost stagnant over the period, suggesting a further losing competitiveness of the country in ginger production.

The global export of ginger has reached to US$ 1.17 billion in 2017 (Table 6). It has increased at an average rate of 6.5% per annum during 2001-17, higher than the increase in ginger production during the period, implying that ginger is increasing becoming an international commodity and it is increasingly being consumed somewhere else than where it is produced.

It is worth noting that there is a demand pressure on ginger market thus despite a high increase in ginger production and its supplies, the ginger export prices are increasing also increasing at 5.9% per annum during 2001-17 (Table 6). So there is further global potential of enhancing the ginger production and its supplies to curtail the increasing prices and improve its consumption.

Table 6: Trends in the global ginger production and trade during 2001-17

Year	World Ginger Production			World Ginger Export		
	Area	Production	Yield	Quantities	Values	Export price
	(000 ha)	(000 tonne)	(tonne/ha)	(000 tonne)	Million US$	(US$/tonne)
2001	302	1141	3.8	249.8	124.6	498.6
2002	323	1216	3.8	291.0	125.9	432.7
2003	331	1275	3.8	311.4	135.6	435.5
2004	330	1257	3.8	291.5	277.6	952.4
2005	354	1394	3.9	380.2	319.2	839.4
2006	388	1499	3.9	385.4	253.0	656.4
2007	243	1609	6.6	418.2	257.8	616.4
2008	251	1624	6.5	420.9	341.9	812.4
2009	261	1670	6.4	497.5	407.2	818.5
2010	264	1719	6.5	460.9	624.4	1354.8
2011	307	2365	7.7	548.0	643.4	1174.1
2012	368	2462	6.7	646.1	469.4	726.5
2013	373	2442	6.6	602.7	666.8	1106.4
2014	309	2270	7.3	531.5	955.5	1798.0
2015	339	2599	7.7	657.3	776.7	1181.8
2016	376	3172	8.4	765.9	662.1	864.5
2017	372	3038	8.2	728.7	855.0	1173.3
Annual growth (%)	0.6	6.5	5.9	6.7	13.0	5.9

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

The top ginger producer countries are India, China, Nigeria, Nepal, and Indonesia. Although China ranks at number two in production but plays a dominant role in exporting ginger to Pakistan. Its annual production in 2017 was around 557 thousand tonnes (Table 7).

United States of America (USA) is the highest ginger yield (tonne/ha) producing countries of the world which is about 30 tonnes per ha (Table 7). Pakistan obtains only 1.5% of the ginger yield in USA. This leaves an uphill task for Pakistan to compete with the countries producing such a high ginger yield. Other highest ginger producing countries of the world are Japan, Fiji, and China. Pakistan has great opportunity to learn improved ginger production technology from China through China-Pakistan Economic Corridor (CPEC) collaborative program.

Table 7: Top 10 ginger producing countries in the world, 2017

Rank	Countries	Area (000 ha)	Country	Production (000 tonnes)	Country	Yield (tonne/ha)
1	India	168.00	India	1070.00	USA	29.88
2	Nigeria	66.45	China	557.30	Japan	28.16
3	China	52.46	Nigeria	349.90	Fiji	25.03
4	Nepal	22.65	Nepal	279.50	China	24.52
5	Indonesia	10.56	Indonesia	216.59	Guyana	24.21
6	Thailand	10.08	Thailand	167.48	Indonesia	20.52
7	Cameroon	9.34	Cameroon	91.82	Thailand	16.61
8	Bangladesh	9.31	Bangladesh	77.48	Mali	15.76
9	Philippines	3.91	Japan	51.47	Malaysia	14.66
10	Ethiopia	3.54	Mali	38.18	CÃ´te d'Ivoire	13.65

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

Although USA is the highest ginger producing country of the world (but not highest ginger producing country), it also imports the highest quantity of ginger worth of US$115 million in 2016. Pakistan ranks 2nd among the top ten highest ginger importing countries spending US$79 million. (Table 8). Ginger is imported in Pakistan in three different shapes namely rhizome, crushed and in the form of ginger bread but major import is in the form of rhizome.

Table 8: Top ginger importing countries and global import values in 2016

Rank	Country	Quantity (tonnes)	Value (Million US$)	Value (Million US$)
1	United States of America	82.78	United States of America	114.94
2	Pakistan	79.11	Japan	100.06
3	Japan	66.87	Netherlands	95.88
4	Netherlands	63.97	Pakistan	70.92
5	Bangladesh	63.88	Germany	54.92
6	United Arab Emirates	43.61	Bangladesh	41.67
7	Malaysia	41.23	United Arab Emirates	41.55
8	Saudi Arabia	33.53	United Kingdom	35.18
9	United Kingdom	23.21	Malaysia	30.88
10	Germany	22.06	Saudi Arabia	29.07

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

Although ginger is considered as minor crop in different countries but still it generates profitable returns to exporting countries because it is a high- value export crop. It is being exported in 3 major forms i.e. rhizome, crushed and in ginger bread form. Currently during

2016, China, Thailand, and Netherlands are the chief exporters of ginger worldwide. In 2016, China exported 53.77 million tonnes of ginger which was worth of US$429 million (Table 9).

Table 9: Top ginger exporting countries and global export values in 2016

Rank	Country	Quantity (000ntonnes)	Country	Value (Million US$)
1	China, mainland	454.55	China, mainland	428.60
2	Thailand	83.32	Thailand	106.78
3	Netherlands	53.80	Netherlands	103.99
4	Peru	26.79	Peru	51.02
5	India	24.42	India	35.06
6	Indonesia	17.80	Nigeria	22.79
7	Nigeria	13.27	Indonesia	13.95
8	Nepal	11.62	Germany	13.21
9	Brazil	5.64	Brazil	7.88
10	Costa Rica	4.29	Viet Nam	6.43

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

1.6 Need of the Study

The above macro analysis suggests that ginger in Pakistan is already in a poor competitive situation. Our team extensively explored the ginger production and found that it has been completely eliminated in the country, although macro data reported in Agricultural Statistics of Pakistan found some increasing trend in its production mainly due to increase in area. Even if we trust on the macro data reported in ASP, ginger yield in Pakistan is only 5.5% of the world average, and its improvement is relatively slow, if any, while world average ginger yield has been improving at the rate of 5.4% per annum. On the other hand, imports of ginger has been ballooned from just US$0.79 million in 2001 to US$70.9 million in 20017 suggesting inability of the local production system to meet the burgeoning local demand. The export of ginger from Pakistan is mainly re-export after some processing and has unable to grow at a fast enough rate causing a big trade deficit of US$69.9 million in 1917. On the other hand, the international trade market has been growing at a fast rate of

Looking at the increasing trade gap in ginger due to its burgeoning demand, deteriorating domestic supply, and increasing international ginger prices, the Planning commission of Pakistan initiated this project to analyze the whole ginger value chain, identify its potential and gaps along the chain and suggest economically viable technological and policy interventions to improve the competitiveness of the ginger value chain in the country. We believe that there is no existing ginger cluster, but to incorporate regional context this analysis is conducted keeping in view the new potential ginger cluster to be identified through consultation with stakeholders.

2 GOAL AND PURPOSE

The overall goal of this study is to improve the competitiveness of the ginger sector and thus contribute to *the Cluster Development Based Agriculture Transformation Plan -V2025* for ginger in Pakistan. The specific objectives of the study are:

1. To identify the existing and potential ginger clusters in Pakistan
2. To conduct a detailed diagnosis and SWOT of the ginger production in ginger cluster
3. To identify technological, institutional, infrastructure and policy gaps in ginger cluster
4. Assess the potential of ginger production
5. Suggest technological, institutional, infrastructure and policy interventions to achieve the cluster potentials
6. Conduct economic and social feasibility of the suggested interventions

3 METHODOLOGY

The data and information related to the characteristics, constraints, potentials and needed interventions to meet the constraints in ginger production were collected from three sources:

a) ***Macro-Data***. Relevant macro data were collected from various published and unpublished reports of government and non-governmental organizations and internet search on ginger value chain
b) ***Stakeholders Consultations***. Primary information was collected through consultation meetings with farmers, input dealers, traders, processors, extension agents and researchers using pretested and structured questionnaires and unstructured discussions
c) ***Literature Review*****.** The literature related to the functioning, gaps, and interventions in ginger value chain is reviewed and synthesized.

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

- Ginger crop and its importance
- Review of ginger sector in Pakistan
- Global context of ginger sector;
- Cost of production;
- Marketing, trading, and processing from traders, wholesalers, retailers, and processors;
- Issues and constraints related to production, harvesting, drying, marketing, storing, trading, and processing from all stakeholders;
- Recommendations and benchmarks based on global parameters;

The author then used these data to first identify the ginger cluster(s) in the country and then used his subjective judgment in prescribing the characteristics of the cluster(s). The author also identified the strengths, weaknesses, opportunities, and threats (SWOT) of ginger production and value chain, and quantified the cluster potentials. Based on the above analysis, we then proposed the interventions for improvement in ginger production and value chain. The costs and benefits of each intervention are also estimated to finally work out the Internal Rate of Return of the whole package. A Ginger Transformation Plan is also formulated, which identifies sustainable upgrading strategies for the development of the ginger sector that can help creating significant economic opportunities for producers, processors and all the stakeholders participating at different points of the value chain.

4 LITERATURE REVIEW

Khanal (2018) investigated the factor affecting market value chain of ginger in district Salyan, Nepal. It is observed that ginger is high value crop for small scale farmers' livelihoods. The study is originally conducted in 2016 to analyze value chain of ginger sub-sector in two villages of Salyan district of Nepal. Primary data is collected from different stake holders involved in ginger value chain by employing semi-structured questionnaire and through focus group discussion (FGD). Key informant interview (KII) and rapid market appraisal (RMA) survey is used. Cross-sectional data from 140 stakeholders/respondents, 70 from each village, is collected through random sampling technique. It is observed that average land use for ginger cultivation is 1.62 ropani which is higher in Dadagaun (2.17 ropani) than Tharmare (1.07 ropani). The difference is statistically significance at 1 percent level. The average marginal cost of fresh ginger is NRs. 12.15/kg at the farm gate level. The study observed that local traders are the major market actor influencing the price of ginger, implying that traders have strong bargaining power while farmers have weaker role in deciding the price in ginger value chain. The empirical finding reveals that traders have huge marketing margin (NRs. 94/kg) while the producers share in retail price is only 14.55%. It is producing empirical evidence that traders are exploiting farmers by offering low price while traders are extracting a large profit among different stakeholders in the value chain. Thus study concluded that ginger value chain analysis in the study area found very unstructured and poor strengthening of business enabling environment, unorganized functional market chain and poor inputs and service provision.

A case study by Singh (2013) in the Salyan district of Nepal assessed the pre and post-harvest factors affecting quality of ginger in the export chain. Nepal is one of the leading ginger producing and exporting countries of the world. Ginger is an important cash crop for Nepalese small holder farmers. The research is based on a combination of literature review, field surveys involving questionnaires, interviews of the producers, traders and other stakeholders involved in the ginger value chain. It is extracted from the survey that main stakeholders involved in the value chain are input suppliers, producers, local traders, commission agents, retailers, exporters and consumers. The study concluded that the main export market of ginger for Nepal is India. Since Indian market requires prime quality rhizomes which are large in size, pale yellow, washed and clean and free from decay. Hence, Nepalese ginger is not meeting the criteria of Indian consumer and therefore, fetching low price. The study concluded that lacking awareness about variety, irrigation, washing and storage management are the important factors affecting the quality of ginger in the export chain which need to be taken care.

Similarly, Karki et al., (2007) attempted to strengthen the cardamom and ginger value chain in the Mechi zone of Eastern Nepal. The ginger industry is contributing over US$ 55 million to the Nepalese economy every year and is grown by over 200,000 families in five regions of the country. It is almost generating profits of over NPR 20,000 per *ropani* per season for smallholder farmers. The aim of the study is to focus on high value crops while incorporating the existing agricultural value chains and emphasizing private and public sector partnerships. Four interventions are identified at different nodes of value chain and among these include input, production, processing and market levels. A major intervention partner is the Nirdhan Utthan Bank, Ltd (NUBL) as a source of micro finance. Production level intervention activities

include business planning training, cash flow analysis, cooperative formation and strengthening, and facilitation of collective marketing. At the processing level, interventions introduced to support improved drying, grading and sorting associated with ginger. At the market and policy level, Mercy Corps provided capacity building support to the Nepali Ginger Producers and Traders Association (NGPTA). The efforts of Mercy Corps resulted in a 15-20 percent increase in the per kg price of ginger. At the market and policy level, the results indicate the strong role played by trade associations in creating an enabling environment for the cardamom and ginger industries in Eastern Nepal.

Weerasooriya and De Silva (2014) analyzed the ginger value chain in Sri Lanka for the districts of Kandy and Gampha. The study used a questionnaire based survey with 40 randomly selected ginger farmers and seven key informants and discussions with different value chain actors. The mapping of domestic ginger value chain indicated that there are eight major actors namely input suppliers, producers, collectors, processors, wholesalers, retailers, exporters and consumers who are directly involved in the primary activities of the value chain. Chain supporters such as Department of Export Agriculture (DoEA), Department of Agriculture, Department of Ayurveda, Export Development Board, farmer organizations, financial institutions, private sector and universities are involved in research and development, financial, marketing and extension services. The study found that the ginger productivity in the two districts is not up to the potential level. The lack of consistent supply and quality ginger are the main constraints faced by collectors and marketers. The lack of technical and market information flow between different value chain actors is also observed. Implementing measures, such as varietal trials, research on crop management, and strengthening the extension service, are strongly recommended to increase the productivity.

USAID started a five-year Value Chains for Rural Development (VC-RD) project as an initiative of the US government's global food security program. A part of this project is to study the ginger value chain and rural development in Burma (2014-2019). The aim of the project is to shift Burma's smallholders' production from low-grade to high quality by increasing farmers' ability to produce high-quality raw ginger, train producers to make value addition in raw ginger, link producers to new specialty buyers in global markets, and support the private sector to develop improved/varied ginger processing capacity. VC-RD worked with trained, community-based extension agents and a local partner (e.g. Myanmar Institute for Integrated Development (MIID)) through an Innovative Grant to reach smallholders growing ginger in environmentally sensitive areas. In Year 2 of the project (FY 2016), VC-RD trained 1,347 ginger farmers and stakeholders on good agricultural practices including compost production and use, contour planting, soil conservation, and safe handling and use of pesticides. Other expected impacts include increased income of participating households by 25 percent over the course of 18 months, improved farmer knowledge of value chains, trade and agriculture practices and increased knowledge sharing, improved market understanding and private sector engagement, including outreach to distant households outside of central village areas.

Ravishankar et al., (2013) analyzed the genetic diversity of ginger based on cluster and principal component analyses for yield and quality attributes in Uttar Pradesh, India. The primary objective of this experiment is to screen out genetically diverse parents for developing high yielding ginger rhizome by using the tools i.e., cluster analysis and principal component analysis (PCA). 25 ginger genotypes with 13 quality and yield traits are assessed. Through cluster analysis, 25 genotypes are grouped into five main clusters. Maximum genetic

divergence is observed among these clusters. The Eigen value is used for determining the number of major principal components to be explained. The study concluded that the first six principal components (PC1-6) having Eigen values >1 accounted for 76.19% of total variability amongst 25 ginger genotypes. Among all PCS, PC1 has higher yield potential and having positive association with plant height, number of primary and secondary fingers, TSS, dry matter per cent and yield per fresh plant. The genetic diversity analysis could be helpful to select diverse parents and strengthen breeding programs of India.

Egbuchua and Enujeke (2013) carried out a field study on the growth and yield responses of ginger to three sources of organic manures in a typical rainforest zone in Nigeria. The aim of the study is to evaluate the responses of ginger to three sources of organic manures namely; cow-dung manure, poultry manure and pig manure at the rate of 20 t/ha. Growth and yield parameters of ginger are taken at the 4, 6, 8, 10, 12 and 14 weeks after planting (WAP), while fresh weight is taken at 16th week after planting (WAP). The growth parameters observed are plant height, number of leaves, leaf area and number of tillers. Data collected is subjected to analysis of variance (ANOVA). Plots treated with poultry manure produced the highest plant height of 12.67 cm, highest number of leaves of 14.87 and leaf area of 231.8 cm. This was followed by pig manure with values of 12.12, 14.25 and 222.5 cm. The general results indicates that organic manures in the forms of cow dung, poultry and pig manures have great tendency to increase growth characters and yield of ginger in a rainforest zone, Nigeria.

Sajeev et al., (2011) identified the genetic diversity analysis in the traditional and improved ginger clones cultivated in North-East India. Genetic diversity analysis is carried out in a set of forty-nine ginger clones cultivated in North-East India using random amplified polymorphic DNA (RAPD) markers. Jaccard's genetic similarity, cluster analysis and principal component analysis identified five clusters. In the present study, PCA of the marker data (grouped on population basis) separated the clones from hill and plain areas, which supported the high contribution of habitat heterogeneity in creating and preserving diversity. Cluster 5 included four clones traditionally cultivated in the Indian state of Meghalaya known for production of high-quality ginger indicating that the clones are a good candidate for ginger improvement. Specific bands for these clones are also identified. Principal component analysis of the molecular data supported grouping of the clones into six hypothetical populations based on their source or location of collection. The study also indicated a fairly broad genetic base in the ginger germplasm of north east India.

Not enough work has been done on ginger value chain in ginger producing countries like China, India and Thailand. In terms of ginger cultivation in Pakistan; it has previously been mentioned that Pakistan is not a ginger friendly country with regards to soil and climatic conditions. Thus, no record of any published work has been found on ginger from government or private sources because of its practically non-existence in agriculture sector.

5 CLUSTER IDENTIFICATION AND CHARACTERIZATION

5.1 Cluster Characterization

As there is no existing cluster in the country, we simply explain the ideal situation required for the cultivation of the ginger here. These are summarized in Table 6. A fertile sloping land is the first requirement for ginger fields. Based on literature, it can be concluded that ginger fields should not be kept water logged; rather soil moisture should be enough to grow ginger. A slightly acidic soil greatly aids in the growth process along with warm and humid temperature. A friable loam, rich in humus are ideal. However, being an exhaustive crop, soil should be rich in fertility. Ideal sowing season for this crop is from February-March. For green ginger marketing, harvesting is done after 6 months, while for dry ginger marketing farmers may harvest after 8 to 9 months. Temperature, humidity, rainfall and soil pH are important variable that require in specific range for the cultivation of ginger (Table 10).

Table 10: : General requirements for ginger cultivation

Characteristics	Required Value
Temperature (^{0}C)	25–31
Humidity (%)	>75
Soil pH	5.5-6.5
Sowing time	March-April
Seed Requirement	1500-2000 kg/ha
Harvesting period	September-October

Source: Discussion with vegetable director in Ayub Agricultural Research Institute (AARI) Faisalabad

5.2 Identification of Potential Ginger Cluster

Currently ginger is not cultivated anywhere in Pakistan, therefore, we do not identify any ginger cluster within the country. However, after discussing with researchers, industry, and some key farmers who have been engaged in ginger cultivation in the past, processor presently involved in ginger processing, researchers, traders, there are indications that Mansehrahh district of KP plains possess characteristics suitable for ginger cultivation thus should be considered as focal point for the development of ginger cluster in Pakistan. This is based on the assumption that the environment required for tea and ginger are very similar. Moreover, the earlier survey by Chinese in 1982 indicated that more than 64000 ha' land of low pH value is available in hilly terrain of (KP) mostly in in Mansehra division (Ilyas, et. al 2020))

These suitable conditions for ginger cultivations are:

Table 11: : Average physio climatic conditions of potential cluster of Mansehrah district

Characteristics	Parameter Value
Suggested sowing time (month)	• March-April
Temperature during sowing months(^{0}C)	• 9C–34C
Humidity during sowing months(%)	• 56%
Soil pH	• Loamy soils, clay loam or red loamy soils • Strongly acidic to moderate acidic • Moderate humid climate.
Availability of irrigation water	• Irrigated water is available

Source: Discussion with vegetable director in Ayub Agricultural Research Institute (AARI) Faisalabad

5.3 Pre Intervention Value Chain Map

As we have discussed above, Pakistan is non-producer of ginger, the pattern of common value chain map cannot be followed here. All of the local consumption is based on imported ginger and therefore, value chain starts from the traders who import from abroad (Figure 3).

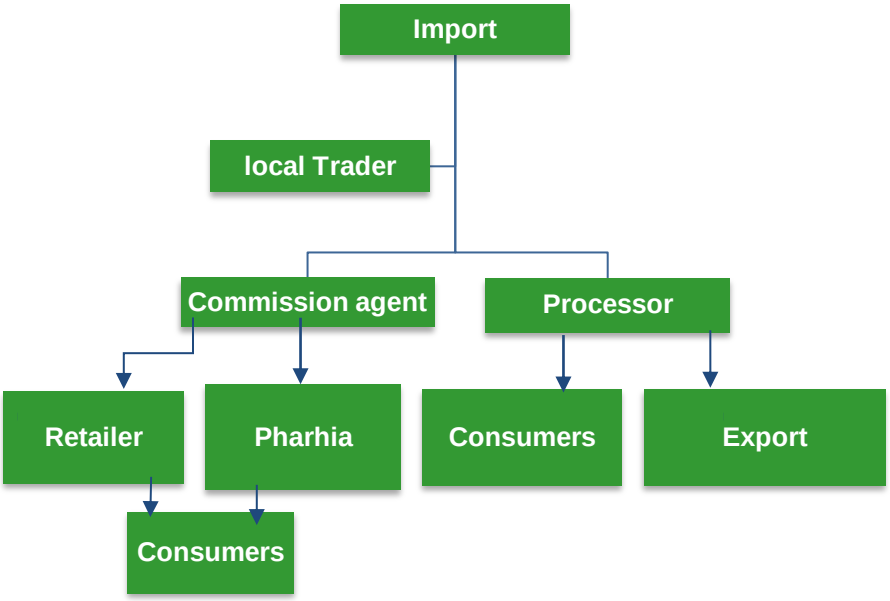

Figure 3: Pre intervention value chain map of ginger

Source: Based on focused discussion with traders and commission agents

5.4 SWOT Analysis

5.4.1. Overview

Building ginger cluster will be an uphill task as currently there is no research capacity, farmers skill, and market network to collect farm-level ginger production in the country. However, the processing industry has the capacity to process imported g0inger, which can provide a great

force for the future ginger production within the country. The greatest threat will be for the crops which will be replaced by expanding ginger production in the country. The land allocated to different crops in the district of Mansehrah during the kharif season is reported in Table 11. It is observed that maize occupy largest share of land i.e., 58 thousand has in kharif season, followed by rice which occupies only 1.6 thousand ha. Each of the remaining crops contains less than one thousands of hectares. This implies that required area of ginger (12 thousand ha) can be drawn from maize production which is only possible if ginger crop will generate significantly higher profit from maize.

Table 12: Area allocated to different crops during 2016-17 kharif season in Mansehrah District (000 ha)

Land utilization	Irrigated	Un-irrigated	Total
Maize	6.13	51.8	58.1
Rice	1.6	0	1.6
Pulses	0.03	0.07	0.1
Vegetables	-	-	0.9
Fruits	-	-	1.1
Fodder	-	-	0.1

5.4.2. Mansehrahh Cluster

The SWOT analysis of ginger crop is reported in Table 13.

Table 13: SWOT analysis of Mansehrah Cluster in KP

Parameters	Strengths	Weakness	Opportunities	Threat
Environment/ Climate Change	Loamy soils or clay loam or red loamy soils Soil between strongly acidic to moderate acidic with moderate humid climate makes the cluster ideal for ginger cultivation.	Prolonged winter and sudden rise in temperature may affect ginger production.	Scope for digitizing ginger production to inform local weather conditions	High variation in temperature and rainfall may affect ginger quality and production
	Availability of canal irrigation can overcome rainfall requirement for ginger production.	Require electric motor to pull canal water	Use of solar energy may reduce environmental pollution	Prolong winter season may lead to shortage of canal water
Ginger Varieties	Currently no varieties of ginger for domestic exists but new varieties suitable for local environment can be developed.	No certified variety of ginger seed is available	Scope to develop new varieties through public-private partnership exists that can be harnessed	Limited research funds

	Some interest of researchers exists in getting engaged in ginger screening and agronomy work which can be exploited.			Climate change may lead to variation in the sowing time
Input Supplies	Ginger needs high doses of fertilizers and pesticides, which is readily available in Mansehrahh.	Non-availability of high quality fertilizer	Proper monitoring and evaluation of input supply system helps to reduce input adulteration problem.	Use of adulterated fertilizer
		Declining organic matter in soils	Increasing animal manure through animal production is an opportunity to halt the declining organic matter.	Use of adulterated or expired pesticides.
		Lack of knowledge of Persistent Organic Pollutant (PoP) & Good Agricultural Practices (GAP) for ginger production.	Information dissemination on PoP and GAP	Injudicious use of chemicals
Production Management Practices	Farmers have long experience to grow different crops which will be useful to learn ginger cultivation	Majority of farmers are illiterate and have small farm size.	Contract farming with defined quantity and quality parameters	Climatic risk due abrupt changes temperature and rainfall
		Limited irrigation facilities can hamper the ginger the production	Arrangements of training modules for farmers on the latest methods of sowing, plant protection, intercropping, efficient irrigation method, harvesting, etc. by several national (NARC, provincial departments, private sector, etc.) and international organizations (AVRDC).	Difficulty of training illiterate farmers about the latest production methods and techniques

		Labour constraint at sowing and harvesting stages due to its competition with maize crop	Training modules for farmers may be developed on the latest methods of sowing, plant protection, intercropping, efficient irrigation method, harvesting, etc. by several national (NARC, provincial departments, private sector, etc.) and international organizations (AVRDC).	
Infrastructure	Good road infrastructure connecting KP ginger cluster with all main markets in the country.	Inadequate infrastructural facilities like storage with producers, traders, processors and at market level, which result in marketing inefficiencies.	Establish storage facilities by PCs as a part of FCSC.	Failure in trust among PCs members
Marketing	In some crops, farmers receive prices based on product quality which can be replicated for ginger.	Poor/weak linkages of farmers with markets	Emerging supermarkets can help to promote contract farming, which may improve retailing quality, and reduce post-harvest losses and trading margin	Small farmers could have disadvantages of contract farming due to limited supply
		Farmers have limited capacity to produce, handle, and market high quality ginger	Financial support to farmers could lead to high quality product delivery	Weather risk could affect the production and can limit supply
		Auctioning in the wholesale market with visual and spot grading	Bulk selling can result in better result for growers	High price risk
Trade/Export	Pakistan is importing ginger from China, Vietnam and Thailand. The high cost of transportation encourages local production to capture national	Limited availability of HYV ginger varieties which are pest and disease resistant.	China has long experience of growing ginger and Pakistan can get benefit from their experience by importing HYV of ginger and learning by doing from Chinese scientist. Under	Adverse weather conditions affect may affect ginger production

	and international market of ginger.		CEPEC we can harness golden opportunities of developing local varieties suitable for local weather conditions.	
	Ginger exports to high value market in processed form (powder and coriander) already exist	Lack of farm mechanization for planting and harvesting increases cost of production which reduces the probability to compete in international market.	Purchase of ginger harvester and HYV varieties from China under CEPEC project.	Poor quality ginger has threatened its whole export
		Food safety standards and traceability (EuropGAP, Global Gap, SGS, etc.) are major limitations to enter into high price markets	Training farmers on food safety standards	High cost of certifications and quality standards
Processing	Demand of ginger is rising quickly owing to higher sales of branded food pickles, curry products, pastes and medicines.	Lack of market information regarding prevailing prices in national and international markets and it may encourage farmers to sell in village locally.	Scope for tie up of PCs through contract farming with firms like Mitchell's, Ahmed, Shan, National; ginger processing units; housing societies in urban areas and retail outlets.	Failure in contract farming
	Neat and clean ginger from China is liked by food processing industry for their recipes.	Low quality ginger may disrupt the peeling and paste making efficiencies	Scope for establishment of primary processing facilities under contract farming by PCs as a part of FCSC with food industries.	
	Raw ginger is used to produce ginger powder, ginger paste, contributing significantly to food industry.	Lack of grading facilities. Limited primary and secondary processing units (mainly in Karachi) for ginger and its by-products such as ginger paste units.	Processing of raw ginger into paste will have potential to contribute to ginger value addition that will significantly increase availability of ginger and related by-products.	

6. CHALLENGES FACED BY THE CLUSTER

6.1. Environmental Constraints

Non-availability of suitable environmental condition for ginger cultivation in Pakistan is one of the major constraints. It requires temperature in the range of 25℃-31℃, humidity level more than 75% and rainfall during the crop period should be more than 2500 ml and equally distributed. In other countries like China, India, Thailand and Vietnam it is grown on marginal sloppy lands with appropriate environmental and soil conditions where high value crops like cotton, wheat, rice and sugarcane are not possible to cultivate.

6.2. Unrestricted Imports

Currently, ginger import in Pakistan is unrestricted from established ginger producing countries China and Thailand. Under this situation, it is difficult for the local growers to even start cultivating ginger especially when no other support in the form of high yielding ginger seed, training, market support, etc. are not provided. To encourage ginger cultivation in the country, it is important to protect the local producers under infant industry argument. The money recovered from tariff can be used in ginger research to develop suitable varieties and provide training to the farmers.

6.3. Production Level Constraints

Ginger could be an important cash crop of Rabi season. Major constraint faced by farmers is the unavailability of high yielding varieties and appropriate technologies. Ginger cultivation requires a balanced combination of climatic and soil characteristics. If any of the components is missing in appropriate proportion, crop production is seriously affected. For example, the soil pH should be in the range of 6.5-7.0 whereas soil pH of most of the soils in Pakistan is more than 8. Similarly, more than 70% humidity is required for optimal ginger cultivation. Non-conducive environment for ginger cultivation and poor performance of existing varieties leads to extremely low yield (0.45 tonne/ha) at farm level compared to the neighbouring countries who are getting 15 to 25 tonne/ha. This implies, that varietal constrains are serious.

Lack of farm mechanization for planting (to make trenches) also lead to inefficiency in production and discourage ginger cultivation. Therefore, modern technology can reduce the cost of production and improve profitability. Among general constraints category, lack of financial resources followed by low risk bearing abilities of farmers are common constraints.

6.4. Marketing Level Constrains

Although distribution of imported ginger to consumers is well established in the country, however, farmers feel uncertain if their ginger production will be purchased at reasonable prices. Therefore, they are reluctant to take initiative of starting ginger cultivation. A local

mechanism of ginger marketing needs to be established to ensure new producers of ginger reasonable price.

6.5. Processing Level Constraints

Currently, there are limited primary and secondary processing units for ginger in the country. By-products of ginger are ginger paste, ginger powder and ginger pickles. Only food industries such as Shan, National, Laziza, Zaiqa etc, in Karachi and Mitchels in Lahore are using imported ginger for ginger paste, ginger powder and ginger pickles. These industries are using ginger powder in making different recipes sold nationally and worldwide and they also sell ginger in powder form. These industries and local consumers are buying rhizome which has high moisture level and low quality because dry ginger is not available in the market. Rhizome sold in the market is not clean and has soil particles attached with it. Hence, industries involved in making by products of ginger are washing, cleaning and drying it before converting it into powder. It is observed that wet rhizome has less shelf life and low quality. The machines required to dry ginger mechanically are available in the market (Figure 4). Farmers have neither resources nor skill to wash, clean and dry at the farm level. However, financial assistance and technical training may help to establish ginger dryer enterprises in the cluster at the farm-level which will not only benefit the industry but also farmers. The dried ginger will also increase its storability thus reduce post-harvest losses.

Figure 4: Ginger drier

7. CLUSTER DEVELOPMENT POTENTIAL

7.1. Production Potential

Our discussions with stakeholders suggest that certain tracts in Mansehrah district of KP can perhaps suitably meet the ginger cultivation requirements. The pH level of the soil in the district is around 6.8 and it has a large tract of sloppy lands suitable for ginger cultivation. The temperature and humidity level of the district during March-May remains in a reasonable range suitable for ginger cultivation. A Chinese survey in 1982 also substantiate these claims. The report concluded that more than 64000 ha land suitable with low pH, appropriate slope and rainfall is available in the hilly tract of KP mostly in Mansehra division (Ilyas, et. al 2020).

Another possibility is to grow ginger under control environmental conditions although its economic viability needs to be established. If reasonable yield level is obtained, competing with imported ginger will be possible. Although ginger in importing countries like China Vietnam and Thailand is grown on marginal lands under conventional practices. Despite this a large potential of domestic ginger production exists in Pakistan because of the high cost of shipment, loading and unloading at port in addition to the local transportation. This potential can be harnessed by identifying suitable land in KP for ginger cultivation as well as developing a suitable variety which can give reasonably high yield under Pakistani environment.

7.2. Demand Potential

Pakistan has invested US$71 million on the imports of ginger in 2017. The demand for ginger is increasing at the rate of 4.5% per annum. If this trend continues, the ginger import will increase to US$89 million in five years' time. Given the current financial situation, this is a large sum of money that is being paid annually for a minor food commodity. With the tightening of foreign exchange resources available for imports, Pakistan has to make arrangement to substitute imported ginger with local production or its prices in the local market will skyrocketed in the coming years. Thus additional production to be supplied through the cluster upgradation plan of this study can easily be absorbed by substituting the imported fresh ginger in Pakistan.

7.3. Marketing Potential

As marketing of distributing imported ginger is well established, the traders would love to buy the locally produced ginger, if it is competitive compared to the imported ginger. This will reduce their hassle of arranging logistic for imports, foreign exchange, etc. Properly linking traders with producers will reduce the marketing uncertainty of both producers and traders.

7.4. Processing Potential

Clean and dry ginger is the need of every consumer because it not only improves the shelf life but also quality of product. Currently major chunk of ginger demand is being filled by importing

fresh ginger which is although clean but not dry. This needs to be dried before using it in different products.

Once, local production of ginger starts then it will be beneficial both for industry as well as farmers to clean and dry at the farm level. These activities at the farm-level will not only generate farm-level employment but may also help to improve the production efficiency of spices exporting sector.

8. PLAN, POLICIES, AND STRATEGIES

8.1. Plan

Based on the gaps and potentials as discussed above, following research-based cluster development plan along with targets is proposed for a five-year development project to make ginger a competitive product (Table 14):

: Table 14: Targets for Ginger Cluster in KP

No.	Targets
1.	Substitute 25% of the imported ginger with local production by Increase ginger area in Mansehrah district along with the supply of high yielding varieties and improved farm management practices
2.	Increase processing/drying of ginger by 10% of total ginger produce in Mansehrah cluster

8.2. Policy Reforms

The structure of subsidies and incentives in the agriculture sector should be reorganized to make these clusters specific and results oriented. Following policy measures shall be adopted:

- Import duties on ginger should be increased keeping in view the subsidized inputs and other incentives available to Chinese and Indian ginger farmers.
- Import duties on ginger dryer should be eliminated for certain period
- Import of ginger germplasm, hybrids and varieties should be funded through PARC
- Link the import permit of ginger with the development activities undertaken by ginger traders in the ginger cluster.
- As an infant crop incentivize the ginger producers at the rate of US$300 per ha to substitute other crops with ginger. Once ginger cultivation is established, the subsidy should be removed as the ginger is expected to be highly profitable compared to other crops in the area.
- Incentivize the ginger drying at the farm-level by providing 20% subsidy on ginger driers and interest free loans to buy these driers.
- Revenues needed for these activities and measures should be recovered by doubling import duties on raw ginger and value-added ginger products within the limit of WTO.

8.3. Strategies for Mansehrah Cluster

8.3.1. Conduct an GIS Survey

Although we have suggested Mansehrah district of KP as future potential ginger cluster, but determining the exact location for the cluster is out of the resources allocated for the study. Therefore, a comprehensive Geographical Information System survey in Mansehrah districts

should be conducted to identify the suitable area for ginger cultivation in the district. Moreover, it should be determined whether a new land should be developed from government 'Shamlat' land or its cultivation should be promoted on the existing cultivated land by replacing less profitable crop like maize in the area. In the latter case, the GIS specialist, agricultural economist and farming system expert team should determine what particular area in Mansehrahh would be suitable, and what crop is more likely to be replaced.

8.3.2. Establish Research on Ginger Value Chain

Institutions like National Agriculture Research Council (NARC), Ayub Agriculture Research Institute (AARI) Faisalabad, Agriculture Universities in Punjab and KP, National Institute on Biogenetic Engineering (NIBGI) and others will be entrusted with the task and proper resources of developing high yielding variety seed of ginger which could be cultivated in less restrictive environmental and climatic conditions. Currently, scientists in Ayub Agricultural Research Institute (AARI) are trying to grow it under control environmental conditions. The challenge however is to make such production competitive.

A team of scientists including breeders, soil scientists, economists, etc. across these institute should be funded to develop new ginger varieties suitable for local environment. They should interact with Chinese scientists through CPEC program to import ginger germplasm and develop appropriate management practices to achieve the target yield at least equal or higher than the world average within the speculated period.

The KP provincial research systems will establish initially a ginger research station and later a Ginger Research Institute in Mansehrah cluster for adaptive research, such as testing new hybrids, varieties, management models, testing and disseminating appropriate planting, harvesting, and value addition technologies, etc.

8.3.3. Production Level Strategies

To establish ginger cluster in Mansehrah district in order to meet 25% of the local demand over the five-year period, the following strategies are suggested:

a) Give financial incentives at the rate of US$300 per ha to shift from maize to ginger cultivation
b) Establishment of Ginger Farmer Entrepreneur Groups (GFEGs) at the Union Council Level in Mansehrah cluster. The government will guide the GFEGs and monitor its functioning through a paid business manager. The GFEGs will have initial endowment fund and generate its own funds through membership fee to sponsor various ginger related R&D activities
c) The GFEG will identify the ginger R&D issues and seek grants from government or fund research from its own resources
d) Promote specialized extension to solve special ginger problems on need and paid basis from GFEGs funds
e) Introduce latest ginger varieties and hybrids developed by the research system.
f) Promote Good Agricultural Practices (GAP) at the farm level

g) Promote improved farm management (IFM) practices like timely sowing, managing plant density, managing irrigation frequency and intensity, optimal and balanced use of inputs particularly fertilizer, effective control of diseases, insects and weeds etc.
h) Establish Farmer Fields School (FFS) to train on adoption of high yielding varieties (HYV), GAP and IFM
i) Introduce ginger maturity index and train the harvesters to harvest ginger at appropriate maturity stage

8.3.4. Marketing Strategies

To overcome uncertainty in ginger market, following strategies will be adopted:

a) Two garlic Collection Centers (CC) will be established in the ginger cluster area which will have the basic facilities of washing, grading, packaging, etc. The Center will be built in public-private partnership mode with 20% of the cost will be borne by the government and remaining 80% by the members of the GFEGs. It will be initially run by the government paid manager, but its management cost and other responsibility will be subsequently transferred to FEGs within three years. Any farmer can get the services of the center on paid basis. The profit will be distributed among the GFEG members based on their contribution in constructing the center.
b) Government will provide guaranteed price of garlic. In case the market price gets lower than the guaranteed price, government will provide income support to the farmers that is equal to the difference in guaranteed and market price multiplied by the average yield of garlic in the area and the acreage under garlic cultivation of each farmer.
c) Contract farming with predetermined price, and quantity and quality to be delivered at particular time will be encouraged through GFEGs.

8.3.5. Processing Level Strategies

To introduce ginger processing on 10% of total ginger produce in Mansehrah cluster, the following strategies are suggested at the farm-level:

a) Import ginger driers once the ginger production is in place in Mansehrah cluster during the fourth year of the project. To dry 10% of the local production, 22 driers will be required.
b) These drying units will be established in three tehsils of Mansehrah district through GFEG, over four years to encourage drying by farmer at a subsidy of 20% with interest free loans for the first year.
c) Train farmers and unit workers to maintain the quality of ginger through contractors and GFEGs

9. FEASIBILITY ANALYSIS

9.1. Overview

Interventions are being proposed here to increase ginger area and promote farm-level processing; so as to reduce import and increase the overall value of the produce for the farmers and for other sector stakeholders. Cost and benefit analysis has been done separately for Mansehrah cluster.

The economic and financial analysis of ginger cluster 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 Mansehrah cluster. Discounted cash flow analysis has been carried out to work out the economic viability of the proposed interventions in terms of net present value (NPV) and internal rate of return (IRR).

9.2. Key Interventions, Benefits and Costs

Following two direct interventions have been proposed for transformation of ginger sector of Pakistan:

i) incentivizing @US$300 per ha for the expansion of ginger area along with introducing new varieties and improved farm management practices
ii) promotion of ginger value addition at farm level

In addition to the above two direct interventions, following indirect interventions are also suggested:

i. Conduct GIS survey
ii. Strengthening of research on ginger value chain
iii. Capacity building of producers and other stakeholders in the value chain
iv. Establishing collection centers in the cluster area and ensuring guaranteed price
v. Providing subsidies on value chain infrastructure and collection centers, and interest free loans on these infrastructure

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

The resources required for the implementation of the proposed interventions package include i) additional operational costs of improved ginger production and increased ginger processing, and ii) sector development investments like R&D by government, iii) fixed capital investment in processing plant etc. by government and private sector, iv) investment on extension, v) investment on training of stakeholders on value chain management. The whole analysis has been based on incremental costs and benefits of the proposed interventions.

The detailed feasibilities of ginger processing plant is separately estimated and explained in annexure 1. For Mansehrah cluster, the number of plants required for drying was estimated based on the estimated ginger area and quantities and capacity of the machines. Total investment and operational costs of these modern technologies in this cluster was incorporated in the main feasibility model. However, in the following section, we just explained the feasibility of the whole package of interventions.

9.3. Current Situation

Ginger is an important imported commodity for Pakistan. Currently, 79,110 tonnes of ginger is imported to meet local demand and its growth rate in imports without any intervention is observed at 4.54% from 2011 to 2017 as shown in Table 15. World average yield is 8.7 tonnes/ha and farm gate price of ginger is US$ 500/tonne.

Table 15: Current import situation

Current Situation	Base Year
Current imports/demand (tonnes)	79,110
Growth rate in imports without intervention (%)	4.54
World average yield (tonne/ha)	7.0
Farm gate price of ginger (US$/tonne)	500

9.4. Benefits of the Proposed Interventions

9.4.1. Intervention 1 – Ginger Area Expansion

Increased ginger area by introducing improved varieties, improved farm management practices (IFM) and R&D in ginger cultivation will lead to increase ginger production. The research will introduce new high yielding varieties (HYV) in the Mansehrah district or import from other countries. These new varieties/hybrids (already released in other countries having similar situation) will be directly tested under farmers' condition starting from the first year and continue until the fourth year of the project. Farmers will be allowed to select the best material for cultivation. Large scale field demonstration of improved farm management practices and new best performing varieties will also be demonstrated by the provincial extension department in collaboration with NGOs and development partners starting from the first year and continue until the fourth year. The improved management practices demonstrated on farmers' field will include: information on high yielding ginger varieties, proper sowing timings, optimal population density, proper input, judicious & proper use of insecticides, proper irrigation and uprooting through farmers' trainings.

Ginger local demand is expected to boost at 82,703 tonnes based on existed growth rate in imports (4.54%) and is assumed to be constant in next five years as shown in Table 15. It is estimated that area expansion of ginger in Mansehrah district of KP will enable the country to meet 25% of the local demand in four years. By introducing improved varieties of ginger and training farmers to adopt IFM practices, it is assumed that local ginger yield will increase to 7 tonne/ha, which is assumed to be 80% of world yield (8.7 tonne/ha). It is assumed that farmers

will gradually increase ginger area to substitute the imported ginger at the rate of 6.3% per year starting from the second year; thus production increase due to area expansion in the cluster will also be gradual. Based on these assumptions, the value of additional revenue obtained by shifting area from maize to ginger would reach to US$8.14 million during the last year of the project (Table 16).

Table 16: Mansehrah cluster - increased ginger area

Increased area	Year 1	Year 2	Year 3	Year 4	Year 5
Future ginger imports/demand (tonnes)	82703	86459	90386	94491	98782
Local expected yield (tonnes/ha)		7.0	7.0	7.0	7.0
Additional area in each year to meet 25% demand(ha)		1544	3228	5062	7056
Additional production (tonnes)		5404	11298	17717	24696
Total Impact of First Intervention					
Expected economic return from expansion in area (000 US$)		**3,574**	**7,472**	**11,718**	**16,333**

9.4.2. Intervention 2 – Ginger Farm-Level Value Addition

To increase value addition at farm level and increase farmers' income, small scale 19 ginger processing units will be incentivized under Ginger Farmers Enterprise Group (GFEG) in the cluster as explained in Annexure 1. It is assumed that 10% of ginger production will be processed/dried over a period of four years and dried ginger will enjoy better price of US$ 2000 per tonne. It is estimated that dried ginger is equivalent to 50% of the raw ginger. Moreover, farmers will be trained on the harvesting index for ginger to help them identify appropriate matured ginger and proper drying of ginger after harvesting. This will lead to increasing the value of the ginger crop for the farmer and the downstream players in the value chain. It has been assumed that drying of ginger will occur from the second year of interventions when the results of increased area and improved value chain management practices will be realized. Again drying of raw ginger will be gradual by the farmers, thus a linear gradual processing at a rate of 2.5% per year has been assumed. Based on these assumptions, the value of increased ginger production in Mansehrah cluster is shown in Table 17.

: Table 17: Mansehrah cluster – ginger processing

Processing	Year 1	Year 2	Year 3	Year 4	Year 5
Percentage of the local production to be additionally processed/dried		2.5%	5%	8%	10%
Quantity of raw ginger to be processed from domestic production (tonne)		135	565	1329	2470
Production of died ginger (tonne)		67.5	282.5	664.4	1234.8
Total Impact of Second Intervention					
Expected additional value of processing (000 US$)		135.1	564.9	1,328.8	2,469.6

9.5. Total Benefits Summary

Summary of the value of the benefits of the proposed interventions is shown in Table 18.

Table 18: Mansehrah cluster - summary of the value of benefits of interventions

Benefits Value (000 US$)	Year 1	Year 2	Year 3	Year 4	Year 5
Value of Increased Area		**1,782**	**3,725**	**5,842**	**8,143**
Value of Increased Value addition		135.1	564.9	1,328.8	2,469.6
Total Value		1,916.8	4,290.1	7,170.4	10,612.1

9.6. Enhanced Costs of the Proposed Interventions

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

9.6.1. Value Chain Improvement 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 Table 19.

Table 19: Mansehrah cluster – value chain cost head

Value Chain Improvement	Cost
Additional cost of substituting maize with ginger (US$/ha)	1698
Additional cost of marketing (US$/ha)	185
Operational cost of processing (US$/tonne)	748

It is assumed that costs of bringing new area under ginger cultivation is US$ 2632/ha, while additional cost of marketing and operational cost of processing are US$ 184/ha and US$ 748/tonne, respectively as shown in Table 18. Based on the above unit costs, total value chain costs for the entire cluster were calculated in Table 19. It was assumed that costs will be incurred from the second year of implementation. Increase in cost of increased area, marketing and value addition are calculated for assumed area increased, marketed, and quantities processed in that year. Value chain costs projections are shown in Table 20.

: Table 20: Central KP cluster – value chain improvement costs

Value Chain Improvement Costs	Year 1	Year 2	Year 3	Year 4	Year 5
Cost of bringing new area under cultivation (000 US$)		2,622.3	5,482.8	8,597.7	11,984.3
Additional cost of marketing (000 US$)		285.9	597.8	937.4	1,306.6
Total cost of value addition (000 US$)		50.5	211.4	497.2	924.0
Total Costs (000 US$)		2,958.8	6,292.0	10,032.3	14,215.0

9.6.2. Cluster Development Interventions Costs

Mansehrah ginger cluster has huge growth potential by virtue of the diverse agro ecological conditions of the KP province. A program of variety development suited to local environment, establishment of Ginger Research Station (instead of full Institute) may be launched, which will work under the main National Agricultural Research Institute in PKP for development of Ginger open pollinated varieties and hybrid. Other interventions include promotion of good agronomic practices and improved farm management practices to improve the quality of fresh ginger and its product demand in local markets, and establishment of drying units by the GFEG.

The proposed budget for cluster development interventions for Mansehrah cluster will be US$ 1.85 million. 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 and government loan scheme at the interest rate of 12.5%. Details are provided in Table 21.

Table 21: Mansehrah cluster - inputs and infrastructure needs for cluster development

S #	Cluster Strategy	Interventions	Implementing Agency
1.	Production Level Strategies	• Establishment of Ginger Research Institutes for variety & Hybrid development and Seed production • Seed will be provided to farmers on discounted rate. • Establishment of model farms with good agronomic practices. • Certify these model farms, using IPPC protocols and other certifications, including organic, Fair trade, and others	PARC/DoA KP/Private sector
2.	Extension Level Strategies	• Distribute information on varietal adoption to farmers • Distribute information on improved farm management practices to farmers	PARC/DoA KP/Extension department/Private sector
3.	Training of Stakeholders on Value Chain Management Level Strategies	• Train farmers/stockholders on proper drying of ginger produce • Train stockholders on grading and packing of ginger produce • Train stockholders on proper storage of ginger produce • Establishing link between different stockholders	PARC/DoA KP/Extension department/Private sector

This proposed cluster development investment cost will be spent in a period of four years starting from year 1. It is assumed that all the fixed costs (US$ 7,222,334) of establishing

ginger research station to develop new varieties for Mansehrah cluster will be spent in year 1. However, its operating cost, which will be 25% to the fixed cost, will be spread equivalently over next 4 years. Investments on extension and processing will be completed in first four years. Similarly, 19 processing units will be established in Mansehrah cluster in each year as per assumptions used for calculating benefits. With these assumptions, the cost distribution is shown in Table 22.

Table 22: Mansehrah cluster – cluster development investments cost projections

Investment Head (000 US$)	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Conduct GIS surveys	100					100.0
Strengthening of research (US$)	407.4	101.9	101.9	101.9	407.4	814.8
Incentives to promote garlic cultivation @Rs. US$300 or Rs. 40,500 per ha	463.2	968.4	1,518.6	2,116.8	-	5,067.0
Capacity building of stakeholders (Farmers, processors, etc.)	100.0	100.0	100.0	100.0	100.0	400.0
Establishing collection center, guarantying garlic price	74.1	103.7	44.4	44.4	-	311.71
Value addition level investment at the farm level (drying units)	27.9	88.8	157.8	235.6	-	499.1
Government loans	3.5	11.1	19.7	29.5	-	62.4
Total investments	1,176.0	1,373.9	1,942.4	2,628.2	1,176.0	7,255.2

9.7. Economic Viability of Cluster Development Plans

Based on the benefits and the costs of the proposed interventions package in the above paragraphs, the economic viability of the proposition has been calculated in terms of project's NPV and IRR. Discounted cash flow analysis has been carried out using an annual discount rate of 8.5%. Calculations and results are shown in Table 23.

Table 23: Central KP cluster - economic viability of proposed interventions package

Economic Viability	Year 1	Year 2	Year 3	Year 4	Year 5
Net Benefits of the Interventions (000 US$)	-1176.0	-623.7	-197.1	385.9	4441.4
NPV (000 US$)	1,473				
IRR	**29%**				

A positive NPV of US$ 1,464.2 thousand indicates that the interventions package proposed for uplift and transformation of Mansehrah ginger cluster is an economically viable proposition.

10. Programs and Plans

A research plan for the initiation of ginger cultivation in Pakistan can be introduced. It has already been concluded that currently ginger is not being cultivated in Pakistan. Mainly, because of soil and climatic conditions in Pakistan do not support the existed local varieties of ginger. Hence, new variety appropriate for our local climatic conditions needs to be developed. For research and development purpose, a five-year research plan is presented in Table 23. A team of 4 members should be made consisting of a research scientist (breeder expert), junior scientist along with supporting staff. The tentative required financial plan that includes investment in terms of salaries of the staff and other operational expenses, which include (cost of experiment, infrastructure cost and travelling costs) is presented in Table 23.

10.1. Program for Organization and Networking of Stakeholders

The following program is proposed for organization of stakeholders at different levels of value chain in Mansehrah cluster as shown in Table 24:

Table 24: : Program for organization and networking of stakeholders in Mansehrah Cluster

S#.	Area of Action	Purpose	Institutions to be involved	Priority
1	• Form Ginger Farmer Enterprise Groups (GFEGs) at grassroots level. 3 GFEGs in total with each having a membership of at least 50 farmers. Mansehrah cluster has 3 tehsils, and thus 1 GFEG per tehsil.	Organization of ginger farming community for collective action	Village Organizations (VOs), DoA KP, NGOs, KP rural support program (RSP) and extension department	Short to medium term (1 to 2 years)

10.2. Program for Research Reform

The following program indicative areas for further research to strengthen the ginger cluster in the Mansehrah cluster of KP district are proposed in Table 25 as:

Table 25: Program for Research Reform in Mansehrah Cluster

S#.	Identification of Areas for Further Research	Research Purpose/ Priority	Indicative Research Institutions
1.1	• To start Ginger Variety Development Program (Selection, adoption & development of high yielding varieties (HYV)) • Distribution of HYV seed to farmers at discounted rate. • Establishment of Model farms with good agronomic practices	Increase ginger area and improve and secure ginger production (Short to medium term (1 to 5 years)	PARC, Agriculture Research Institute Swat, RSP, NGOs

S#.	Identification of Areas for Further Research	Research Purpose/ Priority	Indicative Research Institutions
	• Research into climate change related negative impacts such as new diseases and shifts in crop cycle • To take preventive & curative measures to eradicate the ginger diseases. • Establishment of Ginger diagnostic centers at least one at tehsil level.		
1.2	• Develop ginger maturity index • Develop training modules on adoption of HYV, IFM practices and proper harvesting and storage • Develop formats for Farmer Field Schools (FFS) for on-farm training of Ginger producers	Improve farm management through training and extension (Short to medium term (1 to 5 years)	PARC, Agriculture Research Institute Swat, RSP, extension department
1.3	• Import ginger drying plants • Establishing of drying units through GFEG in three of tehsils of Mansehrah district	Improve farm mechanization (Short to medium term (1 to 5 years)	PARC, Agriculture Research Institute, Private businesses
1.4	• Identify suitable ginger traders to support the cluster • Identify suitable ginger buyers to link with in premium markets through a market survey • Consultation to decide on implementation strategy – wholesale market or individual traders • Develop mental understanding between producers, traders and processors • Create market linkages for quality produced ginger	Improve value chain management product (Short to medium term (1 to 5 years)	PARC, Agriculture Research Institute Swat, RSP, extension department

Note: The estimated costs for research plan mentioned in the above table have already been counted as part of the cluster investments given in section 10.

10.3. Conclusion

Ginger is an important condiment in Pakistan and is consumed by whole population. However, due to low yield and poor quality, its current production is not sufficient to meet consumer demand. Therefore, on an average, the country is spending foreign exchange earnings of US$ 71 million on import of 79 thousand tonnes of ginger from neighboring countries particularly China and Thailand in 2017. This makes Pakistan the 2nd largest importer in the world. This study assumes that this import quantity will rise at the rate of population growth rate (2.1%) in the country. However, Pakistan has huge potential to boost his production due to fertile land, wide spread canal and tube well irrigation system, cheap labor, and proximity and good relation with China, which is the major ginger producing country of the world and having more than double the yield of Pakistan.

The purpose of this study is to identify gaps and potentials and suggest policies, strategies and interventions to enhance the competitiveness of ginger value chain in the country. The analysis was designed at cluster level to incorporate the regional variation in ginger value chain.

This study identifies Mansehrah district as a potential area in KP province to establish ginger cluster. In this cluster, two key interventions including area expansion with IFM practices and ginger drying have been proposed to increase ginger production and improve the quality of ginger supply. Total expected additional production from Mansehrah cluster is reported in Table 25 for four years of interventions. Due to enhanced production from area expansion, 25% of ginger import will be saved in the 5th year of the project, which will be equivalent to US$ 46 million. In brief, ginger cluster development offers huge economic benefits in terms of production creation and import saving.

Table 26: Impact of cluster development on import saving in Pakistan

	Year 1	Year 2	Year 3	Year 4	Year 5
Ginger import quantity (tonne)	**82703**	**82703**	**82703**	**82703**	**82703**
Value of ginger import (million US$)	74	74	74	74	74
Total expected additional production from Mansehrah cluster (tonne)	-	5169	10338	15507	20676
Import saving (million US$)	5	9	14	15	19

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11. Annexure

Annexure: 1 Details of Ginger Dryer

About half of the total production of ginger is being consumed as green ginger whereas the remaining 30% is converted into dry ginger for medicinal purposes and 20% is used as seed material. Drying of agricultural product has a vital role in improving the preservation and shelf life after harvesting. In developing countries, drying of food and herbal products is popular method to preserve it for a longer period of time. Ginger rhizomes sliced to various lengths of 5, 10, 15, 20, 30, 40, 50 mm and whole rhizomes are dried from an initial moisture content of 81.3% to final moisture content of less than 10% by various drying methods like sun drying, solar tunnel drying and cabinet tray drying at temperatures of 50, 55, 60 and 65C. Drying of ginger after slicing rhizomes significantly reduced the drying time in all the drying methods.

Objective:

The objective of the study is to investigate the feasibility of establishment of Ginger drying unit at the farm level so that different functions (Cleaning, washing, drying, packing, loading and shipment, etc.) can be introduced in the value chain:

Cleaning and Drying:

This process of cleaning helps to remove soil adhering to rhizomes while the drying process help to improve shelf life. Ginger drying is carried out through following process;

- The fresh rhizome is harvested at between 8 to 9 months of age.
- The roots and leaves are removed and the rhizomes are washed.
- The rhizomes have to be 'killed' or inactivated. This is done by peeling, rough scraping or chopping the rhizome into slices.
- After peeling and washing, the rhizomes are soaked for 2-3 hours in clean water then soaked in a solution of 1.5-2.0% lime (calcium oxide) for 6 hours
- The rhizomes are dried. The traditional method is to lay the pieces on clean bamboo mats or on a concrete floor and sun-dry until a final moisture content of 10%.
- In rainy conditions, a mechanical drier such as a tray drier should be used to accelerate the drying process. Sliced ginger pieces take only 5-6 hours to dry when a hot air drier is used.
- After drying, the rhizomes are cleaned to remove any dirt, pieces of dried peel and insects. An air separator can be used for large quantities, but at the small scale it is probably not cost effective.
- The dried rhizomes should be packaged into air-tight, moisture proof packaging for storage or export.

The proposed machine will help to clean and dry Ginger with faster speed by maintaining its quality because whole machine is made of stainless steel, adopt advanced air circulating system and the heating source can be electricity, steam or gas etc.

Sorting:

Mother rhizomes and fingers if cooked together are separated.

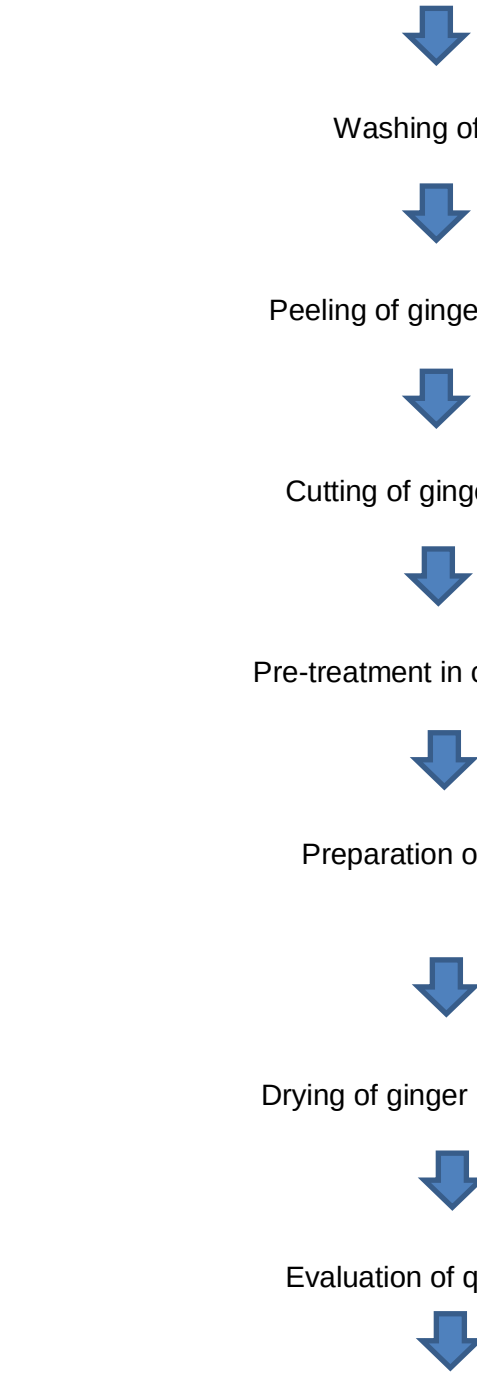

Figure A1: Process Flow chart of ginger processing

Specification of ginger Processing unit:

Main Features:

1. Most hot air circulates inside the oven, high heat efficiency and energy saving
2. Fixed adjustable air distribution plate inside the oven, which could guarantee the materials could be uniformly dried.
3. Low noise and balance operation, automatic temperature control, easy installation and maintenance, adjustable drying time, compact structure.
4. Various heating source to choose from, such as electricity, gas, LPG, hot water etc.
5. Wide application, it could be used as various materials dryer
6. Most hot air is circled inside the oven, high heat efficiency, save energy.
7. Equipped with forced ventilation and adjustable air distribution plates.
8. Adjustable air distributing device uniform air volume, wind speed, ensure material dry quickly and evenly
9. Low machine noise, balance running process, automatic temperature control system, keeping the temperature constant in setting value, if more than limit temperature the alarm will ring, easy installation and maintenance.

Table A27: Technical parameters

Model	CT-C-0	CT-C-1	CT-C-2	CT-C-3	CT-C4
Evaporator area	7.1 m2	14.1m2	28.3 m2	42.4 m2	56.5 m2
Effective volume	1.3m3	2.6m3	4.9 m3	7.4 m3	10.3 m3
Motor for heating	9kw	15kw	30kw	45kw	60kw
Motor for blower	0.45kw	0.45kw	0.45kw*2	0.45kw*3	0.45kw*4
Blowing rate	4510m3h	4510m3h	9020m3h	13530 m3h	18040 m3h
Blower	1 set	1 set	2 sets	3 sets	4 sets
Cars for dryer	1 set	2 sets	4 sets	6 sets	8 sets
Pallets for dryer	24pcs	48pcs	96pcs	144pcs	192pcs
Size	1.38*1.2*2m m	2.26*1.2*2 m	2.26*2.2*2m m	2.26*3.2*2m m	4.28*2.2*2.27m m

Figure 2A: Pictures of the ginger Drying & Processing Plant

Plant and Machinery:

The cost of plant & machinery is estimated at US$ including installation and commissioning. The cost estimates for plant & machinery has been worked out based on the cost figures available from recent orders paced for similar items in the recent past, duly updated to cover the price escalation in the intervening period. These costs are given in the following tables:

Table A28: Plant and Machinery Details

S. No.	Particulars	Qty.	Rate (US$)
1.	Ginger Processing unit	1	3500
2.	Solar generator	1	2000
3.	Packaging machine, Pouch sealing machine	1	270
4.	Building for Processing Unit Installation (800 sq. ft.)	1	4000
	Total		**9770**

Misc. Fixed Asset Costs:

US$ 6820 has been estimated under the heading of miscellaneous fixed assets. The details of electrical installations for power distribution have been considered commensurate with the power load and process control requirements. Other miscellaneous fixed assets including furniture, office machinery & equipment, equipment for water supply, office stationery, telephone and refreshment, workshop, fire-fighting equipment, etc. will be provided on a lump sum basis as per information available with the consultants for similar assets. The details of miscellaneous fixed assets and their associated costs are being shown in table below:

Table A29: Miscellaneous Fixed Asset Costs

S. No.	Particulars	Qty.	Rate (US$)
1.	Office Equipment	1	500
2.	Furniture and Fixture	1	1000
3.	Miscellaneous Accessories	1	1000
4.	Fire Fighting	1	70
5.	Computer with Accessories	2	1000
6.	Water Treatment Plant – 500 litres per hour	1	1000
7.	Loading Tempo	1	250
8.	Electrical Installation	1	2000
	Total		**6820**

Pre-Operative Expenses:

Expenses incurred prior to commencement of commercial production are covered under this head that total US$ **6132.** Pre-operative expenses include establishment cost, rent, taxes, traveling expenses and other miscellaneous expenses. It has been assumed that the funds from various sources shall be available, as required. Based on the project implementation schedule, the expected completion dates of various activities and the estimated phasing of cash requirements, interest during construction has been computed. Other expenses, under this head have been estimated on a block basis, based on information available for similar projects.

Table A30: Pre-Operative Expenses

Sr. No.	Particular (for 1 year)	Amount (US$)
1.	Interest up to production @ 16% on term loan amount of US$ 22700 **(30% of total project cost)**	3632
2.	Electricity charges during construction period	500
3.	Marketing Launch Expenses	500
4.	Technology Know-how	500
5.	Training expenses	500
6.	Travelling Expenses	500
	Total	**6132**

Cost of raw material:

Based on a processing capacity of per day taking into account and 220 days of working per year, the annual raw material consumption of the unit is 220 tonnes. The cost of raw ginger based on its average selling price as determined through interview with randomly selected farmers and converting it into US$ (with conversion rate of one US$=135) is $120/tonne. Adding US$20 per tonne transportation cost from the field to processing unit, the raw material cost for unit would be US$**500**.

Table A31: Cost of Raw Material

Particulars	Rate per tonne (US$) for the raw ginger at the wholesale	Qty. (Tonnes) per season	Raw material cost (US$)
Fresh ginger	**500**	**220**	**110000**

Note: converting three (3) tonnes of fresh ginger will produce (1) tonne of processing and dry ginger,

Land Lease Charge:

Required land is 2,000 sq. ft. which has been considered on lease @ US$100 per annum for first three years and @ US$120 for the fourth year and subsequently @5% increase every year.

Annexure 10 Table 7	Land Lease Charges	
S. No.	**Year**	**Lease charges Per Annum (US$)**
1.	1st year	100
2.	2nd year	100
3.	3rd year	105
4.	4th year	110
5.	5th year	116
	Total	**531**

Electricity and Water Consumption Charges:

The unit cost of electricity has been considered @ PKR.20.70/ unit assuming that the entire power requirement is met from the grid. A power supply of 2.2 Kw is deemed appropriate. The expense on water supply, treatment and distribution has been suitably considered, based on the tariff by water and sanitation agency (WASA) for per month consumption of water tariff of @ 92.82 PKR/thousand gallons. Water requirements are approximately 120 gallons per day.

Table A32: Electricity and Water Consumption Charges

S. No.	Description	Amount Per Annum (US$)
1.	Power Consumption	3000
2.	Water Consumption	100
	Total	**3100**

Human Resource Cost

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

Table A33: Salary and Wages

Sr. No.	Description	Requirement	Salary/month (US$)	Salary/annum (US$)
1.	Plant Manager	1	500	6000
2.	Accountant	1	300	3600
3.	Supervisor	0	0	0
4.	Skilled Workers	2	400	4800
5.	Driver	1	200	2400
6.	Security Guard	2	200	2400
	Total		**1900**	**19200**

Ginger Processing Plant Viability:

The Internal Rate of Return of the project is estimated at 49%, which is significantly higher than the bank return rate of 16%. Hence, the project is deemed financially viable. The NPV of the project is positive (US$ **21051**) at a discount factor of 16% during the first 5 years of operation considered. This implies that the project generates sufficient funds to cover all its cost, including loan repayments and interest payments during the period. This also indicates that the project is financially viable over the long term.

Table A34: Ginger Processing Plant (Costs and Benefit Statement)

	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue (US$)					
Capacity of the unit per day (tonne)		**0.5**	**0.5**	**0.5**	**0.5**
Processing season (tonne)		220	220	220	220
Quantity of raw ginger that can be processed (tonne)		110	110	110	110
Quantity of processed ginger with 2:1 conversion factor	**0.50**	55	55	55	55
Price of the value added ginger (US$/tonne)		2,000	2,000	2,000	2,000
Total revenues (US$)		**110,000**	**110,000**	**110,000**	**110,000**
Direct variable costs					
Raw material price (US$/tonne)		520	520	520	520
Total raw material cost (us$)		57,200	57,200	57,200	57,200
Packing costs (@PKR30 per 20 kg box)		543	543	543	543
Labor cost		19,200	19,200	19,200	19,200
Electricity and water		3,100	3,100	3,100	3,100
Maintenance (1% of the machinery, equipment and furniture cost)		1,625	1,625	1,625	1,625
Land lease charges (5%) increment on annual	100	100	105	110	116
Marketing (5 US$5/tonne)		550	550	550	550
Total variable cost including raw material	**100**	**82,318**	**82,323**	**82,328**	**82,334**
Gross profit	**110,000**	**110,000**	**110,000**	**110,000**	**110,000**
Indirect fixed cost					
Machinery	-22722				
Licensing and regulatory fee	-150	0	0	0	0
Total	**-22,872**	**0**	**0**	**0**	**0**
Grand total cost	**-22,772**	**82,318**	**82,323**	**82,328**	**82,334**
Net profit (Net cash flow)	**-22,772**	**27,682**	**27,677**	**27,672**	**27,666**
NPV (at 8.5%)		**62,562**			
IRR		**116%**			